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Preface

One of the main targets of the DACSEIS-project is the evaluation of different variance estimation methods to calculate sampling errors in different national surveys. To be able to generate the complex universes, to simulate the relevant national surveys and to analyse the influence of the various sample designs and weighting procedures on the accuracy of the variance estimation methods through these simulations, these surveys have to be described.

This is done in workpackage 2 of the project for the five relevant Labour Force Surveys of Austria, Finland, Germany, the Netherlands and the United Kingdom as well as for the German Survey of Income and Expenditure and the Swiss Household Budget Survey.

For this purpose all members in this workpackage delivered information on their national surveys. These are partly used word for word in this report. For an overview of the report see Chapter 1. The report is based mainly on the following sources:

Chapter 2: Haslinger (1996).

Chapter 3: Statistics Finland (2001).

Chapter 4: Gruber (1996).

Chapter 5: Hilbink *et al.* (2001).

Chapter 6: Office of National Statistics, United Kingdom (2001).

Chapter 7: Kühnen (2001).

Chapter 8: Renfer (2001).

Additional sources are - as usual - cited where they are used. As an addendum to this report, one can find an overview to European individual and household surveys in the annex of the report from WP1. This work is related to WP2 but part of WP1 and is a result from the *DACSEIS Questionnaire* (Münnich/Wiegert). An overview to the results of WP2 can be found in Quatember (2002).

I wish to thank all of my partners in this workpackage for their kind cooperation and help.

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Chapter 1

Introduction

> "In social research it is often required to estimate the average value of a character of some individuals. Until recently such averages have been calculated only from the data of general censuses."
> Sukhatme (1935)

With these sentences Sukhatme began his 1935-article "Contribution to the Theory of the Representative Method" in the Journal of the Royal Statistical Society, Supplement.

He continued: "However, it is obvious that an exhaustive enquiry is not at all necessary for the attainment of sufficiently accurate averages and, therefore, in the last few years many social researches have been based on the data supplied by the process of sampling" (p. 253).

And where did we go since then? The sampling method is fully developed and generally accepted. Opinion and market research has become a big industry. Sample statistics play a significant role in the present information society. This allows the conclusion, that from a sampling theory point of view from the 20^{th} century can also be spoken as the century of samples.

The official statistics supported itself since the beginning of the 19^{th} century on censuses. It was thought of this as the only possibility of getting reliable data about populations. Nevertheless the sample method preceded the censuses as in 1800 Sir Frederick Morton Eden calculated the population of Great Britain using sample data on the average number of persons per house and the number of births. This estimate was confirmed by the first census of Great Britain in 1801 (see: Stephan, 1948, p. 14).

It was not until the end of the 19^{th} century when the Norwegian Director of the Bureau of Statistics Anders N. Kiaer became active because of the high expenses and the long lasting analyses of the census data. In the 1895 Berne meeting of the International Statistical Institute he presented his ideas of sampling the population. With this presentation Kiaer is considered as the one who gave the go-ahead for the entire sampling theory and practice (see: Seng, 1951, p. 214ff) and the use of these methods in official statistics.

As we said before, today very important decisions are based on sample results. And here we are right in the area of the Labour Force surveys.

"The European Union attaches great importance to its Labour Force Survey. It regards the survey as a unique and indispensable instrument for preparing and assessing the Unions's programmes of action in the areas of employment, unemployment, long-term unemployment and professional or vocational training and also for the purposes of regional, social, economic and agricultural policies. In the course of implementing the single market, the importance of having comparable data on the labour market is increasing. The Statistical Office of the European Communities (Eurostat) considers the common Labour Force Survey to be the most important source of employment statistics as it covers a great variety of variables at an individual level. The main objective of the Union's Labour Force Survey is the availability of harmonized and reliable statistics for taking measures regarding the labour market." (GRUBER, 1996, p. 4)

There is no question about the importance of statistical data on the labour market like the unemployment rate as indicators of the national labour markets and as international comparable measures of the success of economic and social policies. But the national and international concepts of measuring these variables differ very much.

The national data on registered unemployment cannot be used for international comparisons, because of different national concepts. But often just these data determine the public as well as the political discussions of labour market strategies.

The "international" data on the national labour markets of the OECD or Eurostat refer to the results of the Labour Force Surveys, which are conducted by the Statistical Offices of the European countries. This unemployment rate for instance follows the Labour Force Concept of the International Labour Office (= ILO) and includes all persons that are usually employed, independently of the working hours and any payment. The surveys are household surveys.

In the last decades the national implementation and international harmonization of this concepts was in the focus of attention (see LITZ, 2000, p. 77).

But nevertheless the international comparability is disputed due to the following facts: There are hints, that it is - at least - doubtful, that the national divergences according to the questionnaire - design and the formulation of the questions do not affect the comparability of these data (see: VAN BASTELAER, 1994, p. 281ff). For example van Bastelaer quotes, that for the registration of minor employment of 10 or less working hours per week, it depends very much on the formulation of questions or the explicit giving or not giving of alternatives of answers, if the person affected counts herself or himself as employed or not (p. 290ff.).

The proportion of minor employment being between 1 or 2 % in most countries, but up to 5 or 6 % in Denmark and the United Kingdom and 10 % in the Netherlands is another fact that makes the international comparability of the unemployment rates totter. In those countries, where the proportion of minor employment is higher than in the others, the total of work is divided up to more persons than in the others. The unemployment rate following the above mentioned ILO-concept is, of course, lower in these countries, although this means no real reduction of unemployment, except this form of employment is voluntary and corresponds to a need of the employees. There is a big difference in the meaning of the employment statistics due to such structural differences.

Another problematic aspect with regard to the international dimension of the national labour market statistics are different national levels of retraining programs as an instrument of labour market policies. Following the Labour Force Concept the participants in such programs have to be classified as employed (see LITZ, 2000, p. 81f).

Because of these differences and also due to the different tasks of the Labour Force Statistics LITZ (2000) suggests a modular system comprising the latent and the manifest unemployment to quantify the influence of the various contextual levels (p. 84ff).

But apart from the problems of definitions and structures there is - of course - also the problem of accuracy of data collected in samples. Here the DACSEIS-project sets on. There are various factors that affect the comparability of the data from this sampling theory point of view.

In order to be able

1. to generate the national population very closely and

2. to simulate the national surveys, that are included in the DACSEIS-project and then to look at the variance of the most important variables and to find out which methods will be the best to estimate this variances

this report compares the five Labour Force surveys of Austria (as described in Chapter 2), Finland (3), Germany (4), the Netherlands (5) and the United Kingdom (6) as well as the German survey of Income and Expenditure (7) and the Household Budget Survey of Switzerland (8).

For this purpose each chapter comprises

- general remarks on the survey (Section 1. Introduction)

- the definition of the underlying population (2. The Target Population)

- the most important facts regarding the survey process (3. The Survey Process)

- the description of the sampling frame out of which the sample is selected (4. The Sampling Frame)

- the description of the sampling methods used (5. The Sample Design)

- the description of the weights that are used to compensate different nonresponse rates and to adjust the data to a given population structure (6. The Weighting Procedure)

- a short overview on known nonsampling errors (7. The Nonsampling Error) and

- a description of the currently used estimation method for the variance of the sample results (8. The Sampling Error).

Each chapter is further summarized very shortly in Section 9. So every reader of this report should be able to look at the similarities and differences of these surveys from a sampling theory point of view, so that he or she should be able to gain an insight into these surveys. In the first Section of Chapter 9 we have a look at some important population parameters. This is followed by a direct comparison of the five Labour Force Surveys and the two Household Budget Surveys, so that the differences and national specialities will be pointed out once again.

Chapter 2

The Austrian Microcensus

2.1 Introduction

The Austrian Microcensus (= AMC) is a multipurpose quarterly sample survey conducted by the *Bundesanstalt Statistik Austria* and carried out by face-to-face interviewing in about 1% of all dwellings in Austria.

The main purpose of this survey is to find out in which economic and social direction the Austrian society is developing. In this order population data have to be gathered regularly. Since the censuses of the whole population only take place in large temporal distances (every ten years), the information becomes outdated relatively fast. Administration, economy and science however need a data base as current as possible in order to be able to react in time to modifications of the society regarding fields of the labour market, health, education and others. For this subjects the AMC shall paint a small, but representative picture of the entire population of dwellings, households, families and persons between two censuses. It therefore takes a central position in the system of the official statistics in Austria. The main beneficiaries of the results are decision-makers of all national, economical and social levels as well as institutions of the social, market or opinion research.

The AMC was established in 1967. Since March of 1995 the Labour Force Survey of the European Union is also part of each AMC in the first quarter of the year.

2.2 The Target Population

There are four different kinds of universes of interest in the AMC. These are the populations of

- dwellings
- households
- families
- inhabitants

of Austria. The survey unit is the dwelling. In each of these units there may be more than one household, family and - of course - person.

2.3 The Survey Process

The AMC is carried out by face-to-face interviewing. The questionnaire of the AMC comprises

- a household sheet and
- a personal (= individual) sheet.

Both sheets contain a core program, which is mandatory. This core program is constant over long periods and is supplemented by a varying special program, which is voluntary.

The core program contains variables on the living conditions, the labour market or education, whereas the special programs contain quarterly modified subjects like income, working conditions, journeys or state of wealth. The Labour Force Survey of the European Union is part of the special program of the AMC in the first quarter of each year. One advantage of connecting the LFS with the microcensus is that every record of the LFS is directly connected to a basic person-record of the microcensus, which makes it possible to refer to specific sociodemographic variables.

The interviewing starts on the 1^{st} of March, June, September and December of each year. The interviewers than have three weeks to collect their interviews. Dwellings in which nobody is found are not substituted by others.

2.4 The Sampling Frame

The basis from which the main sampling frame for the AMC is built is the dwellings stock (dwellings inhabited or not) of the Austrian Housing Census which is performed together with the population census every 10 years. For example for all AMC's from March 1994 until December 2002 the census of 1991 builds this basis. Even when the universes of persons, families or households are the primary goal of the questions, it is the dwellings stock that builds the basis for the sampling frame. The reason is that there is no central register of persons in Austria.

In order to make sure that the sample persists a reasonable representative image of the reality, this basis has to be supplemented annually by the annual rise in dwellings. This is summarized in the "statistics of the building activities" of each year (in Austria called "Wohnbaustatistik").

In order to be able to take a stratified sample by systematic selection of the dwellings (see: Section 2.5), the dwellings stock of the last census has to be rearranged.

Since 1994 - similar to the first period of the AMC from 1967 to 1973 - to build the sampling frame at first this stock is partitioned in two disjunctive sets of dwellings (see: Figure 2.1). One set consists of all dwellings that are situated in large, urban municipalities (Austr.: "Gemeinde"), the other set of all in small ones. The definition of "large municipalities" differs from federal state to federal state (Austr.: "Bundesland"). In the

federal state of Burgenland dwellings belong to the set of dwellings in large municipalities when they are situated in municipalities with more than 600 dwellings, in the federal state of Salzburg this boundary is 1,000, in Carinthia (Austr.: "Kärnten") 1,200 and in the federal states of Upper and Lower Austria (Austr.: "Oberösterreich" and "Niederösterreich") it is 2,000 dwellings. The other two of the nine Austrian federal states consist only of large municipalities and so all dwellings of these two federal states, which are Vienna (Austr.: "Wien") and Vorarlberg, belong to this part of the Austrian dwellings.

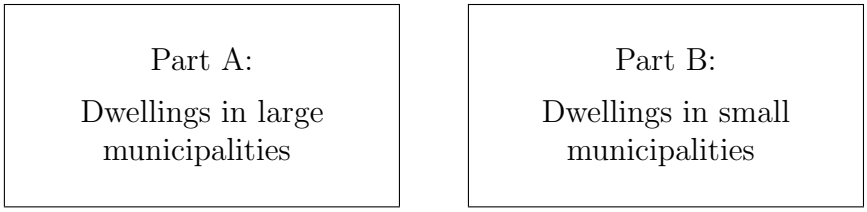

Figure 2.1: The partition of the universe of dwellings

The method used for sampling in part A of the dwellings stock is stratified random sampling of dwellings with proportional allocation of the sample number to strata. The method for part B is a two-stage sampling of dwellings. The elements of part A of the dwellings stock become allocated in nine federal state strata. Within each federal state the dwellings are arranged by some dwellings characteristics:

- kind of dwelling, then within these (sub)strata by
- period of construction, then within these (sub-sub)strata by
- kind of building, then by
- floor space of dwelling, then by
- kind of heating and at last by
- number of inhabitants.

Since a combination of all categories would produce a lot of very small "strata", many of them have to be combined, so that the sample size covers at least 10 dwellings for each stratum and survey. Therefore for each federal state between 100 and 150 strata are built.

At last the dwellings of each federal state are arranged once again within all these strata regionally, according to district (Austr.: "Bezirk"), municipality, counting parish (Austr.: "Zählsprengel") and position order in the census. These lists of dwellings build the sampling frame for the selection of dwellings in this part of the dwellings stock.

All dwellings of part B of the dwellings stock are located in small, rural municipalities. In the case of a very small number of dwellings in such a unit, spatially neighbouring municipalities are combined. If this would not be done, the number of dwellings would not be sufficient for all AMC's over one decade. In the following these "combined" and the other municipalities are simply called the primary sampling units of part B.

So at last the sampling frame for the sampling within part B has to be built. Within the selected primary sampling units the dwellings are arranged according to three categories: dwellings built 1981 and later, older dwellings in single family houses and other dwellings. Within these categories the dwellings are arranged once again by using the position number of the last census.

In 1991 1.9 % of the Austrian population lived in non-private households of institutions or communal accomodations. To paint a representative image of the entire population this part of the population has also to be investigated in the survey.

Therefore in March of each year additional to the survey in private households, only the core program is conducted also in the institutional households of halls of residence, boarding schools, old people´s houses, prisons and others. The sampling frame from which this part of the sample is taken is an address list of all institutions with at least 50 inhabitants.

The sampling frame for the sample of persons living in communal accomodations like accomodations for foreign workers or guesthouses is the last census.

2.5 The Sample Design

The total sample size for 1994 was $n = 30,800$ dwellings, which is about 1 % of all dwellings in Austria. In each sample-dwelling all households, families and persons are asked. For all questions concerning these universes, the dwellings are clusters of units. Since in the larger federal states of Austria the "part B-universe" and thus the cluster-effect to the accuracy of the sample-result is substantially higher than in the smaller ones the allocation of the total sample number on the federal states were as different as shown in Table 2.1.

Although Vienna consists only of a part A-set of dwellings, the sample-number is bigger compared to the sample-numbers in larger federal states with high part B-proportion, because there are much more single-households in Vienna, so more dwellings have to be included in the Vienna-sample to interview the desired number of persons.

Altogether - as Table 2.1 shows - the survey is executed in more than 800 of all 2,333 municipalities.

But there is no independent selection of dwellings for each AMC, because there is a quarterly exchange of one eighth of the dwellings by new ones. Each selected dwelling therefore remains in the sample for at the most two years (= 8 AMC's). This "rotating" system represents a compromise between the request of the interviewers, who wish to have as few as possible a modification in the sample, and the respondents, who wish to be asked as rarely as possible. In this rotational system also the new built dwellings of the statistics of the building activities are included in the AMC's. This inclusion is the reason for the increasing total sample number during the period of ten years. For the annual LFS this means that one dwelling stays in the sample for two times, because there is an annual exchange (quarter by quarter) of one half of the dwellings by new ones.

Table 2.1: Characteristics of the sample-design of the AMC in the year 1994.

federal state	number of sample-dwellings	part A - municipalities	part B - municipalities	sampled part B - municipalities
Burgenland	2,600	73	80	38
Kärnten	2,700	39	89	34
Niederösterreich	4,500	60	509	101
Oberösterreich	4,000	32	413	82
Salzburg	2,800	40	79	29
Steiermark	4,000	30	514	78
Tirol	3,000	32	246	63
Vorarlberg	2,800	96	0	0
Wien	4,400	1	0	0
Österreich	30,800	403	1.930	425

The actual selection of the dwellings of part A is done systematically from the selection frame of each federal state with the help of a starting number and a constant interval.

Since the selection for the survey in March 1994 should take place at the same time with the selection for the 43 "rotations" (4 more than necessary, so that there is a reserve for the year 2004), the total of addresses to be selected in the federal state h was $n_h + (43/8)n_h = (51/8)n_h$ ($n_h \ldots$ number of sample-dwellings in the federal state h). The interval S_h and the starting number A_h therefore are for each federal state given by

$$S_h = \frac{8 \cdot N_h}{51 \cdot n_h} \quad \text{and} \quad A_h = \frac{S_h}{2} + \frac{1}{2}$$

($N_h \ldots$ number of dwellings in the federal state). All dwellings were selected for the AMC's of the decade 1994 to 2004, whose sequence numbers in the list, which built the selection frame, corresponded with one of the numbers

$$[A_h + (s-1) \cdot S_h] \quad s = 1, 2, 3, ...$$

The sequence $s = 1, 2, ...$ forms a numbering of the selected sample dwellings. Each sequence of 51 consecutively selected dwellings was subdivided in 8 part sequences, of which the first 3 covered 7 dwellings each and the last five 6 dwellings each. The dwellings were successively assigned the rotation numbers from Table 2.2.

The first sample of March 1994 consisted therefore of all dwellings with numbers $s = 1 + 51 \cdot k, 11 + 51 \cdot k, 21 + 51 \cdot k, 24 + 51 \cdot k, 33 + 51 \cdot k, 35 + 51 \cdot k, 42 + 51 \cdot k$ and $50 + 51 \cdot k$ ($k = 0, 1, 2, \ldots$). For the next AMC, the dwellings with number $s = 1 + 51 \cdot k$ were

Table 2.2: Rotation numbers of the selected dwellings in part A of the dwellings stock

part sequences	Rotation numbers of the sample-dwellings						
1	1	9	17	25	33	41	49
2	26	18	10	2	50	42	34
3	51	43	35	27	19	11	3
4	36	44	4	12	20	28	
5	13	21	29	37	45	5	
6	46	6	14	22	30	38	
7	23	15	7	47	39	31	
8	40	32	24	16	8	48	

substituted by the dwellings with number $2 + 51 \cdot k$ and so on. So this system guarantees, that a dwelling will be substituted by a dwelling with very similar dwelling-characteristics.

In this way an approximately proportional allocation of the sample number of each federal state to each stratum is guaranteed. The stratification by dwelling-characteristics may also produce a gain in precision, because most of the variables of interest (especially the labour force variables), should be correlated with these "strata-variables".

The selection-method used for part B of the dwellings stock, which consists of all dwellings of small, mainly rural municipalities (definitions above), is a two-stage cluster sampling with primary sampling units as described in Section 2 and the dwellings as secondary sampling units.

In order to select the primary sampling units, they are stratified within each federal state by a combination of two municipality characteristics. These are their "number of dwellings" and "district". The stratum with the smallest municipalities is additionally partitioned into strata of almost the same proportion of dwellings in farm buildings (= agrarian proportion).

The stratum boundaries of the variable "number of dwellings" result from the following demands:

- the selected sample addresses should be distributed over the strata proportionally to the number of dwellings of the strata and
- the number of sampling municipalities should be between 5 and 10 for each stratum.

Due to these conditions the municipalties of this sub-universe become distributed over 5 to 16 strata. Additionally it is payed attention to a representation of the political districts proportional to their number of dwellings. So there is a proportional selection of municipalities following the two-dimensional variable "number of dwellings and district". The problem of rounding is solved by minimizing the euclidian distances between the real and the rounded values with an optimization-method (see: HASLINGER, 1996, p. 316). The calculated number of primary sampling units within each two-dimensional stratum

were selected randomly. The random selection was checked manually by drawing the selected municipalities in a map. If the spatial allocation proves as "uneven" within a district in only few cases a selected municipality is replaced by a not-selected of the same stratum and district.

So in 1994 the selection of the dwellings of the two-stage area B could take place for each sampling municipality h systematically with the help of a starting number B_h and an interval T_h and is to be demonstrated by the example of selection of 20 dwellings for each municipality (as has happened in Burgenland, Carinthia, Salzburg and Tyrol). Also within this part B of the universe the selection of the addresses took place for 44 surveys altogether, therefore the address volume was $20+(43/8)20 = 127.5$ dwellings. The sample size of secondary sampling units within each primary sampling unit was fixed alternating as 127 or 128. The interval T_h and the starting number B_h resulted therefore as

$$T_h = \frac{M_h}{127} \quad \text{or} \quad \frac{M_h}{128} \quad \text{and} \quad B_h = \frac{T_h}{2} + \frac{1}{2}$$

($M_h \ldots$ number of dwellings in the selected primary sampling unit h).

The further procedure was similar to the part A-area. Here also each one of 51 consecutively selected dwellings received successively the rotation numbers of Table 2.3, whereby in municipalities with 127 dwellings to be selected, the start of the allocation of numbers began with part sequence 1, and with part sequence 5, if 128 dwellings were selected. The rotation numbers repeated cyclically, i.e. if the numbers of the section series 8 were assigned, it was started again with part sequence 1.

Table 2.3: Rotation numbers of the selected dwellings in part B of the dwellings stock

part sequences	Rotation numbers of the sample-dwellings						
1	26	18	10	2	50	42	34
2	36	44	4	12	20	28	
3	46	6	14	22	30	38	
4	40	32	24	16	8	48	
5	1	9	17	25	33	41	49
6	51	43	35	27	19	11	3
7	13	21	29	37	45	5	
8	23	15	7	47	39	31	

For surveys in the period of 1994 to 2002 a sample from the census of houses 1991 would clearly no longer be representative, since the housing stock changes constantly. The housing aborts are no problem, since they appear as such within the survey and are correctly projected. But the newly built dwellings must be added annually into the sample. Nevertheless a period of 1-2 years passes between the completion of a dwelling and the inclusion into the sampling frame.

The annual rise in dwellings of a certain year is defined as the population of all dwellings finished in this year, including the ones made by adding to or changing of existing houses.

The annual sample selection out of this population is made only from the newly built dwellings. The other new dwellings are considered in the weighting procedure. The selection occurs similarly to the main sample. The allocation of rotation numbers starts with that number, which directly follows the last assigned rotation number of the previous year within the same federal state. The housing increase of each year starting from 1991 is understood as own stratum within the part A-universe of each federal state. On the other hand both the dwellings from the census and the newly built dwellings within the same primary sampling unit belong to the same stratum in the part B-universe. Because of the different intensity of building of new dwellings and the fixed interval B_h, the originally constant sample sizes of the municipalities of a federal state (20 or 25) will therefore develop differently from municipality to municipality in the course of time.

In the census of 1991 there were 154,000 persons living in no dwelling in the usual sense of private households. 89,000 of them lived in institutional households, the remainder of 65,000 persons in communal accommodations. That were together only 1.9 % of the total population, who however substantially differs in many features from the remaining population due to its specific life situation. Ignoring them completely would cause a bias. The population of institutions is therefore entered into the AMC annually in March by a special survey which is executed not by face-to- face but by postal interviewing.

The selection frame for this survey consists of all persons living in larger institutions (usually over 50 inmates). The address directory of these institutions is being updated with each census and in the meantime completed by known openings of institutions. Within these institutions only persons are chosen whose surnames begin with the initial letter N. Surnames with this initial letter are distributed approximately equal in all regions. The sampling fraction from the institutions with 50 or more inhabitants, obtained by means of the initial letter N, is about 2 %.

At last from the 65,000 persons of the census 1991 living in community accomodations a sample was selected and the distributions of the variables of the AMC's core program were derived. Since an interviewing of these persons is hardly possible, it was planned to add this sample to each AMC. This idea was never realised.

2.6 The Weighting Procedure

The estimation of the AMC-results takes place in two steps. In the first step the basic weights of the dwelling sample for each data record are determined. In the second step the adjustment of the basic weights to the given population structure takes place. These distributions are given by the projections of the population of the "Bundesanstalt Statistik Austria".

In raising the sample, it depends on whether an interview could be executed in a dwelling or whether the dwelling existed at all. These collection losses are recorded in the household sheet under the feature "Leermeldung". The categories of this variable are:

1 dwelling untraceable

2 dwelling demolished

3 no longer used as dwelling

4 seasonal housing unit

5 vacant

6 no one at home

7 rufusal

If none of these categories applies, meaning a successful questioning had taken place in this dwelling, the "Leermeldung" will be defined as "blank". From these categories the following variables result for part A of the dwellings population (dwellings in big - mainly urban - municipalities):

$w_{Abh}^{(1)}$	Number of the dwellings of the sample in federal state b and stratum h of the part A-population of dwellings with "Leermeldung" "blank" and at least one "positiv" personal sheet. This number of dwellings is the net sample.
$w_{Abh}^{(2)}$	Number of dwellings of the sample in stratum bh of the part A-population of dwellings with categories (6) or (7).
$w_{Abh}^{(3)}$	Number of dwellings of the sample in stratum bh of the part A-population of dwellings with categories (2) to (5).
w_{Abh}	Number of dwellings of the sample in stratum bh of the part A-population of dwellings in which at least one interview took place, plus all quoted categories.
W_{Abh}	Number of the dwellings in the population in stratum bh of the part A-population of dwellings.

It is: $w_{Abh} = w_{Abh}^{(1)} + w_{Abh}^{(2)} + w_{Abh}^{(3)}$

For the extrapolation of the dwellings sample within this part of the population, the basic weight for all data records of stratum bh results as given:

$$\begin{cases} \dfrac{W_{Abh}}{w_{Abh}} & \text{for empty dwellings,} \\ \dfrac{W_{Abh}}{w_{Abh}} \cdot \dfrac{w_{Abh}^{(1)} + w_{Abh}^{(2)}}{w_{Abh}^{(1)}} & \text{for inhabitant dwellings and her inhabitants} \end{cases} \tag{2.1}$$

For uninhabited dwellings the extrapolation weight is given by the reciprocal value of the sampling fraction. Dealing with inhabited dwellings, the collection losses of the persons from dwellings in which nobody was found or in which information was refused have to be numerically equalized, too.

The notations stated above count also for part B of the dwellings population, if changed accordingly. Within this part the sample municipalities are selected first and then from these primary sampling units the selection of the sample dwellings takes place. For the extrapolation these steps are executed in opposite direction: First the sample dwellings of a municipality are projected on the total of dwellings of this municipality. In the second

step the extrapolation of the dwellings stock of the primary sampling units takes place onto the dwellings stock of all municipalities of the same stratum in the same federal state. This is being made by summing up all these primary units. The extrapolation weights of the housing sample of this area are for all data records of the primary unit bhi given as:

$$\begin{cases} \dfrac{\sum_{i=1}^{N_{Bbh}} W_{Bbhi}}{\sum_{i=1}^{n_{Bbh}} W_{Bbhi}} \cdot \dfrac{W_{Bbhi}}{w_{Bbhi}} & \text{for empty dwellings,} \\ \dfrac{\sum_{i=1}^{N_{Bbh}} W_{Bbhi}}{\sum_{i=1}^{n'_{Bbh}} W_{Bbhi}} \cdot \dfrac{W_{Bbhi}}{w_{Bbhi}} \cdot \dfrac{w^{(1)}_{Bbhi} + w^{(2)}_{Bbji}}{w^{(1)}_{Bbhi}} & \text{for inhabitated dwellings and her inhabitants} \end{cases} \tag{2.2}$$

The following notations apply:

N_{Bbh}	Number of primary units of the population in stratum bh of the part B-population of dwellings.
n_{Bbh}	Number of primary units of the sample in stratum bh with at least one "positive" household sheet.
n'_{Bbh}	Number of primary units of the sample in stratum bh with at least one household sheet and at least one positive personal sheet.

W_{Bbhi} or w_{Bbhi} within this part refers to the number of dwellings of the basic mass respectively the number of sample dwellings of a primary unit i which are summed up. In n_{Bbh} all municipalities are contained, in which at least one dwelling has been surveyed, even if no personal sheet could be filled out. However only those primary units are contained in n'_{Bbh}, in which at least in one dwelling one person could successfully be interviewed.

In the current population estimates of the "Bundesanstalt Statistik Austria" births, mortality, immigration and emigration are included (see: HASLINGER, 1996, p. 319ff). Therefore the variables federal state, age, sex and nationality are considered. Usually the population numbers of the AMC won by the basic weights regarding age, sex and nationality do not correspond with the appropriate numbers of the population update. This is the reason why it is being tried to amend the basic weights in such a way that the results being won by the AMC correspond with the given numbers of the population update. This adjustment to the given population structures takes place with an iterative process according to the following Figure 2.2 in the second step of the weighting procedure (see: BURG, 1998).

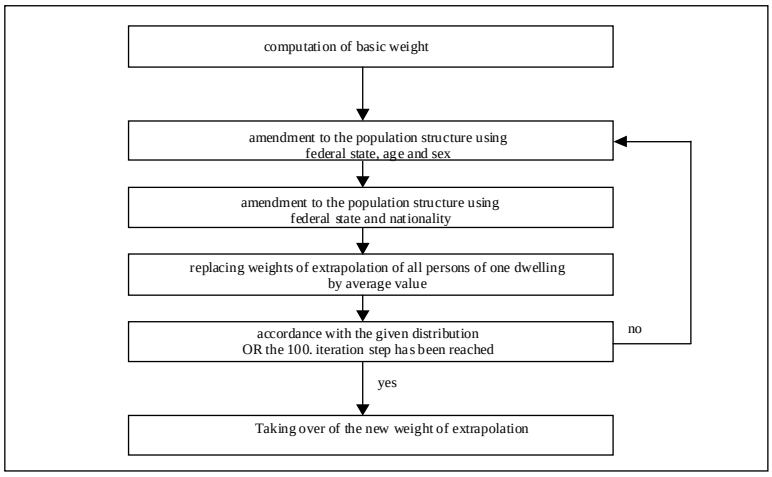

Figure 2.2: The Algorithm of the weighting procedure in the AMC

2.7 The Nonsampling Error

In December 1998 for the AMC the total number of dwellings because of the newly built dwellings (see 2.4) had increased from 30,577 dwellings in March 1994 to $N = 32,533$ (see: Schwarz, 2001, p. 36). 4.9 % of this total had to be classified as "not existing". This loss can be explained by deficiencies of the selection frame. These dwellings had been part of the census for houses and dwellings 1991, but in the meantime they were demolished or used for other things than living. A second part of 8.3 % of the total of 32,563 dwellings were recorded as second homes or not occupied dwellings. These two parts of dwellings are not real losses, because the estimation of the proportion of such dwellings is also one of the functions of the AMC. So for the interviewing of persons (families or households) in the sample dwellings there remained a sample total of 28,233 dwellings (gross sample number).

Now there is a third group of losses and this consists of the real nonresponses (see Figure 2.3):

Not-at-homes:	2,506 (8.9 %)
Refusals:	216 (0.8 %)
Losses due to interviewer-retirement:	1,953 (6.9 %)

The high rate of "Not-at-homes" is explainable by the fact that the interviewers have only three weeks to complete all of their interviews. A sample of 23,500 dwellings is a sample of more than 50,000 persons. The rate of refusal of the core program is very low, because the cooperation as a matter of fact is obligatory. The item-nonresponse in the voluntary program, which comprises the questions of the LFS is low for all variables, too. But a problem of the AMC seems to be, that in some of the Austrian federal states, interviewers who retire during the survey are not replaced by others. This losses may

cause a systematic error, if the variables of interest have different distributions in the regional districts, that are not included in the sample for this reason, compared with the others.

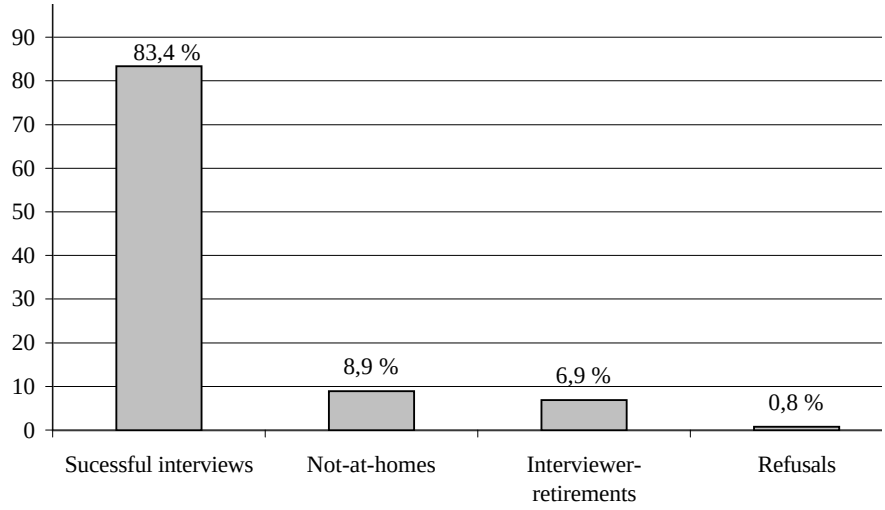

Figure 2.3: The Interviews of the AMC in March 1998

2.8 The Sampling Error

For example the variance of a total of a variable of interest may be estimated by (notations as in 2.6):

$$\sum_{bh} \frac{W_{Abh}^2}{w_{Abh}} \left(1 - \frac{w_{Abh}}{W_{Abh}}\right) s_{Abh}^2$$
$$+ \sum_{bh} \left[\frac{N_{Bbh}^2}{n_{Bbh}} \left(1 - \frac{n_{Bbh}}{N_{Bbh}}\right) \frac{\sum_{i=1}^{n_{Bbh}} \left(W_{Bbhi} \cdot \overline{x}_{Bbhi} - \frac{1}{n_{Bbh}} \sum_{k=1}^{n_{Bbh}} W_{Bbhk} \cdot \overline{x}_{Bbhk}\right)^2}{n_{Bbh} - 1} \right.$$
$$\left. + \frac{N_{Bbh}}{n_{Bbh}} \sum_{i=1}^{n_{Bbh}} \frac{W_{Bbhi}^2}{w_{Bbhi}} \left(1 - \frac{w_{Bbhi}}{W_{Bbhi}}\right) s_{Bbhi}^2 \right] \tag{2.3}$$

where the first part stands for the contribution of the variance in the big municipalities (part A):

s_{Abh}^2 sample variance of the variable of interest in stratum bh of part A

The second part of the formula stands for the contribution of the variance in the small municipalities (part B):

$\overline{x}_{Bbhi}$	mean of the variable in primary sampling unit *Bbhi* of stratum *Bbh*
$\overline{x}_{Bbh}$	mean of the variable over all primary sampling units in stratum *Bbhi*
s^2_{Bbhi}	sample variance of the variable of interest within primary sampling unit *Bbhi*

In practice it is sufficient for the consumers of the mcrocencus results to be able to imagine the size of the sampling error. For this reason the sampling error is effectively estimated using only formulas for unrestricted (= simple) random sampling. In this estimation of the sampling error neither the effects of stratifications on the one side nor the cluster-effects on the other side are taken into account. What is considered are the different sample fractions within the federal states. So for totals of persons the variance of the estimator X is calculated for Austria with

$$VarX = \sum_b \frac{(N_b - n_b) \cdot (N - x) \cdot N_b}{n_b \cdot N^2 \cdot x}$$

$N_b \ldots$	number of persons within the population of federal state b
$n_b \ldots$	number of persons within the sample of federal state b
$N \ldots$	number of persons within the population of Austria
$x \ldots$	estimated number of persons, in the Austrian population with an interesting character.

2.9 Summary

The AMC is a quarterly rotational survey of about 1 % of all households in Austria with obligatory participation. The main sampling frame is built by the dwellings of the last census. They serve as the survey units and all households, families and individuals of the selected dwellings are included.

The sample design for the selection of dwellings is characterized by a partition of the universe in two disjunct sets: The universe of large municipalities-dwellings (part A) of the nine Austrian federal states is arranged within each federal state due to dwelling characteristics. Then a systematic sampling of dwellings is carried out, so that this procedure leads to a stratified random selection of dwellings with nearly proportional allocations of the sample number to each stratum.

On the other hand the primary sampling units, i.e. the municipalities, of the universe of small (rural) municipalities-dwellings (part B) become at first stage stratified by the two-dimensional variable "number of dwellings in the municipality and district", which are municipality characteristics. Then a stratified random sample of these primary sampling units is carried out within each federal state. On the second stage the dwellings of each of the selected municipalities are arranged by dwelling characteristics and a systematic sampling of these dwellings is carried out (see Figure 2.4)

Each collected data set is weighted within each federal state and stratum to compensate known nonresponses by its sampling fraction and then adjusted to the population structure from the continuous population updating procedure. The Unit-nonresponse of the AMC's core program is $\sim 16\,\%$. The Sampling Error is currently estimated by the formulas for unrestricted random sampling with consideration of the different sample-fractions per federal state.

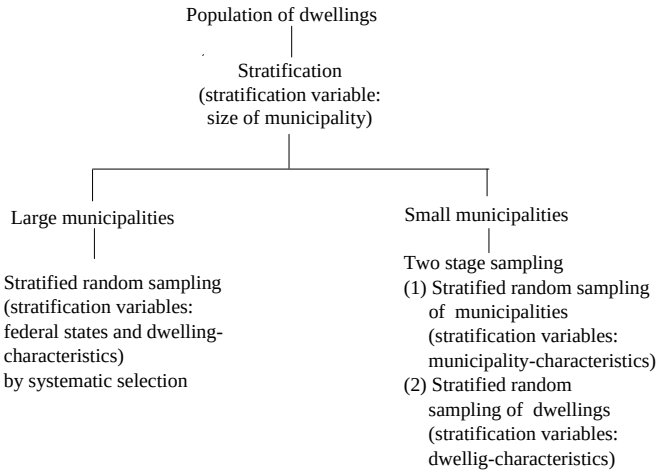

Figure 2.4: The sample design of the AMC

Chapter 3

The Finnish Labour Force Survey

3.1 Introduction

Statistics Finland is continuing the integration of the national monthly Labour Force Survey (=LFS) and the former Community LFS for a continuous (monthly) Community LFS to meet the targets of the relevant Community and Commission regulation. This far, for an integrated questionnaire it was introduced the strict ILO (= International Labour Office) definitions of the key concepts. This change was made in two stages, in January 1997 and May 1998. The required questionnaire contents were implemented in our monthly LFS in April 1999. Move towards a continuous reference week was started in 1999 by making a preliminary statistical study and preliminary field experimentation. Provisional implementation of continuous reference week took place in January 2000 (previously there was a fixed reference week in each month).

3.2 The Target population

The target population for the Labour Force Survey consists of all persons who are registered as permanently resident in Finland, with the exception of those who are temporarily located abroad for a period of less than a year. The population includes foreign nationals who have been living in Finland for at least a year or intend to do so.

3.3 The Survey Process

The basic design of the survey is a rotating panel design. The rotating design is arranged so that each person is to be interviewed altogether five times in the course of 15 months. The lag between the interviews is three months except between the 3rd and 4th times, when it is six months. The participation is voluntary.

In every survey we have five rotation groups:

- one rotation group starts the survey and they participate at the first time.
- one group has participated three months earlier and is surveyed the second time.

- one group is participated six months earlier and is surveyed the third time.
- one group is participated 12 months earlier and is surveyed the fourth time.
- one group is participated 15 months earlier and they are with the last time.

The design ensures the independence of the monthly samples in each three-month period. This simplifies the estimation of quarterly figures. In the pooled samples of two consecutive quarters, 60 % of individuals were interviewed twice. In the pooled sample for one year, 90 % of individuals were at least in two interviews. The overlap between the same months over a year is 40 %.

However, elderly people (aged more than 64 years) are interviewed only every second time. Meanwhile, information on their activities is imputed from the earlier interviews. Also proxies (i.e. eligible family members) are allowed but not in the first wave interview. The interview is rather short, only about 15 minutes in the first interview and even shorter in the subsequent interviews.

Data are collected by professional interviewers of Statistics Finland using decentralized computer assisted telephone interviewing (= CATI). Paper- and -pencil questionnaires (= PAPI) were used until 1996. After the first interview, in the subsequent ones proxies and imputations are allowed.

Until the end of 1999 the reference week was normally the week containing the 15th day of the month. In the case of a continuous survey (beginning in January 2000) the interviews are spread uniformly throughout the whole year and thus there are four or five reference weeks in each month. Data collection for the LFS is carried out during a two-week-period following the LFS reference week. So the active work time is quite short.

3.4 The Sampling Frame

The sampling frame from which the sample is drawn is built from the Central Population Register (= CPR). The CPR contains in principle all resident persons. The Finnish system of registers is quite up-to date, especially in register data on individual persons. The updating delay in the CPR is normally less than one month.

There remains another, far more important delay factor - the lag between the primary sample selection and the actual start of the survey.

3.5 The Sample Design

According to DJERF (2001), "the data set of one month can be regarded as simple random sample of individuals aged from 15 to 74 years, although the true selection procedure is actually systematic sampling from the Central Population Register, where the Register is sorted according to the domicile codes before the sample selection. It means that the sample has implicit geographical stratification. So far we have not encountered any

indications of selection bias due to systematic sampling, so the selection procedure can be approximated by simple random sampling without replacement" (p. 38). The sampling design is so based on element-level sampling. This is because we are able to draw samples from the CPR covering the whole population. A separate sample is taken of persons aged over 75 years and children under the age of 15 years, who are not interviewed but their data are included in the response database on a quarterly basis for Eurostat purposes.

The total sample size is about 12,000 selected persons (including nonresponse) divided into five waves and four or five reference weeks. The Council Regulation (EC) No. 577/98 concerning the organisation of a Labour Force Survey defines the frequency of the survey in the Paragraph 1 of the Article 1. The reference quarters and years are respectively groups of 13 or 52 consecutive weeks. A list of the weeks making up a given quarter or year is drawn up according to the procedure laid down in Article 8 of the Regulation. Procedures for the new allocation scheme of the sample, a SAS macro, has been developed and tested technically. The monthly sample allocates so that the weekly sample sizes are equal in each waves (see Table 3.1).

Table 3.1: The total sample divided into waves and weeks in December 2000

	Reference week					
Wave	1	2	3	4	5	Total
1	519	519	520	519	520	2,597
2	487	488	488	488	488	2,439
3	449	449	449	449	449	2,245
4	441	442	442	442	442	2,209
5	425	426	425	426	426	2,128
Total	2,321	2,324	2,324	2,324	2,325	11,618

3.6 The Weighting Procedure

Until the end of 1996 a detailed post-stratification scheme in weighting was used. The strata were constructed by gender, age (12 categories: 15 to 19, 20 to 24, etc.) and province (13 categories consisting of provinces and the Greater Helsinki area), totalling 312 cells. The main advantage of such detailed post-strata was the achievement of a high level of precision for various subgroups of the population.

However, weighting and estimation of results was studied intensively after the unemployment started to grow in the 1990s. Djerf and Väisänen (1993) reported different weighting procedures that were scrutinized in order to improve the precision of unemployment estimates. There were no gains to be achieved using the traditional demographic variables. But there was one way of getting a real improvement. It was possible for Statistics Finland to merge on micro level the survey data set with auxiliary register information from the Ministry of Labour's unemployed job-seekers' register. The Ministry of Labour keeps a register of job-seekers, in particular of all unemployed job-seekers receiving unemployment benefits. Djerf (2001) reported that the register information is

linked directly to each record using unique personal identification number (PIN). DJERF (1996, 1997) showed that the use of such information could also reduce bias due to non-response. DJERF (2001) concluded that it is not easy to obtain unbiased estimates on unemployment without using proper auxiliary information.

The use of the job-seeker information caused following changes in the estimates:

- The precision of the unemployment estimates improved markedly. For the overall total the gain in precision was 60 %.
- The level of the unemployment estimates changed (a net change from the employed to the unemployed). It is due to the correction for the negative bias present in the original estimates. The strong correlation between the two measures of unemployment moved the LFS estimate upwards, too. DJERF (2001) reported that the correlation between the two concepts of being unemployed (the ILO unemployed and unemployed by the register data) proved to be fairly high, about 0.80.

A new weighting procedure was introduced from the beginning of 1997. In order to maintain the population distribution as correct as possible, weights are first post-stratified in the similar post-stratification scheme as before. The strata were constructed now by gender, age (6 categories: 15 to 24, 25 to 34, etc.) and region (21 categories consisting of the regions on NUTS level 3 and the Greater Helsinki area), totalling 252 cells.

Subsequently the post-stratified weights are calibrated both on the marginal distribution of population and the register indicator of the being unemployed job-seeker. The indicator is further divided into three categories according to the length of being unemployed in the register: 0 to 180 days, 181 to 360 days and over 360 days. Additionally four indicators are used which tell if the person in question is included in the unemployed job-seekers register but he or she is not actually unemployed at the time of measurement. Those persons may, for example, be in some type of education to improve their employability. For practical reasons the register counts were selected for the last day of each month for use with the next month's LFS data.

In the case of a continuous survey, response rates vary weekly (see Section 3.7). So the response rates must be balanced that there would be the equal 'representation' of weeks on monthly level. Balancing can be done by different ways, and three basic methods were studied in more detail; first, the use of weekly multipliers based on the ratios of the means and numbers of weekly respondents, second, a response homogeneity groups model (RHG model) where weeks are considered as groups, and third, calibration techniques where a week is one of the calibration variables. The first method is not in generally unbiased. The second method is unbiased but it needs more programming handling of the gross sample, so it is not very practical. The calibration scheme was selected finally for the balancing technique because it is unbiased and can be done in connection with the calibration of the other auxiliary variables. An updated estimation procedure, including adjustment procedures of weekly respondents, was implemented from the beginning of 2000.

So currently, step 1 of the estimation design is the calculation of post-stratified weights, where post-stratification is done according to gender, age group and region. This gives the following estimate $\widehat{t}$ for a total t:

$$\widehat{t} = \sum_{h=1}^{252} \frac{N_h}{n_h} \sum_{k=1}^{n_h} y_k$$

Then in step 2 of the weighting procedure the calibrated weights are calculated: Post-stratified weights are calibrated according to gender, age group, region, reference week and register-based job-seeker status, taken from an administrative register maintained by Ministry of Labour.

- Gender (2 categories)

  1 = male 2 = female

- Age (12 categories)

1 = 15-19	7 = 45-49
2 = 20-24	8 = 50-54
3 = 25-29	9 = 55-59
4 = 30-34	10 = 60-64
5 = 35-39	11 = 65-69
6 = 40-44	12 = 70-74

- Register-based job-seeker status (8 categories)

  1 = Those (i.e. job-seekers) who have work in the conventional labour market
  2 = Unemployed for 0 to 180 days
  3 = Unemployed for 181 to 360 days
  4 = Unemployed for over 360 days
  5 = Laid off
  6 = Those who have work in subsidized employment
  7 = Other job-seekers (on reduced working week, persons not in labour force, unemployed pensioners)
  8 = Those who have not registered job applicants at the employment offices

- Region (21 categories consisting of the regions on NUTS level 3 and the Greater Helsinki area)

1 = Other Uusimaa	11 = North Karelia
2 = VarsinaisSuomi	12 = Central Finland
3 = Satakunta	13 = South Ostrobothnia
4 = Häme	14 = Coastal Vasa
5 = Pirkanmaa	15 = Central Ostrobothnia
6 = Päijät-Häme	16 = North Ostrobothnia
7 = Kymenlaakso	17 = Kainuu
8 = South Karelia	18 = Lapland
9 = South Savo	19 = Itä-Uusimaa
10 = North Savo	20 = Åland
	21 = Greater Helsinki area

- Reference week (4 or 5 categories)

3.7 The Nonsampling Error

Here we refer to the first-wave figures because the data is clean for that wave from the following disturbing features:

- proxies and imputations are allowed in the subsequent interviews.
- panel attrition may be a problem (However, the sampling procedure takes it in some extent into account because people are actually sampled after becoming 14 years old and they will be included once they are 15. Those becoming 75 are respectively exempted from the further interviews).

In the LFS the nonresponse rate of the 12,000 selected persons has grown during the years. From 1994 the annual average has varied from 7.4 % to 14.2 %. The nonresponse rate increased fairly slowly until 1994. However, since 1995 nonresponse rates grew rapidly due the following three possible explanations:

1. The household-based Community LFS (in March, April and May, 1995 to 1998) raised the nonresponse rates due to the increased response burden. The household survey was approximately three times as heavy as the national survey because of
   - the longer questionnaire
   - all household members aged from 15 to 74 years had to be interviewed
2. The use of CAI techniques (from January 1997).
   - special nonresponse operation were discontinued: i.e. reissuance, and the use of paper questionnaires, which were especially good for some noncontact cases
   - the questionnaire became considerably more comprehensive which increased response burden - the overall fieldwork time was shortened
3. The final change to use the longer EU-LFS questionnaire (from April 1999).

Since 1997 the annual average rose gradually from 12.9 % to over 14 % where it has remained since that. (See Figure 3.1).

DJERF *et al.* (1997) illustrates that the nonresponse rate grows systematically in the summer months, especially in July. There are contact problems then because a lot of families have a summer cottage where they stay even months. In some cases there have been clear neglects of the calendar, thus in June 1999 only three full days were available for the LFS fieldwork because of Midsummer, a big celebration for the Finns. The weather, too, was extraordinary fine over the whole summer. In the spring months 1997 and 1998 the nonresponse rate of the Community LFS increased by about three %-points. (See Figure 3.2).

There is a stable relation between genders: response rates of women is usually 2-3 %-points higher compared that of men (e.g. 87.3 % versus 84.3 % in 2000).

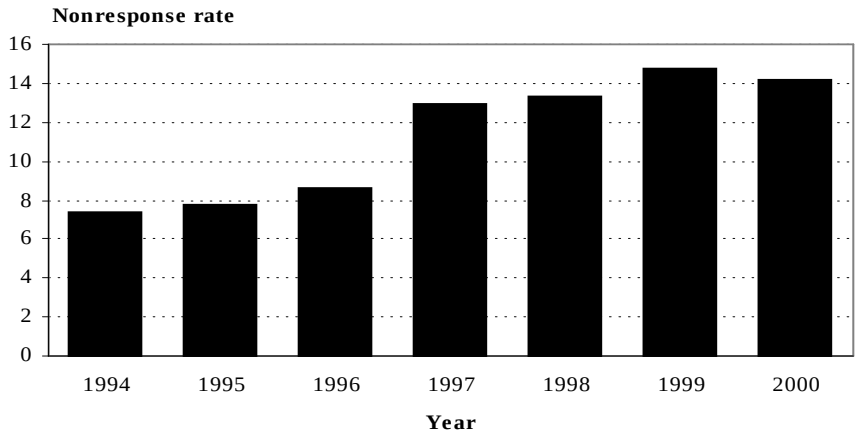

Figure 3.1: Nonresponse rates (%) of the LFS from 1994 to 2000

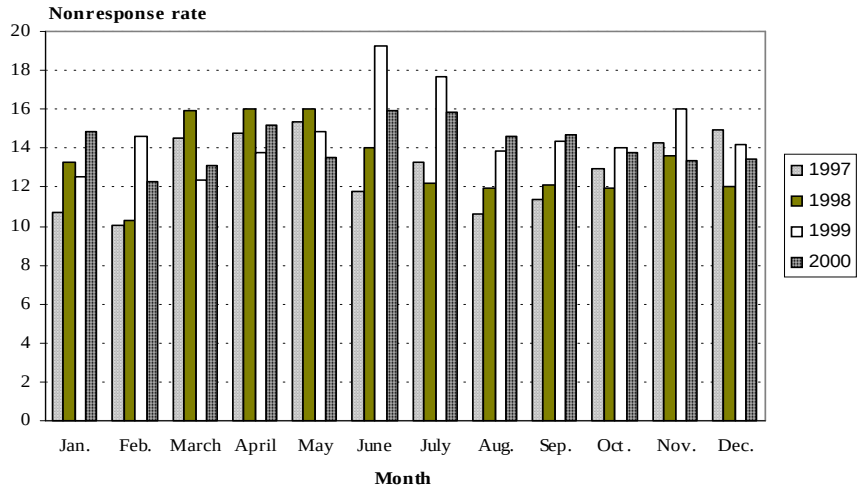

Figure 3.2: The monthly nonresponse rates (%) of the LFS from 1997

Regarding age one can see a flat inverse U-surface in nonresponse indicating that the most reluctant interviewees are in their active working age (see Figure 3.3).

In the geographical consideration three regions tend to have higher nonresponse rates in comparison to the rest of the country. These regions are the Greater Helsinki Area, the Other Uusimaa and the Autonomous Territory of Åland Islands. In these regions the nonresponse rates were about 20 % in year 2000. Whereas in the Eastern and Central Finland the rate was in general less than 10 %.

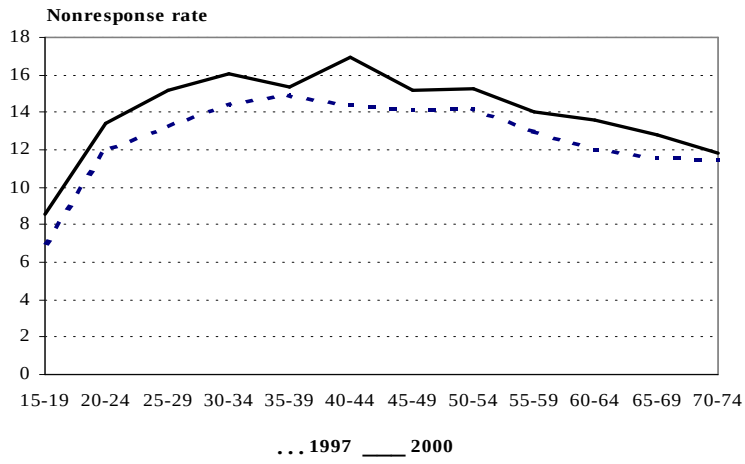

Figure 3.3: Nonresponse rates (%) of the LFS by age, 1997-2000

The continuous LFS (since 2000) causes some new effects on nonresponse. Response rates vary weekly. For example, in March the response rates has varied from 82.3 % to 88.7 %.

3.8 The Sampling Error

The basic sampling design can be regarded as stratified random sampling and due to the calibration weighting procedure, Statistics Finland approximates the sampling variance by the variance estimator for the generalized regression estimator.

3.9 Summary

The Finnish Labour Force Survey is a monthly, rotational, voluntary survey of about 12,000 selected persons, who are registered as permanently resident in Finland. The sampling frame is the quite up-to-date Central Population Register.

The sampling method used for this survey is a systematic sampling of persons, out of the Central Population Register. This register is sorted according to the domicile codes. This means, that the sample becomes geographically stratified with nearly proportional allocation of the total sample number to the strata (see Figure 3.4).

The Weighting procedure includes a post-stratification and then a calibration of these weights both on the marginal distribution of the population and the register indicator of the being unemployed job-seekers. The unit-nonresponse is about 14 % (without proxies) and the currently used variance estimation formulas are give by those of unrestricted random sampling.

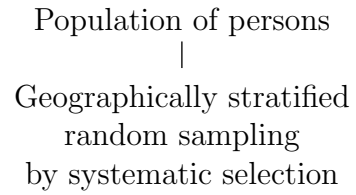

Figure 3.4: The sample design of the Finnish LFS

Chapter 4

The German Microcensus

4.1 Introduction

The German microcensus (= GMC), which is a representative sample survey of the population and its economic activity, was conducted in Germany for the first time in 1957. Like any official survey in Germany, the microcensus requires a legal basis, too. The new Microcensus Law of 17 January 1996 will be effective until the year 2004. The GMC is designed as a multi-purpose sample survey and is of importance not only because it continuously provides major basic data, but also because of its characteristics such as flexibility, problem-orientation, up-to-dateness and accuracy as an instrument of data collection. The basic contents-related sampling and organizational components of the microcensus conception have proved their adequacy. Based on the new Law of January 1996, the data collection procedure as a modern and demand-oriented instrument of data production has been further advanced. This development, considering both effort and cost aspects, has focused not only on minimizing the burden on respondents and ensuring a positive response to the survey, but also on finding solutions to reduce the organizational effort required for conducting the survey and processing the data collected.

Advancing the GMC became the more urgent since the requirements of the microcensus have considerably increased due to the expansion of the microcensus-related Labour Force Survey of the European Union in the context of Council Regulation (EEC) No. 3711/91 of 16 December 1991 on conducting an annual labour force survey in the Community.

In a detailed subject-related breakdown, the GMC provides information on the structure of the population, the economic and social situation of both the population as a whole and the families, the labour market, and the occupational structure and education/training of the economically active population.

Apart from its main function to provide reliable and low-cost information on major changes in population and labour market statistics at short and regular intervals, the GMC is a data source which has become indispensable for parliament, general government, administrative authorities, research institutes and the general public at both the national level and the level of federal states (in German: “Länder”).

Beginning with 1990, a new sample design is being used for the GMC. The former one was replaced mainly to enable the provision of more detailed results. It was possible to attain

this objective without an increase or regional differentiation of the sampling fraction of annually 1 % of the population.

After the unification of Germany East and West in the beginning of the Nineties, in the new Länder and Berlin-East the GMC was conducted for the first time in April 1991. To meet the great demand for timely information about the deep structural changes in the new Länder as a result of the unification, two additional microcensus surveys were carried out with a reduced sampling fraction (25 % of the households interviewed in April 1991) in October 1991 and in January 1992.

The GMC is an essential component of the overall system of the German official statistics. In its capacity as a continuous representative multi-purpose survey covering one percent of the population it does not only close the gap between two population censuses, but regularly also provides information for a large variety of purposes. Among other things, it serves to continuously monitor the labour market, to enlarge the scope of socio-economic information offered for many purposes of social relevance and to continuously observe socio-economic changes at personal, family and household levels. In addition, it is used as an instrument for expansion, adjustment and control purposes for many other surveys, in particular sample surveys of empirical social research, but also official surveys such as the sample survey of income and expenditure (see Chapter 7).

Integrated into the GMC, the common annual Labour Force Survey to be conducted in all countries of the European Union in the framework of European cooperation can be carried out in an effective way in line with the German system.

To better meet the requirements of expanding the Labour Force Survey, i.e. to reduce the burden on respondents, the organisational effort and the cost of data collection, and to enhance the up-to-dateness of the data provided, the new Microcensus Law has been aimed at further harmonising the definitions and delimitations of variables, the frequencies of conduct and the sampling fractions of the microcensus and the Labour Force Survey.

4.2 The Target Population

The target populations for the GMC are

- the universe of households
- the universe of families and
- the universe of persons

in Germany. Survey units are buildings or parts of buildings. They build clusters of households, families or persons.

4.3 The Survey Process

The Microcensus Law provides a combination of methods, i.e. postal and face-to-face interviewing. The aim of using this combination of methods is to guarantee the respondents' right to self-determination, but also to ensure an exhaustion of the microcensus capacity. However, the completion of questionnaires should by no means be regarded as an alternative to interviews as the latter essentially reduce the burden on respondents. Since the data collection program and some methodological and organizational aspects of the microcensus are rather complex and its questions often need explanation, the work of interviewers is indispensable. Interviews are the most adequate instrument to achieve a high response rate and good data quality. Through direct contact with an interviewer, the respondents can be better informed about the use and purpose of the survey. And the interviewer has the chance to win households for participating in the survey. In addition, the interviewer can directly respond to questions that might come up.

However, there are households whose members are not at home during normal interview hours and are therefore only prepared to provide written information. In order to guarantee the right to self-determination of those households, it is necessary to allow written response, too. It should however be considered that written response requires a considerable additional effort regarding the organization and conduct of the survey and also the processing of its results.

The GMC is based on the reference week concept. Typically, the reference week of the microcensus, which coincides with the reference week of the Labour Force Survey of the European Union, is a week without holidays in April. The interviews, which are conducted by interviewers commissioned by the statistical offices of the Länder, usually take place in May or June. The interviewers are trained for their job and assigned to the individual sample districts by the statistical offices of the Länder.

To minimize nonresponse, interviewers several times repeat their visits to those persons to be interviewed whom they did not meet during their first visit. Nonresponse detected at the statistical office of a Land or unplausible responses are examined and, where required, the households concerned are contacted again. Compulsory response to many questions is another factor contributing to a low level of nonresponse. In addition, administrative fines may be imposed on persons who refuse to provide information altogether. The most effective instrument to keep unit nonresponse low is the option to respond in writing. Unit nonresponse amounts to about 3 %, while item nonresponse is up to 40 % for questions with voluntary response.

4.4 The Sampling Frame

The GMC and the integrated Labour Force Survey are annually conducted by the Federal Statistical Office together with the statistical offices of the Länder. When the microcensus was suspended due to the discussion about the latest population census in 1983 and 1984, the Labour Force Survey was conducted as an independent survey. The sample design of the microcensus, which the European Union Labour Force Survey is a subsample of, is based on area sampling.

The sampling frame used for the former territory of the Federal Republic encompassed the population census and the census of buildings and housing of 1987. Only the number of persons and dwellings in each building (more exactly: address) could be used for constructing the sampling frame. For the new Länder, a comparable sampling frame was constructed from the *Bevölkerungsregister Statistik* (statistics based on the population register).

To build the sampling frame from which the sample can be taken, the buildings of the census of 1987 are regionally stratified at first. The regional strata used are 201 spatial units with an average of about 350,000 inhabitants. Cities with more than 200,000 inhabitants and other regions with more than 250,000 inhabitants, which generally cover one or several administrative districts, in some cases are regional strata of their own. Regional stratum subgroups with at least 100,000 inhabitants are formed additionally by suitably arranging the sample districts.

In the second step the buildings are stratified within each regional stratum by the variable "size of the building": The buildings are allocated to 3 size classes or strata depending on the number of their dwellings. Stratum 1 includes small buildings with 1 to 4 dwellings (mainly in rural areas) and a number of inhabitants not exceeding a certain value (see Table 4.1). Stratum 2 includes medium-sized buildings with 5 to 10 dwellings (mainly in urban areas) and a number of inhabitants similar to stratum 1. The buildings of stratum 3, comprising 11 or more dwellings (mainly in urban areas) have the same maximum of inhabitants like the other strata. The additional stratum 4, which was of special nature, covered the population living in collective accommodations (see Figure 4.1).

Table 4.1: Assignment of the buildings to strata 1 to 4 of size-classes within each regional stratum

number of persons (i) in a building	number of dwellings (j) in a building			
	$j = 0$	$1 \leq j \leq 4$	$5 \leq j \leq 10$	$j \geq 10$
$i = 0$	–	1	2	3
$1 \leq i < (j + 4) \cdot 4$	4	1	2	3
$i \geq (j + 4) \cdot 4$	4	4	4	4

The components used for defining the sample units (= clusters of households) are either one or more complete buildings or - as for large buildings - parts thereof. Within each regional stratum the buildings are arranged by part of region, street and house-number. The sample units in this way all receive a number. The buildings of stratum 1 of the buildings size are grouped to form sample units with a target number of 12 dwellings. Grouping is based on the sequence of house numbers in a street and, where necessary, covers more than one street. In stratum 2 each of these buildings forms a sample unit of its own. The buildings of stratum 3 are divided into sample units with a target number of 6 dwellings. Hence the size of the sample units differs between the individual strata (building size classes). The average sample unit size is 9 dwellings. The buildings of stratum 4 are divided into sample units with a target number of 15 persons. For a good regional representation the sample units are sorted in terms of region, i.e. within each

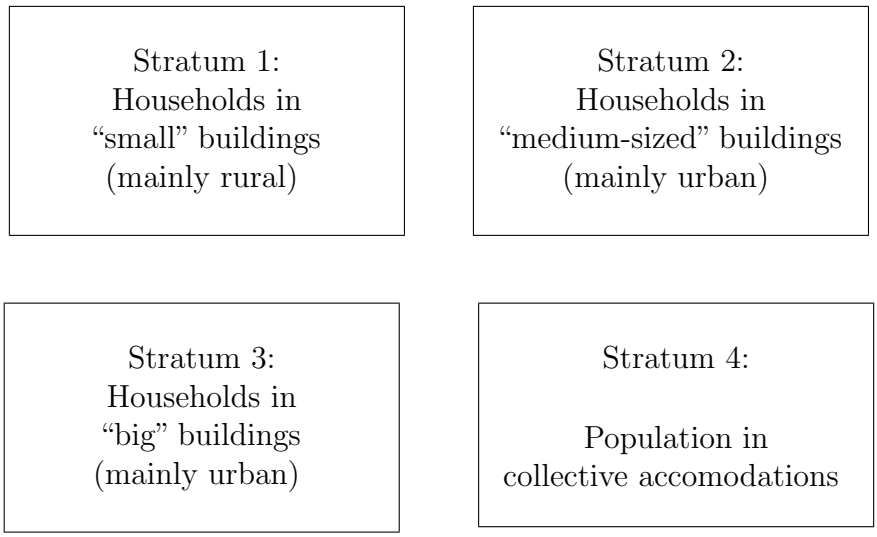

Figure 4.1: The partition of the universe of households within each regional stratum

stratum they are sorted by regional stratum subgroup, administrative district, community size class, community and sample unit number.

Another stratum serving to update the basic sample is added to the aforementioned subject-related strata. Annual updating of the sample is based on the data reported for building activity statistics. New buildings reported are assigned to the size classes specified above. Compared with the selection based on the 1987 population census, the following modifications have been made: As regards new buildings, the building size class only serves to form sample units rather than to stratify the sample. The minimum number of dwellings per building is 9 in the third size class. The information whether a specific building belongs to the special stratum of collective accommodations can be directly obtained from the data reported. And finally, the sample units formed by buildings with 1 to 4 dwellings have a target number of 6 dwellings (instead of 12). This means that the sample units of all building classes have roughly the same size; they are grouped to form just one subject-related stratum ("stratum of new buildings") per regional stratum.

For the new Länder of Germany the GMC-sample is constructed similar to the Länder of the former federal republic of Germany using the Bevölkerungsregister Statistik as the basis for the sampling frame.

4.5 The Sample Design

The sampling method applied, i.e. sorting, defining zones, and sampling within the zones, guaranteed for all these regions an effect similar to stratification.

A total of 20 1 % samples of the sample units, which are clusters of households, families and persons are defined by random selection. The 1 % samples are divided into 0.25 % and 0.05 % subsamples. The 0.25 % subsamples, referred to as *rotation quarters*, permit

an annual substitution of 25 % of the sample districts, while the 0.05 % subsamples serve to provide subsampling fractions like those required for the Labour Force Survey of the European Union and the supplementary program. Article 3 of Council Regulation (EEC) No. 3711/91 of 16 December 1991 on conducting an annual labour force survey in the Community specifies the accuracy standards demanded by the European Union. To meet those requirements, the sampling fractions for the Labour Force Survey subsample amount to 0.4 %, 0.6 %, 0.8 % or 1 %, depending on the administrative region concerned. The result for the territory of the Federal Republic as a whole is a disproportionate sampling fraction of an average 0.45 % at present.

"Zones" are formed by 100 consecutive sample units each. The sample units of each zone are formed at random by permutation of numbers 0 to 99 by means of a random number generator. Sample units with the same number, i.e. the same "sampling number", are grouped to form a (1 %-) sample. Thus the population is divided into 100 1 %- samples. The random number generator is also used to form at random four successive zones each by permutation of numbers 1 to 4. This permits to divide every 1 %- sample into 4 rotation quarters of 0.25 %. The 20 1 %-samples are determined at random by sampling from an urn an interval comprising 20 sampling numbers between 0 and 99. Subsequently, the first 1 %- sample to be used for the 1990 microcensus was determined also by sampling from an urn. The subsamples, too, are obtained systematically with a random start. Within each sample unit the information are taken about all households, families and persons. The total sample size of households is about 295,000 (about 650,000 persons) in western Germany and about 70,000 (about 160,000 persons) in eastern Germany.

4.6 The Weighting Procedure

The introduction of the new sample design for the GMC and the labour force survey from 1990 also involved developing a new weighting concept. The method applied before (doubling and eliminating at random individual files of persons) was replaced by weights. The new concept maintains the basic idea of a procedure divided into two steps, which was applied before 1989 and proved to be suitable. With the aim to compensate for random and systematic errors, which are unavoidable in sampling procedures, the first step serves to compensate for the nonresponses known. In the second step, the sample is then raised and adjusted by means of key data from the continuous population updating procedure.

Relevant information that may be available on the nonresponding households is used as far as possible by means of the compensation algorithm. After all collection activities have been finished, the nonresponding household is allocated to one of the pre-defined compensation types on the basis of the information available. Eighteen compensation types are formed by the combination of the following characteristics: household size (single, two persons, three or more persons), citizenship (Germans, foreigners), for Germans: main or secondary place of residence, and for one-person households: sex and age (under 60 years, 60 years and over). The compensation algorithm design is variable, so that incomplete information and even entire nonresponse on a household are used, too. Thus 50 household compensation types are formed as well as an additional compensation class for nonresponding persons in collective accommodations.

For each of those 51 compensation types, a factor can be calculated consisting of the ratio between the number of households questioned plus the number of nonresponding households in the respective class and the number of households actually questioned in the respective class. This is done at a regional level with at least 100,000 inhabitants, namely at the level of the 391 "regional stratum subgroups". The compensation weights calculated can then be inserted into the files of persons of responding households, according to the household characteristics.

In a second step, following the compensation for known nonresponses, there is an adjustment, using key data from the continuous population updating procedure. This method has proved suitable despite various problems arising. The adjustment frame distinguishes between Germans and foreigners, in combination with the sex. The adjustment is performed within the 123 regional adjustment strata - regional units with an average of at least 500,000 inhabitants - rather than at the level of administrative districts. The adjustment weight of a specific adjustment class is calculated by the ratio between the target number from the continuous population updating procedure and the actual number from the microcensus, after compensation for the known nonresponses. Multiplying the household-related compensation weight by the person-related adjustment weight results in the respective person weight.

Including this person factor in households- or families-tables is not satisfying. Therefore since 1990 in addition to the person weight a household weight is calculated as the average value of all person weight of one household.

4.7 The Nonsampling Error

To minimize nonresponse, interviewers several times repeat their visits to those persons to be interviewed whom they did not meet during their first visit. Nonresponse detected at the statistical office of a Land or unplausible responses are examined and, where required, the households concerned are contacted again. Compulsory response to many questions is another factor contributing to a low level of nonresponse. In addition, administrative fines may be imposed on persons who refuse to provide information altogether. The most important instrument to keep unit nonresponse low is the option to respond in writing. Unit nonresponse amounts to about 3 %, while item nonresponse is normally between 3 and 25 % for questions with voluntary response. For example the item-nonresponse for the item "highest educational level" was 27 % in the year 2000.

4.8 The Sampling Error

Currently the variance of a total of persons (or households) is estimated by a formula that takes into account the selection of clusters of survey units and the stratification of these clusters. It does not include the (positive) effects of regional stratification and bounded estimation and the (negative) effect of systematic sampling. Then the design-effect is calculated as the ratio of this variance estimator and the variance estimator for unrestricted random sampling. This calculations done for some hundred characteristics. It

has been shown, that this design-effect is never below one. This value is not constant but increases nearly linear as the proportion of persons (or households) having an interesting characteristic increases. The model is

$$k_g = a + b \cdot p_g + e_g$$

(k_g: design-effect of the interesting characteristic g; $a, b : \ldots$ regression coefficients; e_g: error term; p_g: proportion of the interesting characteristic g). The regression is done separately for three groups of characteristics. So the sampling error of variables in the GMC is calculated by the variance for unrestricted random sampling multiplied by the design-effect.

4.9 Summary

The GMC is an annual, rotating obligatory survey of about 1 % of all households (ca. 370,000; about 800,000 persons) in Germany. All families and persons of the selected households are included. The sampling frame is built with the census in Germany West and the Population Register in Germany East.

The buildings are at first regionally stratified. Within these strata they are stratified once again by the size of the building and then arranged by region, street and house number. At last they are grouped to clusters that form the sample units. These units are sorted in terms of region. "Zones" are formed by 100 consecutive sample units. One sample unit is selected at random from each zone (semi-systematic sampling).

Each data set is weighted by a compensation factor for the known nonresponses and adjusted by means of key data from the continuous population updating procedure. Including proxy-interviews the unit-nonresponse is very low: ca. 3 %. The sampling error of the interesting variables is calculated by the product of the variance under unrestricted random sampling and a design effect.

Population of buildings
|
Stratification
(stratification variables:
region and building-size)
|
Definition of sample units
(= clusters of households)
|
Semi-systematic selection
of sample units

Figure 4.2: The sample design of the GMC

Chapter 5

The Dutch Labour Force Survey

5.1 Introduction

From 1987 to 1999 the Dutch LFS was carried out as a continuous cross-sectional survey based on a sample throughout the whole of the Netherlands. In 2000 it has changed from a cross-sectional into a rotational survey. Every month about ten thousand households are contacted, except in the months of July and August, when the number of addresses in the sample is halved. This has to do with the reduced capacity of the interview staff during the holiday season. The objective of the Dutch LFS is to provide accurate information on the labour market, especially on employment and unemployment. From the end of 1999, the design of the LFS is changed from a cross-sectional survey into a rotating panel survey with four waves.

5.2 The Target Population

The target population of the Dutch LFS consists of all persons aged 15 years or more, living in the Netherlands, with the exception of persons living in institutions and most of the figures derived from the Dutch LFS concern persons aged 15 to 64. Some additional tables with information about people older than 64 are produced. Besides figures on persons also figures on households are derived from the LFS and published as the Annual Household Statistic. The households are the ultimate sampling units for the Dutch LSF.

5.3 The Survey Process

There are many domains of interest. Some of them are demographic, like age, sex and ethnicity, or geographic, like province and RBA-region (Regional Employment Board). Others are connected with the labour situation, for instance level of education, economic activity of the employee and labour position.

Once the sample is taken, Statistics Netherlands sends each household a letter. This tells them that they have been chosen to take part on the Dutch LFS, that the information

they give to interviewers will be treated in confidence and that one of the interviewers will visit them shortly. Then the interviewers try to contact and interview people living at the sampled addresses face-to-face. The Dutch LSF is voluntary. Between 50 and 60 percent of households visited by interviewers agree to take part in the survey.

In 1999, about 500 interviewers worked on the data collection of the Dutch LFS. They were trained at Statistics Netherlands. The interviewers try to collect information from at most four persons in a household. The so-called core of the household is always interviewed. The members of the core of the household are the wage earner and his or her possible partner. When there are more then four household members the other respondents are selected first from the members aged younger than 65 years. If the number of four is not reached after this selection, persons aged 65 years or more are selected too. Therefore, persons aged 65 years or more are underrepresented in the Dutch LFS.

It often happens that not all selected persons are available for the interview, for example if a selected person is not at home during the visit of the interviewer. In this case the Dutch LFS allows interviewers to take answers to questions by proxy. This means that another member of the household, preferably a member of the core of the household, answers the questions concerning the absent person. By allowing proxy interviews the number of partially nonresponding households is reduced. About 35 percent of Dutch LFS responses are collected by proxy.

Since the year 2000 in the first wave data are collected by means of CAPI. In the other three waves of the rotating system data are collected by means of CATI. After the interviews the data are transmitted by telephone line to a network of computers present at Statistics Netherlands and become available for coding and for further statistical processing. Households for which one or more of the selected persons did not respond directly or by proxy, are treated as nonresponding households.

5.4 The Sampling Frame

The sampling frame for the Labour Force Survey is mainly based on the Geographical Base Register (= GBR). The GBR consists of all addresses in the Netherlands and is composed by the postal service. An additional register is used for the city of Amsterdam, namely the register of houses in Amsterdam. These two registers are combined into one list of addresses. Addresses not occupied by households, for instance belonging to amusement parks or campsites, are excluded.

For the statistic Registered Unemployment the registration of the Employment Exchange is used. This registration is called GIS, which is the Dutch abbreviation of Common Information System, formerly called ISVA (the Dutch abbreviation of Information System of Demand and Supply). This registration contains information about the labour force position of persons. A person can be registered as unemployed or employed or not registered at all. This information is used in the sample design and the weighting procedure.

5.5 The Sample Design

The Labour Force Survey is conducted continuously. The sample is drawn in the month November of the year proceeding the survey year. The total sample consists of twelve subsamples: one for each month. The sample-size of contacted households per month is 10,000 with the exception of July and August, when the sample-size is halved. Six months after the drawing of the sample a supplementary sample from addresses of recently finished houses is drawn.

The Labour Force Survey is based on a stratified two-stage sample design. At first the population is stratified according to a combination of two regional classifications called COROP (Committee for the Co-ordination of a Regional Research Programme) and RBA (Regional Employment Board). At second a two-stage sample is drawn from each stratum. In the first stage municipalities are drawn from which addresses are selected in the second stage.

In the first stage a systematic sample of municipalities is drawn in each stratum and the number of addresses to be sampled from the drawn municipalities is determined. First the sample design for one month is discussed. Next it is explained how the design is extended to be adequate for a whole year.

The inclusion probability of a municipality depends on the number of addresses. If a municipality is large compared to the other municipalities in the stratum, it is possible that this municipality is selected more than once in a month, because the sample is drawn systematically. These so-called self-representing municipalities are separated from the rest of the municipalities and are drawn with certainty in the first stage.

To demonstrate how the self-representing municipalities are separated, the following notation is introduced. The population is divided into H regionally defined strata. Stratum h consists of N_h municipalities, from which n_h elements are sampled. Within a selected municipality i in the stratum h, m_{hi} addresses are sampled. The number of addresses in a municipality is M_{hi}.

At first, the number of addresses to be sampled in stratum h is computed:

$$m_h = \frac{M_h}{M}\, m \tag{5.1}$$

with

M_h : the total number of addresses in stratum h,
M : the total number of addresses in the population,
m_h : the number of addresses to be sampled in stratum h,
m : the total number of addresses in the sample.

This means, that the number of addresses to be sampled in a stratum is proportional to the size of the stratum. Before drawing the sample, the cluster size m_0 is determined. The cluster size is the desired number of addresses to be sampled in a non-self-representing

municipality. For the Dutch LFS m_0 is chosen to be 12. The number of municipalities to be sampled in stratum h equals

$$n_h = \frac{m_h}{m_0} \ . \tag{5.2}$$

If the value of n_h is not an integer, it is rounded. Values of n_h smaller than 1 are replaced by 1 to achieve that every stratum is represented in the sample. Next, the value of the sampling interval in stratum h is determined as the number of addresses in stratum h divided by the number of municipalities in the sample in stratum h: M_h/n_h. For some municipalities i in stratum h it is possible that

$$M_{hi} > \frac{M_h}{n_h} \ . \tag{5.3}$$

In these municipalities the number of addresses exceeds the sampling interval. The municipalities, for which this is the case, are separated as being self-representing. The number of addresses to be sampled in a self-representing municipality equals

$$M_{hi} = \frac{M_{hi}}{M} \ m \ . \tag{5.4}$$

The number of addresses sampled in a self-representing municipality is proportional to the size of the municipality.

After the self-representing municipalities are separated, they are treated as an extra stratum. A systematic sample is drawn from the remaining municipalities. The number of addresses to be sampled in a stratum is computed again using (5.1), but now the numbers for the self-representing municipalities are removed from all three components on the right hand side. After this, a new value for n_h, say n_{h^*}, is computed. Again it is checked whether there are municipalities satisfying (5.3). If there are, they are separated and the computations start again. If there are no municipalities satisfying (5.3), the number of addresses to be sampled in a non-self-representing municipality equals

$$m^*_{hi} = \frac{m^*_h}{n^*_h} \tag{5.5}$$

Here the asterisk indicates that the numbers for the self-representing municipalities are removed.

If $n^*_h = m^*_h/m_0$, we have $m^*_{hi} = m_0$. Since n^*_h is the maximum of the rounded value of m^*_h/m_0 and 1, m^*_{hi} often differs from m_0.

The sample design for one month is constructed. The sampling interval in every stratum and the number of addresses to be sampled within a drawn municipality are known. Before actually drawing the sample, the design is extended to a design for twelve months. For the Dutch LFS the sample designs for the twelve months of the year are made at once to make sure that the distribution of the sampled municipalities over the months is optimal.

For the self-representing municipalities no changes are necessary. The same sample design is used in every month. They are included with probability one and the number of

addresses to be sampled is computed as described before. For the non-self-representing municipalities the computed sampling interval is adjusted. To make sure that in each stratum twelve times the number of municipalities needed in a month is sampled, the sampling interval is divided by twelve. This results in the sampling interval that is actually used in drawing the systematic sample of municipalities. A part of the municipalities will appear more than once in the sample. This means that they will be examined in different months of the year. All (or nearly all) municipalities will be present in at least one month of the year.

The number of months a municipality is part of the sample is proportional to the number of addresses in the municipality. The selected municipalities have to be assigned to one or more months. This is realized as follows: The months of the year are put in an order that differs from the usual calendar. This alternative order of the months is used for all strata. The first sampled municipality is assigned to the first month. If this municipality is sampled twice, it is also assigned to the second month. If not, the second selected municipality is assigned to the second month. This is continued until the twelve months are covered. Then the process starts again from the first month in the alternative order. In this way the selected municipalities are divided equally over the months of the year. The alternative order of the months is used for all strata, but the month that is the starting point varies over the strata.

The starting value of the sampling scheme in a stratum is a fixed fraction of the sampling interval. This fixed fraction varies from year to year to make sure that the samples differ in the succeeding years.

In the second stage of the sampling process addresses are sampled from the selected municipalities. The numbers of addresses to be sampled in a selected non-self-representing municipality are computed in the first stage. The number of addresses to be sampled in a self-representing municipality is equal to the number of addresses in this municipality multiplied by the overall sampling fraction (m/M). In every selected municipality a random sample of addresses is drawn without replacement.

This results in the first order inclusion probabilities displayed in (5.6) and (5.7). For the self-representing municipalities the inclusion probability of address k equals

$$\pi_k = \frac{m_{hi}}{M_{hi}} = \frac{M_{hi}\frac{m}{M}}{M_{hi}} = \frac{m}{M}, \tag{5.6}$$

where (5.4) is used to derive the result. For the addresses in the non-self-representing municipalities, the inclusion probability equals

$$\pi_k = n_h^* \frac{M_{hi}}{M_h^*} \frac{m_{hi^*}}{M_{hi}^*} = \frac{m}{M}. \tag{5.7}$$

The derivation of (5.7) is straightforward when the equations (5.1), (5.4) and (5.5) are used. Because every address has the same inclusion probability the sample is called self-weighting.

After addresses are drawn within the municipalities, clusters of addresses are formed that are close to each other. Each cluster of addresses is assigned to one of the months

in which the municipality should be sampled. Because the addresses in a cluster are geographically close to one another, the features of the residents on the sampled addresses can be comparable. Nevertheless, this clustering has little effect on the variance of the estimates (see: De REE, 1989).

Within a selected household all persons aged 15 and over are interviewed, with a maximum of four persons. When a household consists of more than four persons from the target population, the interviewer selects four persons before the interviews take place.

Until 1998, the sampling frame contained information about the number of postal delivery points on the addresses. Generally the number of postal delivery points corresponds with the number of households on an address. The inhabitants of addresses with two or more households are homogeneous with regard to their labour force position. If all the households on such an address are included in the sample, this results in an overrepresentation of persons with similar labour market positions in a region. To reduce this overrepresentation at the regional level, only half of the households on such an address are interviewed.

So strictly speaking, a third stage in the sampling process might be distinguished. Without further corrections this should lead to an underestimation at the national level of this type of household. To solve this problem, the inclusion probability of addresses with more than one postal delivery point is two times the inclusion probability of the other addresses.

Since the LFS has to provide accurate outcomes for the monthly publication of the Registered Unemployment, addresses, which occur in the register of the Employment Exchange, are oversampled. Since most target variables of the LFS concern people aged 15 to 64 years, addresses with only persons aged 65 years or more are undersampled. Technically this is carried out by drawing a sample that is three times as large as necessary for the LFS (that is 3 x 10,000 addresses per month). The number of addresses drawn from each municipality in the second stage is determined such that a self-weighted sample of addresses is obtained as described in the preceding sections. This sample is randomly divided into three subsamples of 10,000 addresses. From the first subsample 60 % of the addresses with only people aged 65 years or more are removed. The remaining addresses of the first subsample are included in the final sample. From the second subsample only the addresses, which occur in the register of the Employment, Exchange (employed or unemployed) are included. From the third subsample only the addresses of persons who are registered as unemployed are included. Addresses with persons found on the list of the Employment Exchange are oversampled since July 1988. The undersampling of addresses with only persons aged 65 years or more is carried out since January 1998.

5.6 The Weighting Procedure

Population parameters estimated with the LFS are defined as ratios

$$R = \frac{t_y}{t_z} \ , \tag{5.8}$$

where t_y and t_z are population totals.

After the households are interviewed, the samples of the twelve months are put together. To estimate population parameters from the response, a weighting factor w_i is assigned to each respondent i. Estimators for the population totals are given by

$$\widehat{t_y} = \sum_{i=1}^{n} w_i y_i \tag{5.9}$$

where y_i is the observed value of the target variable of respondent i. The weighting factors are used for all target variables. Estimators for ratios are given by

$$\widehat{R} = \frac{\widehat{t_y}}{\widehat{t_z}} \ . \tag{5.10}$$

The weighting factors are calculated by means of the generalized estimator, taking into account the probability of inclusion, different response rates between regions and external information about population counts concerning age, sex, marital status, nationality and region.

The weighting procedure of the LFS starts with deriving inclusion weights for the responding persons, taking into account:

1. The oversampling of addresses which occur in the register of the Employment Exchange.
2. The undersampling of addresses with only persons aged 65 years or more.
3. The month of interview (the sample is halved in July and August).
4. Differences in response rates between geographical regions. Regions are the self-representing municipalities; for the other municipalities regions are formed by province.

These weights are viewed as approximations for the net inclusion weights and are the starting weights for the regression estimator discussed below.

The sample of the LFS is used to make estimates at the person level. It also is the input of the Annual Household Statistics that produces estimates at the household level. The estimated totals at the household level and at the person level should be mutually consistent. To realise this consistency, a weighting procedure is implemented that guarantees equal weights for members of the same household. Lemaître and Dufour (1987) developed this method. With the more traditional weighting procedures, the weights are not the same for all household members.

Regression based weighting procedures use auxiliary variables that are observed in the sample and for which the population totals are known. For the LFS only categorical

auxiliary variables are available and the corresponding population totals are present as population counts. For each category a dummy variable can be defined with the value one if the person corresponds to the relating category and the value zero otherwise.

The following weighting scheme is used

$$Area1 \cdot (A + B) + Area2 \cdot (C + D) \tag{5.11}$$

where

$Area1$:	consists of 15 classes: the twelve provinces and the three largest municipalities Amsterdam, Rotterdam and The Hague,
A:	a classification based on age, sex and marital status into forty classes,
B:	a classification based on age, sex and ethnicity into five classes,
$Area2$:	a detailed geographical classification nested within $Area1$ based on COROP and RBA (the classification of $Area2$ differs between the classes of $Area1$),
C:	a classification based on age and sex into eight classes,
D:	a classification based on age, sex and marital status into three classes.

In order to force equal weights for all persons within one household, the weighting procedure is conducted at the household level. Let H denote the number of auxiliary variables of the weighting scheme (5.11), after eliminating variables, which are linear combinations of other variables. Let $\mathbf{x}_{ij} = (x_{ij1}, \ldots, x_{ijH})^t$ denote a vector of order H with each element x_{ijh} the h-th auxiliary variable of individual i in household j. Let y_{+j} denote the household total of the observed variables y_{ij} of household members i in household j. Similarly, $\mathbf{x}_{+j}$ denotes the household total of the auxiliary variables $\mathbf{x}_{ij}$. For each target variable a linear regression model for all households in the population is defined by

$$y_{+j} = \mathbf{b^t x}_{+j} + e_j, \tag{5.12}$$

with model assumptions

$$E(e_j) = 0$$

$$Cov(e_j, e_{j'}) = \begin{cases} \omega_j^2 : & j = j' \\ 0 : & j \neq j' \end{cases}$$

Here $\mathbf{b}$ denotes a vector of order H with regression coefficients, e_j the residuals and ω_j^2 the variance of the regression model. Let d_j denote the final inclusion weight of the persons in household j, see above, m the total number of completely responding households in the sample, $\mathbf{X}$ an $m \times H$ matrix with row j containing the auxiliary variables $\mathbf{x}_{+j}$, $\mathbf{D}$ an $m \times m$ diagonal matrix with $\mathbf{D}_{j,j} = d_j$, Ω an $m \times m$ diagonal matrix with $\Omega_{j,j} = \omega_j^2$, $\mathbf{y}$ a vector of order m containing the observed variables y_{+j} and $\mathbf{j}$ a vector of order m with each element equal to 1. The regression estimator for t_y is defined by (SÄRNDAL *et al.*, 1992)

$$\widehat{t}_y = \widehat{t}_{y\pi} + \widehat{\mathbf{b}}^t(\mathbf{t}_x - \widehat{\mathbf{t}}_{x\pi}). \tag{5.13}$$

Here $\mathbf{t}_x$ denotes a vector of order H containing the known population totals of the auxiliary variables, $\widehat{\mathbf{t}}_{x\pi}$ the Horvitz-Thompson estimator for $\mathbf{t}_x$, $\widehat{t}_{y\pi}$ the Horvitz-Thompson estimator for t_y and $\widehat{\mathbf{b}}$ the estimator for the regression coefficients $\mathbf{b}$.

We have

$$\widehat{t}_{y\pi} = \sum_{j=1}^{m} d_j y_{+j} = \mathbf{y}^t \mathbf{D} \mathbf{j}, \tag{5.14}$$

$$\widehat{\mathbf{t}}_{x\pi} = \sum_{j=1}^{m} d_j \mathbf{x}_{+j} = \mathbf{X}^t \mathbf{D} \mathbf{j}, \tag{5.15}$$

$$\widehat{\mathbf{b}} = (\mathbf{X}^t \mathbf{D} \Omega^{-1} \mathbf{X})^{-1} \mathbf{X}^t \mathbf{D} \Omega^{-1} \mathbf{y}. \tag{5.16}$$

By substituting (5.14) and (5.16) in (5.13) it follows that the regression estimator can be written as

$$\widehat{t}_y = \mathbf{y}^t \mathbf{D} (\mathbf{j} + \Omega^{-1} \mathbf{X} (\mathbf{X}^t \mathbf{D} \Omega^{-1} \mathbf{X})^{-1} (\mathbf{t}_x - \widehat{\mathbf{t}}_{x\pi})) \equiv \mathbf{y}^t \mathbf{w}. \tag{5.17}$$

Here $\mathbf{w}$ is a vector of order m containing the regression weights w_j for each household j. Each person in household j receives the same regression weight w_j. The variance structure in the linear regression model (5.12) is chosen proportional with the size of the household. Nieuwenbroek (1993) showed that in this situation the weighting procedure corresponds to the integrated method for weighting persons and households proposed by Lemaître and Dufour (1987).

Finally a bounding algorithm is applied to avoid negative weights. This algorithm can be described by the following iterative procedure.

1. Determine lower and upper bounds for the regression weights.
2. Compute regression weights w_j.
3. Replace the weights, which are smaller than the lower bound by the lower bound and replace the weights, which are larger than the upper bound by the upper bound.
4. Compute regression weights where the replaced weights from step 3 are fixed.
5. Repeat steps 2 through 4 until all the regression weights are within the boundaries determined in step 1.

In the LFS the lower and upper bounds are 10 and 750 respectively.

The weighting procedure is implemented in a Pascal program in order to calculate the regression weights w_j. After a final adjustment, described below, these weights are applied in (5.9) and (5.10) for the estimation of population parameters.

The regression weights are the final weights for the Annual Household Statistics. However, they cannot be entirely used for the LFS. For households that are not interviewed completely, because they consist of more than four persons belonging to the target population, some values for the target variables are missing. To compensate for these missing data a final weighting step is introduced, giving some respondents a higher weight. The persons belonging to the core of the household keep their regression weight. The regression weights of the other respondents in the household are multiplied by the number of persons in the household belonging to the target population but not to the core of the household, and divided by the number of respondents in the household not belonging to the core of the household. The persons who are not interviewed receive a final weight zero. As a consequence of this modification the single weight per household condition is not satisfied for all households. Since less then 1 % of the households in the sample is adjusted in this final weighting step, the constraint that the weighted auxiliary variables sum up to the known totals is hardly disturbed.

After the data for the LFS of a specific month is collected, the datafile of the respondents is linked with the data of the Employment Exchange at the person level. Respondents of the LFS that occur in the registration of the Employment Exchange form the sample of the statistic Registered Unemployment. To link the data, the variables date of birth, sex and postal code are used. When there are small differences in the date of birth or the postal code, the house number is used as well.

Addresses that appear in the registration of the Employment Exchange are oversampled, and addresses with only persons aged 65 years or more are undersampled. As for the LFS, a basic weight is computed to compensate for these effects. After this, the weighting procedure differs from that of the LFS.

For the statistic Registered Unemployment, three-month rolling averages are calculated. For this purpose the samples of three months are joined. In the weighting procedure the distribution of the population with respect to demographic variables is used. The population totals of these auxiliary variables are determined by computing the mean of the levels at all days belonging to the three months.

To estimate the Registered Unemployment, the multiplicative weighting method, sometimes called iterative proportional fitting or raking, is used. This method is described in the Bascula Reference Manual (CENTRAAL BUREAU voor de STATISTIEK, 1999). The population is classified by six auxiliary variables. For every auxiliary variable the weighted totals equal the totals according to the data of the Employment Exchange. The six auxiliary variables are

- labour position according to the registration of the Employment Exchange, active or inactive,
- sex crossed with duration of registration ($<$ 1 year and ($\geq$ 1 year),

- age in three classes (16-24 year, 25-34 year and 35-64 year),
- level of education according to the registration of the Employment Exchange in three classes,
- region: North, East, South, West (without the four largest cities), the four largest cities: Amsterdam, Rotterdam, The Hague and Utrecht.

The two variables sex and duration of registration are crossed because outcomes are published for the combination of these two variables.

The weight that results from the method Multiplicative Weighting is the product of the basic weight and factors for all the classifications. The method Multiplicative Weighting computes weights by means of a step-wise procedure. The general procedure is summarised as follows (see Bascula Reference Manual). A weight factor is computed for the first cross-classification so that the weighted totals for this classification equal the population totals. The weight factors are adjusted for the next cross-classification, so that the weighted sample is representative for the variables involved. Generally, this will disturb representativeness with respect to the other cross-classification terms in the model. This adjustment process is repeated until all cross-classification terms have been dealt with. The above mentioned steps are repeated until the weight factors do not change any more. When this convergence is reached, the weighted sample totals of the auxiliary variables equal the population totals.

5.7 The Nonsampling Error

As mentioned above, the nonresponse-rate of households visited by interviewer is between 40 and 50 percent. This results in a response of approximately 5,000 of the 10,000 contacted households per month, which contains approximately 11,000 persons. At the person level by allowing proxy interviews in addition the number of partially nonresponse-households is reduced, because about 35 percent of the Dutch LFS responses are collected in this way.

5.8 The Sampling Error

Statistics Netherlands does not estimate variances for the LFS.

5.9 Summary

The Dutch Labour Force Survey is a monthly, voluntary survey of about 10,000 households in the Netherlands. The households are the survey units for the Dutch LFS. The sampling frame is built from the Geographical Base Register, which includes all addresses in the Netherlands.

The sample design is a stratified two-stage one within regions. In the first stage municipalities are selected systematically and in the second stage the addresses are selected at random. Out of them households are selected. Within each selected household either all persons aged 15 or more are interviewed or - if the household consists of more than 4 persons - the interviewer selects four persons.

The starting weights for a regression estimator take into account inclusion probabilities. The regression based weighting procedure uses as auxiliary variables region, age, sex, marital status and ethnicity.

The nonresponse is at 40 to 50 % for households (before proxies).

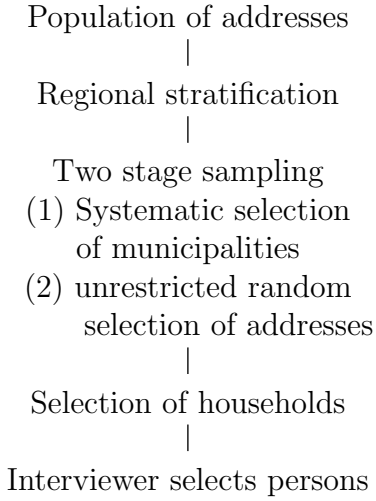

Figure 5.1: The sample design of the Dutch LSF

Chapter 6

The United Kingdom Labour Force Survey

6.1 Introduction

The Labour Force Survey is a survey of persons living in private households in the United Kingdom (= UK). Its purpose is to provide information on the UK labour market which can then be used to develop, manage, evaluate and report on labour market policies. It is carried out by the Social Survey Division (= SSD) of the Office for National Statistics (= ONS) in Great Britain and by the Central Survey Unit of the Department of Finance and Personnel in Northern Ireland on behalf of the Department of Economic Development.

The first LFS in the UK was conducted in 1973 under a Regulation derived from the Treaty of Rome. The Statistical Office of the European Union (Eurostat) co-ordinates information from labour force surveys in the member states in order to assist the European Community in matters such as the allocation of the European Social Fund. The ONS is responsible for delivering UK data to Eurostat.

The survey was carried out every two years from 1973 to 1983 in the spring quarter and was used increasingly by UK Government departments to obtain information which could assist in the framing and monitoring of social and economic policy.

Between 1984 and 1991 the survey was carried out annually and consisted of two elements:

- a quarterly survey of approximately 15,000 private households, conducted in Great Britain throughout the year;
- a "boost" survey in the quarter between March and May, of over 44,000 private households in Great Britain and 5,200 households in Northern Ireland.

Published estimates for 1984-1991 are available for the UK and are based on the combined data from the "boost" surveys and quarterly surveys in the spring quarters (Mar-May). The quarterly component of the 1984 to 1991 surveys were not published because the small sample sizes meant that the results were not robust. However, the quarterly survey proved to be invaluable in developmental terms, and in making early assessments of seasonality.

Quarterly publication of LFS estimates for GB became possible in 1992 when the sample was increased to cover over 60,000 responding households every quarter. Since Spring 1992 LFS-results refer to the seasonal quarters March-May (Spring), June-August (Summer), September-November (Autumn) and December-February (Winter). LFS microdata are available in databases covering these periods, although since winter 1997/98, monthly estimates have also been published.

Coverage of the survey was extended with the adoption of a quarterly LFS in Northern Ireland, such that from winter 1994/95 quarterly UK estimates are available (as the sum of Great Britain and Northern Ireland data).

The Northern Ireland Labour Force Survey is the responsibility of the Department of Enterprise, Trade and Investment (= DETI) and fieldwork is carried out by the Central Survey Unit of the Department of Finance and Personnel.

From 1973 - 1983, as in GB, the survey in Northern Ireland was conducted in alternate spring quarters. From 1984 - 1994 it was carried out annually. This annual survey consisted of 5,200 addresses drawn at random from the Rating and Valuation List - approximately 1 % of private addresses in Northern Ireland. Over this period interviewing was conducted only in the spring, with no quarterly element. UK LFS estimates are available for Spring quarters from 1973-1994.

In the winter of 1994/95 a quarterly Labour Force Survey was introduced to Northern Ireland. Each quarter's sample consists of approximately 2,000 households spread over five "waves" - 650 in each wave. A rotational pattern was also adopted, identical to that being operated in the GB LFS. Respondents at "wave" 1 are interviewed face-to-face with subsequent interviews at "waves" 2-5 taking place, where possible, by telephone. Computer assisted interviewing has been used in the Northern Ireland Labour Force Survey since 1992. Quarterly UK LFS estimates are available from winter 1994/95.

Income questions have been asked in the Northern Ireland LFS since the survey went quarterly in Winter 1994/5 but results were not grossed up until early 1998. LFS income data on a UK basis is now available for each quarter from Winter 1994/5. From Spring 1997, the income questions in both the GB and NI LFS have been asked of respondents in waves 1 and 5, producing a larger sample size then when previously asked only of wave 1 respondents.

Since April 1998, the Department of Enterprise, Trade and Investment (DETI) have published a Northern Ireland Labour Market Statistics Release to the same timetable as publication of the Labour Market Statistics First Release.

6.2 The Target Population

The universe to which the UK-LFS-results should refer to persons in private households and in National Health Service (=NHS) accomodation in the UK. For most people residence at an address is unambiguous. People with more than one address are counted as resident at the sample address if they regard that as their main residence. The following are also counted as being resident at an address

- people who normally live there, but are on holiday, away on business, or in hospital, unless they have been living away from the address for six months or more;

- children aged 16 and under, even if they are at boarding or other schools;

- students aged 16 and over are counted as resident at their normal term-time address even if it is vacation time and they may be away from it

Households are the survey units, in which all persons are interviewed.

6.3 The Survey Process

The questionnaire content is determined jointly by the Labour Market Division (= LMD) and Social Survey Division (= SSD) of the ONS. The questionnaire comprises a "core" of question which are included in every survey, together with "non-core" questions which change from quarter to quarter. These "non-core" questions provide information which is only needed once or twice a year.

Some questions in the core are only asked at the first interview as they relate to characteristics which do not change over time (eg. sex, ethnic group). There is also a section on income, which since Spring 1997 has been asked in respondents first and fifth interviews (prior to that it was asked only in the fifth interview). The income data are processed along with the rest of the data each quarter but are grossed up separately.

The Labour Force Survey interviewing force comprises some 175 face-to-face interviewers and over 200 telephone interviewers. All first interviews (wave 1, see Section 6.5) at an address are carried out face-to-face, except those north of the Caledonian Canal (see Section 6.4). Recall interviews are by telephone if the respondent agrees to it. Over 80 % of recall interviews are by telephone. Overall, including wave 1, over 65 % of interviews are by telephone, and 35 % are face-to-face.

The bulk of the LFS requests information about respondents' activities in a seven day period ending on a Sunday: this is a reference week. The majority (about 80 %) of interviews are carried out in the week following the reference week, although if this is not possible interviewers are given a further week and two days in which to obtain interviews (hangover period). Face-to-face interviewers only interview in the last two days of the hangover period, whilst the telephone unit interview throughout the hangover period. The hangover period is extended during some weeks leading up to and including Christmas (in addition face-to-face interviewers use the whole of the hangover period).

The LFS uses dependent interviewing, where answers given at the previous wave are available to interviewers. The use of dependent interviewing has been shown to provide more accurate results than asking the questions from scratch each time. Methodological investigations by the US Bureau of the Census have shown the considerable improvements in the quality of data produced from dependent interviewing; this technique was recently introduced on their equivalent of the LFS, the Continuous Population Survey (= CPS).

For most core questions on the LFS the information from the previous wave is rotated into the next quarter. Interviewers must check this information either by asking the question again or checking that the information given in the last wave is still correct.

There are some core questions which have to be asked each quarter without reference to previous answers. These are as follows:

- Whether on Government Training Scheme
- Whether in paid job
- Do you ever work paid or unpaid overtime
- Hours work in main job
- Usual hours worked in main job
- Number of hours paid overtime worked per week in main job
- Number of hours unpaid overtime worked per week in main job
- Total usual hours worked per week in main job
- Total actual hours worked in main job
- Actual paid overtime in main job
- Actual unpaid overtime in main job
- Total actual hours worked in main job
- Whether looking for a different or additional paid job
- Whether looking for any kind of paid work

However, there are a number of key questions in the survey, some of which are fundamental in classifying a respondents' economic status, which, if not answered cause that whole record (though not the whole household) to be dropped.

These "forced response" questions are currently as follows:

- Relationship to head of household and to other household members
- Sex of respondent
- Age of respondent
- Marital status
- Is spouse a member of household
- Whether respondent is living together with someone as a couple
- Whether accommodation is owned/rented in respondent's name

- Whether respondent on a government scheme in the reference week
- For those respondents on New Deal, the type of option in which they were participating
- Whether respondent was on a TEC, LEC or some other scheme
- Whether respondent did any paid work in the reference week
- Whether respondent was away from a paid job in the reference week
- Whether respondent did any unpaid work in the reference week for a business owned by him/herself
- Whether respondent did any unpaid work for a business owned by a relative
- Whether respondent was working as an employee or self-employed
- Whether respondent was looking for paid work in the previous 4 weeks
- Whether respondent was looking for a place on an Government scheme in the previous 4 weeks
- Whether respondent was looking for a place on an Government scheme in the reference week
- Seeking work as an employee
- Seeking work as self employed
- Seeking work no preference whether as an employee or self employed
- Main method of looking for work as an employee
- Main method of looking for work as either an employee or self employed
- Main method of looking for work as self employed
- Main method of looking for work-combined data from the previous 3 variables

The LFS allows interviewers to take answers to questions by proxy if a respondent is unavailable. This is usually from another related adult who is a member of the same household, although there are exceptions to this rule:

- a young person, of the same household, may translate for a non-English speaking relative;
- a carer of the elderly or infirm, although not related, may answer for someone in their care if it can be established that they know the respondent well enough;
- anyone can respond by proxy with the personal permission of the head of household or spouse.

About 30 % of LFS responses are collected by proxy.

6.4 The Sampling Frame

The sampling frame from which the UK LFS for the universe defined in Section 6.2 is taken consists of different parts and is different for Great Britain and Northern Ireland, too.

The LFS is intended to be representative of the whole population of the UK. The sample design of the LFS and its detailed implementation are the responsibility of ONS' Social Survey Division. The population covered is all persons resident in private households, all persons resident in National Health Service accommodation and young people living away from the parental home in a student hall of residence or similar institution during term time (these latter groups are included in the LFS sample specifically to improve the coverage of young people).

6.4.1 Great Britain

The sampling frame from which most (99 %) of the GB sample is taken is the "small users" sub-file of the Postcode Address File (= PAF). The PAF is a computer list, prepared by the Post Office, of all the addresses (delivery points) to which mail is delivered. "Small users" are delivery points which receive fewer than 25 articles of mail a day. With the use of special ONS procedures the coverage of the PAF is about 97 % of private households but not most communal establishments (= CEs).

In addition to private households the PAF contains non-private and non-residential (and therefore ineligible) addresses which cannot be identified as such prior to the interviewer making contact. Interviewers have instructions to exclude such institutions and classify them as ineligible. About 11 per cent of addresses on the PAF are ineligible: allowance is made for this in determining the sample size needed to obtain the required number of interviews.

The 1991 Census defined communal establishments as accommodations where some sort of communal catering was provided. Contained within the classification were the following groups: The sampling frame for NHS accommodation (group 1 and 2 in Table 6.1 - 14 % of the total CE population) was specially developed for the LFS. All district health authorities and NHS trusts were asked to supply a complete list of their accommodation (this accommodation mainly comprises what was once known as "Nurses Homes", but the coverage is more extensive than that name implies). Information was received from 417 out of the 455 authorities, trusts and teaching hospitals and the frame is therefore not complete. If the coverage of the frame is proportional to the coverage of authorities etc., then the frame contains 92 percent of all NHS accommodation.

Because the area north of the Caledonian Canal is sparsely populated, interviewing an unclustered face-to-face sample would be very expensive. So the choice lay between a clustered sample and one drawn from the telephone directory. The disadvantage of a clustered sample is the increased sampling error it entails. The disadvantage of a telephone sample is the bias resulting from non-coverage of people not on the telephone and, among those who are on the telephone, non coverage of ex-directory numbers and new numbers not yet in the directory. After investigations of the possible use of random digit dialling it was decided to draw the sample from the published telephone directory sampling frame.

Table 6.1: Classification of communal establishments

Type of Communal Establishment, GB		Number of residents aged 16+
1.	NHS Hospitals/Homes - Psychiatric	33,680
2.	NHS Hospitals/Homes - Other	79,652
3.	Non-NHS Hospitals - Psychiatric	2,904
4.	Non-NHS Hospital - Other	5,291
5.	Local Authority Homes	113,463
6.	Housing Association Homes and Hostels	21,594
7.	Nursing Homes (non-NHS/LA/HA)	135,945
8.	Residential Homes (non-NHS/LA/HA)	182,633
9.	Children´s Homes	1,024
10.	Prison Service Establishments	15,359
11.	Defence Establishments	49,620
12.	Education Establishments	33,264
13.	Hotels, Boarding Houses etc.	81,438
14.	Hostels and Common Lodging Houses (non-HA)	18,486
15.	Other Miscellaneous Establishments	24,484
16.	Persons Sleeping Rough	1,940
17.	Campers	199
18.	Civilian Ships, Boats and Barges	1,202
TOTAL		802,178

6.4.2 Northern Ireland

The source of the sample in Northern Ireland is the Valuation List used for rating purposes, excluding commercial units and known institutions, arranged into three geographical strata. These are

1. Belfast District Council area,
2. Eastern sub-region (most of Antrim, Down and part of Armagh),
3. Western sub-region (remainder of Northern Ireland).

6.5 The Sample Design

The sample currently consists of about 59,000 responding households in Great Britain every quarter, representing 0.3 % of the GB population. A sample of approximately 2,000 responding households in Northern Ireland is added to this, representing 0.4 % of the NI population, allowing United Kingdom analyses to be made.

Each quarter's LFS sample of 61,000 UK households is made up of five "waves", each of approximately 12,000 private households. In this "rotation"-system each wave is interviewed in five successive quarters, such that in any one quarter, one wave will be receiving their first interview, one wave their second, dan so on, with one wave receiving their fifth and final interview. Thus there is an 80 % overlap in the samples for each successive quarter.

For most people residence at an address is unambiguous. People with more than one address are counted as resident at the sample address if they regard that as their main residence. The following are also counted as being resident at an address:

- people who normally live there, but are on holiday, away on business, or in hospital, unless they have been living away from the address for six months or more;

- children aged 16 and under, even if they are boarding or other schools;

- students aged 16 and over are counted as resident at their normal term-time address even if it is vacation time and they may be away from it. Students living in halls of residence have been included by changing (for LFS purposes only) the standard Social Survey definition of a household. The standard definition says that "Adult Children, that is, those aged 16 and over who live away from home... should not be included at their parental address". For LSF purposes those living in halls of residence will be included at the parental address. Because of this LFS households are marginally larger than those in other surveys, including for example the General Household Survey (= GHS).

A systematic separately sample of addresses with a random start and constant sampling interval of 281 is drawn from the PAF for Great Britain south of the Scottish Caledonian Canal, from the telephone directory of the area north of the Caledonian Canal and from the "NHS-list".

So the sample in Great Britain is effectively stratified by area. The sample is allocated into 145 interviewing areas. Each of these areas is then split into 13 "stints". Theses 13 stint areas have been randomly allocated to the 13 weeks of a quarter. The same stint area is covered by an LFS interviewer in the same week each quarter. A systematic sample of addresses is selected for each quarter throughout the country and is distributed between stint areas to provide a list of addresses to be interviewed each week. So the sample is designed as a series of weekly two-stage-samples spread over the 13 weeks such that the whole country is covered in the quarter and therefore the quarter as a whole constitutes a single-stage-sample.

In Northern Ireland within each stratum (see Section 6.4.2) rateable units are selected at random every quarter. Altogether, this provides every quarter a sample of approximately 83, 200 addresses from the PAF, 300 telephone numbers for the north of Scotland sample, 40 units of NHS accommodation and 3, 250 addresses in Northern Ireland. Including the response-rate this leads currently to the in Chapter 1 mentioned sample of over 60, 000 responding households every quarter.

6.6 The Weighting Procedure

The LFS collects information on a sample of the population. To convert this information to give estimates for the population we must weight the data. Each case is given a weight which can be thought of as the number of people that case represents. In a perfect world each person in the population would have an equal probability of being selected for the LFS (as in a simple random sample). The weight would simply be the reciprocal of this probability. However, because of differential nonresponse, some people are more likely to be in the sample than others. People with a lower probability of being in the sample, such as young people in London (see previous section), should have a higher weight.

It is impossible to measure directly what probability each member of the sample had of being selected. Instead, the population is split into sub-groups (or cells) where the number of people in each sub-group is known (based on population estimates). The known population weights are calculated by assigning each case in the sub-group the weight calculated by dividing the population in that sub-group by the number of cases in the sample in that sub-group. As a result the weighted estimates of the total population for that sub-group equals the actual population and the weighted estimate of the total population from the sample will equal the known estimate.

There is one limitation to this method. If the cells are too small, there is a possibility that none of the sample will come from that sub-group. The weighted estimate of the population in that sub-group will be zero and hence the estimate of the total population will be too small. To avoid this (and to make the task of producing the population control totals easier) a multi-stage weighting procedure is used. Each stage corrects for a different cause of nonresponse: stage 1 corrects for non response at a local area level, stage 2 corrects for nonresponse amongst young people by age and sex; and stage 3 corrects for nonresponse by region, age (banded) and sex.

The LFS weighting methodology requires population figures for each Local Authority District (= LAD; The LFS weighting control totals were calculated at a time, and using underlying population figures, when the administrative geography of the country comprised shire districts and counties, and metropolitan districts (and London boroughs). This geography has been largely replaced following the introduction of unitary authorities.), with a five-year age-breakdown by sex, for each region. The starting point in the production of weighting totals is projections. All population projections (and estimates) are based, directly or indirectly, on the decennial Census of Population, and use additional information from the NHS Central Register for internal migration, the International Passenger Survey for international flows, and registration data for births and deaths. Projections use a variety of assumptions about the rates at which the components of population change will evolve.

A number of adjustments are made to the “raw” data:

- population projections for shire districts are produced by rolling forward the latest growth rate (between estimates) for each LAD, then constraining to the published shire county projections.

- adjustments to reflect the LFS (private household etc.) population are made as follows. Estimates of communal establishment population have been made by assuming that the percentage of people in communal establishments was the same (by quinary age-band, sex, and region) as it was in the results of the 1991 Census. Hence, for example, as the number of old people changes, the number of old people in institutions changes in line. Then the LFS population is calculated by subtracting the estimate of communal establishments from the total population figures.

- quarterly estimates are produced from the annual population figures - the mid-year estimate/projection less the communal establishment population - by simple linear interpolation. Similarly, monthly estimates for grossing rolling LFS data are produced by interpolating between seasonal LFS quarters.

LFS weighting involves three distinct stages and, in addition, several iterations of the process. This approach to weighting may be termed "iterative proportional fitting" or "raking".

Stage 1 weighting to population estimates for individual Local Authority Districts;

Stage 2 weighting to national population estimates by sex for the ages,

0-15, 16, 17, 18, 19, 20, 21, 22, 23, 23, 24 and 25+;

Stage 3 weighting by sex for the following regions and age groups:

Regions:	Tyne and Wear	Rest of Yorkshire and Humberside
	Rest of North	West Midlands Metropolitan County
	South & West Yorkshire	Rest of West Midlands
	Rest of North West	Greater Manchester and Merseyside
	East Midlands	South West
	East Anglia	Wales
	Inner London	Strathclyde
	Outer London	Rest of Scotland
	Rest of South East	
Age groups:	0-4 5-9 10-15 16-19 20-24 25-29 30-34 35-39 40-44 45-49	
	50-54 55-59 60-64 65-69 70-74 75-79 80+	

Thus there are 17 regional groups, 17 age groups and the two sexes, giving a total of 578 cells for stage 3 weighting.

Stage 1 of the weighting allocates a weight to each individual according to the LAD in weighting which they live. So all people living in Cleethorpes are given the same weight, all people in Derby are given the same weight, and so on. The weight is derived by dividing the number of people in the sample for each LAD, into the population total for the LAD.

At stage 2, the weighted figures for each individual are read into the single years of age table and the process is repeated.

In stage 3, the resulting weights are read into the age by sex by region table.

The problem is that the second and third stages can upset the corrections made in stage one and, of course, stage 3 can upset corrections in stage 2. Were we to stop at stage 3, therefore, the published results might show the "wrong" figures for local authorities and for single years of age. The solution is to iterate, that is to say, after stage 3 go back and do stage 1 again. If this process is repeated a sufficient number of times the resulting corrections gradually approach unity, so that the later stages are no longer upsetting the earlier ones.

The LFS iteration ceases when all the correction factors lie in the range .996 to 1.005 (rounded to three decimal places), so that they are all within the range 1.00 ± 0.01.

Earnings data, collected at waves 1 and 5 interviews only (before Spring 1997 collected at wave 5 only), is weighted separately. The aim of the earnings weighting exercise is twofold: to weight the cases in the database in such a way that the weight of a sub-group corresponds to that sub-group's size in the population; and to weight the sample to give estimates of the number of people in certain groups. The weighting exercise is restricted to employees' earnings: other income data are not (yet) grossed. During 1998, income weights for Northern Ireland data were added to existing datasets so that it is now possible to do earnings analysis at UK level from Winter 1994/5 onwards.

The main LFS database is considered to be the best source of data on the size of different groups. The weighting procedure thus attempts as far as possible to replicate the results of the main LFS in the weighted earnings data. However, because the earnings data is based on a sub-sample of the main survey, it is impossible to match the distribution of every variable in the survey in the earnings data. A small number of variables, likely to be important determinants of income (as stated in the December 1994 Employment Gazette article "Income and earnings data from the Labour Force Survey"), was chosen for use in the weighting process. These were sex, age, region, occupation, industry, and whether full or part-time.

The variables used are:

SEX	The sex of the respondent
AGEBAND	Age coded into age bands (16-19, 20-24, 25-29,30-34, 35-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80+)
URESMC	Region of residence, with Metropolitan counties and inner and outer London separately identified.
SOCMAJM	Occupation in main job.
INDS92M	Industry in main job.
FTPTWK	Whether full or part time in main job.

Even with the limited number of variables, it is not possible to replicate the distribution of all variables simultaneously because there is the possibility that there would be "empty cells" (a certain combination of variables for which there are no matching cases in the earnings sub-sample but where there are cases in the main sample).

As with the main weighting, a multistage approach is adopted where, for each stage, the distributions of a subset of the variables is matched. Each stage disrupts the distributions for variables matched in earlier stages, so only the variables in the final stage are matched perfectly. Overall the distributions for any of the variables included at some stage should be reasonable.

The five stages are as follows:

Stage 1:	SEX, FTPTWK, INDS92M weighting to reflect distribution of men and women, full-time or part-time, by industry category (drawn from the full LFS)
Stage 2:	SEX, FTPTWK, URESMC weighting to reflect distribution of men and women, full-time or part-time, by usual region of residence
Stage 3:	SEX, FTPTWK, AGEBAND, SOCMAJM weighting to reflect distribution of men and women, full-time or part-time, by age band, by occupation in main activity
Stage 4:	SEX, FTPTWK, AGEBAND weighting to reflect distribution of men and women, full-time or part-time, by age band
Stage 5:	SEX, AGEBAND weighting to reflect distribution of men and women, by age band,

At each stage, the earnings sub-sample is aggregated into groups defined by the relevant variables, weighted by the main weighting factor. For each person in the earnings sub-sample, the count for the appropriate cell is divided into the corresponding cell for the main survey sample and multiplied by that person's grossing factor to obtain a weight to be fed into the next stage of the process.

Finally, as with the main weighting, an iterative procedure is employed so that the corrections converge.

6.7 The Nonsampling Error

The LFS, in common with other voluntary surveys, suffers from some nonresponse among sampled units. During the 1980s, household response rates averaged between 80 % and 85 %, which is somewhat lower than in the period 1973 to 1979 when 86 % was normal. Currently the nonresponse rate for the LFS lies beyond 25 %. These are relatively high levels of response for a general population survey, reflecting the considerable efforts made to maximize response through fieldwork strategies and interviewer training, and the nature of the LFS as an interview-only survey.

Although there is interest in absolute levels of survey response, a greater concern is that differential response may result in some groups being under-represented in the achieved sample. If such nonresponse bias occurs then survey estimates based on the achieved sample may be inaccurate. After the 1981 Census a substantial amount of information about nonrespondents was available for the LFS and other continuous surveys carried out by ONS. These studies involve finding the census information for households in the survey sample around the date of the Census, and provide a rich source of data for nonresponding households. They are possible because both the Census and the surveys are carried out by ONS, so records can be identified and compared within the same Department without infringing the confidentiality undertakings to informants.

The analysis for the LFS involves carrying out a comparison of the census characteristics of responding and all nonresponding households, and also separately of non-contacted and

refusing households. This includes some multivariate analysis to identify those variables which are independently associated with response. Almost 5,000 households were involved altogether, of which 15 % were LFS nonrespondents.

Many of the characteristics associated with nonresponse rates appear to be related, so logistic regression analysis was carried out to identify which variables had independent effects on each of the rates. The variables most strongly associated with each nonresponse rate are region, building type, number of cars, number of adults, number of children, age of head, marital status of head, sex of head and qualification level of head. A comparison was also made of the distributions for apparently equivalent census and survey variables, which is relevant when assessing whether survey variables can be used as valid substitutes for census measures for defining weighting classes. Most of the variables available on the LFS showed weight agreement in excess of 90 %: lower levels were recorded for the qualification level, economic status and social class of the head of household.

The discrepancies suggest that these variables would not be suitable to be used to define weighting classes in a reweighting scheme using response probabilities from the census-linked checks.

In addition to these variables for which weight disagreement was relatively high, individual categories of some other variables also showed substantial net differences. These included some categories of housing tenure and the number of adults usually resident in the household. If these variables were to be used in a weighting scheme then it would be necessary to regroup categories in an attempt to reduce net differences.

All things considered, ONS regard the current weighting procedure - which involves weighting data to sub-regional population estimates and then adjusting for the estimated age and sex composition by region - as satisfactory. When evaluating whether additional information might improve the performance of a weighting methodology, it is important not to lose sight of issues such as the availability of up-to-date population data at the sub-regional level and the relative transparency of the method.

6.8 The Sampling Error

In the case of the LFS sample design, there is a clustering effect. This reflects the fact, that addresses are sampled, but that results are shown for individuals. For example, ethnicity is particularly clustered, since it is likely that all members of a household living at a particular address will share the same ethnicity. This results in, for example, the design factor, which is the square root of the design effect, for the Pakistani and Indian ethnic groups being 1.71 (so the calculated standard deviation is 1.71 times the standard deviation assuming unrestricted random sampling), which is higher than for the other ethnic groups because of the relatively large household sizes for Indians and Pakistanis. The design factor for full-time part-time employees on the other hand is 0.96, reflecting the fact that part-time employee status is not clustered within a household.

By itself clustering would tend to increase the design effect of LFS estimates. However, the LFS sample design employs stratification. Since addresses are stratified by postcode sector there is a reduction in the standard error of estimates related to the factors used

in stratification. The standard errors of the UK LFS estimates shown in Annex A of the Labour Force Survey User Guide - Volume 1: Background & Methodology (p.123ff) are produced using a Taylor series approach by treating the Interviewer Area as a stratum and the household as a primary sampling unit (PSU): The sampling variance in the survey was estimated by treating each household as a primary sampling unit (PSU). The method used to estimate the standard error of a ratio $R = Y/X$ (where X might, for example, be the number of men aged 16 and over who are economically active and Y might be the number of them who are unemployed) was that of successive differences. The formulae used were:

$$Variance(X) = \sum_s \frac{N_s}{2\,(N_s - 1)} \sum_{p=2}^{N_s} (X_{s,p} - X_{s,p-1})^2$$

$$Variance(Y) = \sum_s \frac{N_s}{2\,(N_s - 1)} \sum_{p=2}^{N_s} (Y_{s,p} - Y_{s,p-1})^2$$

$$Covariance(X,Y) = \sum_s \frac{N_s}{2\,(N_s - 1)} \sum_{p=2}^{N_s} (X_{s,p} - X_{s,p-1})\,(Y_{s,p} - Y_{s,p-1})$$

$$StandardError(R) = \frac{1}{X}\sqrt{(VAR(Y) - 2R \cdot COV(X,Y) + R^2 \cdot VAR(X))}$$

where s represents the stratum, p the PSU, i the individual case, $X_{s,p}$ and $Y_{s,p}$ the PSU totals, and N_s the number of PSU's in stratum s.

Currently only a very approximate allowance for grossing method is made. It is possible that the standard errors of most estimates would be reduced if grossing was taken into account - ONS has investigated alternative methods of calculating standard errors to produce valid sampling errors for post-stratified estimates. Implementation of a new methodology is currently being assessed.

It is also possible that the seasonal adjustment of LFS estimates will reduce their standard errors. ONS is also investigating methods for calculating standard errors of seasonally adjusted estimates. The tables in annex A of the LFS User Guide list show, for a number of estimates from the March to May 1999 LFS, the standard errors and other related statistics. Although design factors for the UK are not yet available, the standard errors shown in the Labour Market Statistics First Release, LFS Quarterly Supplement and Annex A are shown for the UK and are calculated using GB design factors and assuming that UK design factors would not be significantly different. Almost all design-factors or -effects of estimates for the population or subgroups are higher than one, but most of them very close to one.

6.9 Summary

The UK LFS is a quarterly, rotational, voluntary survey of about 87,000 selected resp. 60,000 responding households in the United Kingdom. The households are the survey units. For Great Britain south of the Caledonian Canal the small users sub-file of the postcode address file builds the sampling frame. This is done for the area north of the Caledonian Canal by the telephone directory and for Northern Ireland by the Valuation List for rating purposes. A systematic sample is drawn out of the GB sampling frame

that gives nearly a geographically stratified random sample. In Northern Ireland there is a stratified random sampling done by region.

The weighting procedure involves three distinct stages of an “iterativ proportional fitting”. The Unit-nonresponse is at ca. 15 % The variance estimation is done by multiplying the unrestricted random variance with a factor of the design effect.

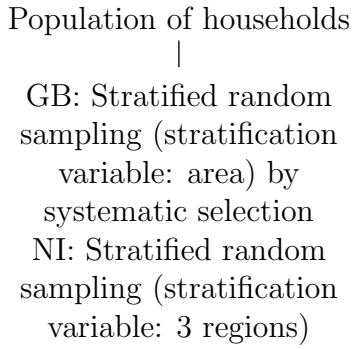

Figure 6.1: The sample design of the UK LFS

Chapter 7

The German Sample Survey of Income and Expenditure

7.1 Introduction

The German sample survey of income and expenditure (= EVS) of households is a nationwide survey conducted every 5 years and is part of the household budget surveys. The main purpose of the survey is to represent the economic and social situation of households from the aspect of income distribution and use. The results are used, among other things, in national accounting and for adjusting the weights of the consumer price index. For the 1998 EVS a new survey design was developed with the intention of disburdening the responding households and improving the timeliness of results (see: Chlumsky and Ehling, 1997, p. 457ff). Also the survey characteristics of the EVS and the continuous household budget surveys were largely coordinated with each other.

7.2 The Target Population

The population of interest for the EVS is the population of German households. They constitute the survey units of this survey.

7.3 The Survey Process

Altogether, the survey of 1998 extended over the period of one year. It consisted of the following three survey parts:

- At the beginning of the survey year, an introductory interview (reference day 1st January 1998) was held with all sample households, asking for household composition, socio-economic characteristics of the household members, equipment with consumer durables and housing situation. The introductory interview was held by trained interviewers.

- The overall sample of households was divided into four parts, with every part having to record for one quarter each their incomes and expenditures in a household book. Specifically, the recorded data referred to the incomes of all persons living in the household, with a breakdown by income type and level, and any expenditure classified under final consumption of households, e.g. for food, rent, personal care, transport or personal effects. Unlike for the 1993 EVS, such income and expenditure had to be recorded for just 3 months rather than over the entire year. Other questions asked in the 1998 EVS household book referred to the formation of monetary wealth and debts. In previous surveys, such data were covered separately during a final interview.

- The contents of the household book were complemented by a "detailed log book" where for a given month the expenditure made on food, beverages and tobacco products had to be entered in a more detailed manner by quantity and price. As the expenditure on food, beverages and tobacco are subject to smaller fluctuations than other expenditure items, they were covered only for a subsample of about 20 % of the total sample.

7.4 The Sampling Frame

The EVS sample is a quota sample (see 7.5 below), therefore there is no sampling frame. The German microcensus, which is the only official statistics with compulsory response providing household and family data is the basis for constructing the quotas and for weighting. The target population comprised all households represented in the GMC, at their main place of residence, whose monthly household net income was less than DM 35,000. This means that all households were excluded whose reference person was contacted at a secondary place of residence or whose income exceeded the above threshold. Persons living in institutional households or collective accommodation were not included either. To define the target coverage, it was necessary first of all to redefine the household reference person according to the EVS-concept, which differs from the microcensus concept where that person can be indicated at will by any household member. So, the person with the highest income indicated was defined to be the reference person. If no income data were available on any person of a microcensus household, the person indicated first was selected. If several persons of a household were in the same income class which, at the same time, was the highest income class of the household, the person indicated first within that income class was defined to be the reference person.

First of all, this household population was structured by federal Länder, as recruiting and interviewing had to be done by the statistical offices of the Länder. For Berlin, strata were formed in addition by the western and the eastern part of Berlin. For each Land, the total of households was grouped by the characteristics:

"type of household" (6 groups)

- One-person households

- Married couples/consensual unions without children (no other persons)

- Lone parents with never-married children under 27 years and with at least one child under 18 years (no other persons)
- Married couples/consensual unions with never-married children under 27 years and with at least one child under 18 years, not more than one partner engaged in economic activity (no other persons)
- Married couples/consensual unions with never-married children under 27 years and with at least one child under 18 years, both partners engaged in economic activity (not other persons)
- Other households

"social status of the main income earner" (6 groups)

- Self-employed
- Public officials
- Salaried employees
- Wage earners
- Pensioners
- Other persons not engaged in economic activity

"household net income" from ... to under ... DM (5 groups)

- 0 - 1,400
- 1,400 - 2,500
- 2,500 - 5,000
- 5,000 - 7,000
- 7,000 - 35,000

These characteristics were selected for forming quotas because they are the crucial factors determining the consumption behaviour of households and they are of major importance for the breakdown of results. Theoretically, combining all the values of these characteristics would produce a total of 3,060 quota cells. Cells with fewer than 5,000 households in the population were grouped with neighbouring cells. Generally, what was grouped first was the income classes, then the classes of social status values and, finally, the household type classes. That process resulted in the formation of a total of 1,274 quota cells.

The number of microcensus households without any income data were proportionately distributed across all income classes for every group formed through the combination of the characteristics "household type" and "social status of the reference person". As households with a monthly household net income of DM 35,000 and over do not belong to

the EVS survey population, they have to be excluded from the microcensus data. However, in the microcensus, that income class is not covered separately; the income class without upper limit is DM 12,000 and over. The number of microcensus households with a net income of DM 35,000 and over was estimated (on the basis of income tax statistics) to be some 120,000 households.

When households were recruited, microcensus results referring to 1995 were available. As in 1993, for the 1998 EVS an average sampling fraction of 0.2 % of the 1995 GMC population was defined, which corresponded to a sample size of about 73,890 households.

7.5 The Sample Design

The first question that arose in selecting the sample method was whether, instead of quota sampling with combined quotas applied in the preceding sample surveys of income and expenditure, stratified random sampling could be used, as this method offers advantages in terms of methodology. It had to be considered here that EVS participation is voluntary, which automatically leads to the problem of nonresponse. To settle this issue, the result of a pilot survey regarding the new concept of continuous household budget surveys was used (see: GERTKEMPER *et al*, 1998), which had been conducted in 5 federal Länder in 1996 as a random sample by way of a random route procedure. It showed that, depending on the Land, only 9 % to 15 % of the contacted households participated in the survey. What is more, nonresponse did not turn out to be at random, it rather was concentrated in specific population groups such as one-person households, wage earner households and households with very low or very high income. Based on that experience, it was decided to apply quota sampling again.

It is true that the purposive quota sampling procedure involves some methodological disadvantages compared with random sampling because not all households have a chance of being selected and, consequently, some bias in the results cannot be ruled out. However, the advantage of the random principle in terms of sampling methodology has lost much of its relevance in this context because of the low, and differing readiness to respond. One of the major consequences of such small willingness to respond would have been that the number of households to be contacted would have been many times the sample size required in terms of sampling methodology, which would have involved an unjustifiable level of costs.

As is generally known, what is done in quota sampling with combined quotes - similar to stratification in random sampling - is structuring the population by groups, using specific characteristics (the “quota characteristics”), and defining for each group (the “quota cells”) the quota of households to be covered.

This method of quota sampling proved to have big advantages compared to quota sampling with marginal quotas, which is mostly used in commercial market and opinion research. QUATEMBER (1996, 1997) proved that also under conditions of the urn model (random sampling), the quota procedure with marginal quotas is biased as a rule and the variance of the estimator may be bigger than for unrestricted random sampling. The actual value of the variance depends on the different associations of the variable of interest and the quota characteristics.

Through various recruiting campaigns, it can then be attempted to recruit for participation the required number of households per group. Unlike many conventional quota sample surveys conducted in market and public opinion research, in the EVS the interviewers get the actual addresses of households to be contacted, i.e. they do not have to look for sample households meeting the quota requirements. Thus it is ruled out that households to be contacted are selected on a subjective basis by the interviewers.

For the 1998 EVS, more than half of the participating households were recruited through "indirect solicitation" (media reports, distribution of information material, verbal propaganda). The remaining households were recruited by "direct solicitation", i.e. letters sent direct to households that had participated in other statistical surveys.

The allocation of the sample size of 73,890 households to the Länder and the quota cells which were formed in each Land by combining the quota characteristics mentioned under 7.1 was based on the "principle of comparable precision for structured results" (see: Krug *et al*, 1999, p. 122ff). That method allows to control the allocation of the sample size to strata in a way as to obtain a graduation of the relative standard error of the allocation variable as a function of its stratum values, according to the relation

$$\varepsilon_h = \frac{C}{\widehat{X}_h^{\alpha}} \tag{7.1}$$

with

ε_h:	estimated relative standard error of the allocation variable X in stratum h
$\widehat{X}_h$:	estimated stratum value of the allocation variable X
α:	exponent of precision graduation ($0 \leq \alpha \leq 0.5$)
C:	constant

The exponent α controls the degree of error graduation between the strata. The smallest value possible 0 of the exponent causes the relative standard error to be the same for every stratum, while the largest value possible 0.5 causes a particularly strong graduation. In the latter case, the objective is to obtain a precision for stratum results that is in inverse proportion to the root of the stratum value and generally provides a higher precision for the overall result than with a smaller exponent. The constant C is determined through an iterative procedure in a way that formula (7.1) is fulfilled for all strata while the sample size to be allocated to any stratum is maintained.

For the square of the estimated relative standard error of the allocation variable X in stratum h there is:

$$\varepsilon_h^2 = N_h \cdot \frac{N_h - n_h}{n_h} \cdot \frac{s_{hx}^2}{\widehat{X}_h^2} = \frac{N_h - n_h}{n_h \cdot N_h} \cdot v_{hx}^2 \tag{7.2}$$

with

N_h: number of units in the population of stratum h
n_h: sample size in stratum h
s^2_{hx}: variance of the allocation characteristic X in stratum h
v_{hx}: variation coefficient of the allocation characteristics X in stratum h

Equating the equations (7.1) and (7.2) and solving them for the sample size n_h results in:

$$n_h = \frac{N_h}{\frac{C^2}{\widehat{X}_h^{2\alpha}} \cdot \frac{N_h}{v_{hx}^2} + 1} \tag{7.3}$$

In the EVS case, this principle, which was developed for stratified random samples, is applied to the Länder and, within any Land, again to the quota cells.

As was done for the 1993 EVS, it was assumed by way of modelling also for the allocation of the total sample size to the Länder that the allocation variable had uniform mean values ($\overline{X}_L = \overline{X}$) and variation coefficients ($v_{Lx} = v$) per Land L, because the Länder did not wish the new sample size to deviate considerably from the former sample size. This means that the graduation of the relative standard errors between the individual Länder was made dependent only on the number of households N_L of the Land concerned. As was done for sample allocation in the 1993 EVS, the degree of error graduation was defined to be $\alpha = 0.45$, so that a strong graduation of precision between the Länder was obtained, whose effect is quite close to that of proportionate allocation.

$$\varepsilon_L = \frac{C}{N_L^{0.45}} \tag{7.4}$$

with

ε_L: estimated relative standard error for the estimated Land result $\widehat{X}_L$ of a characteristic which has the same mean value and the same variation coefficient in all Länder.

The goal of that approach was that the relative standard errors of the results for the smallest Land "Bremen" (sampling fraction of 0.25 %) should be about four times the level of those for the largest Land "North Rhine-Westphalia" (sampling fraction of 0.18 %), provided that the characteristics to be represented have the same mean values and variation coefficients.

Applying formulas (7.3) and (7.4) and maintaining uniform variation coefficients and mean values provides the optimal sample sizes of the Länder, according to the formula

$$n_L = \frac{N_L}{C'^2 \cdot N_L^{0.1}} \qquad \text{with } C' = \frac{C}{v \cdot \overline{X}^{0.45}} \tag{7.5}$$

Table 7.1: Allocation of the sample size to the Länder

Land	Number of households in 1,000 (micro-census, 1995)	Number of sample house-holds	Sampling fraction in %
Baden-Württemberg	4,701.7	9,026	0.19
Bavaria	5,339.3	10,118	0.19
Berlin-West	1,180.1	2,434	0.21
Berlin-East	652.5	1,430	0.22
Brandenburg	1,073.7	2,390	0.22
Bremen	344.6	860	0.25
Hamburg	881.4	2,002	0.23
Hesse	2,707.7	5,496	0.20
Mecklenburg-Western Pomerania	760.8	1,750	0.23
Lower Saxony	3,434.5	6,803	0.20
North Rhine-Westphalia	8,031.8	14,614	0.18
Rhineland-Palatinate	1,757.6	3,719	0.21
Saarland	507.1	1,213	0.24
Saxony	2,030.2	4,241	0.21
Saxony-Anhalt	1,200.6	2,644	0.22
Schleswig-Holstein	1,258.5	2,752	0.22
Thuringia	1,075.6	2,398	0.22
Germany	36,937.7	73,890	0.20

The constant C was iteratively determined in a way ensuring that the total of the rounded sample sizes of the Länder equaled the total sample size. The allocation method provided the results as shown in Table 7.1.

For each Land, the calculated sample size was allocated to the quota cells h. Allocation was performed so that, even for quota cells with small frequencies, results with sufficient precision can be obtained. Here again, the method of precision graduation as described above was applied. The allocation variable used was "final consumption of households", as this is a particularly important characteristic for the representation of results. Choosing the exponent was a trade-off in the sense that the precision of the partial results for the allocation characteristic "final consumption of households" is graduated in a way that, on the one hand, quite large sampling fractions in quota cells with small frequencies are avoided and, on the other hand, good precision of the overall result can be achieved. Taking account of this condition for the graduation of the relative standard error of final consumption of households by

$$\varepsilon_h = \frac{C}{\widehat{X}_h^{0.3}} \tag{7.6}$$

results in the following allocation formula for the sample sizes of the quota cells:

$$n_h = \frac{N_h}{\frac{C^2}{\widehat{X}_h^{0.6}} \frac{N_h}{\upsilon_{hx}^2} + 1} \tag{7.7}$$

For reasons of simplicity, no additional Land index was included in formulas (7.6) and (7.7). Again, the constant C was determined in a way that, for each Land, the total of rounded sample sizes of the quota cells equalls the Land sample size. The data on final consumption of households required for sample allocation were obtained from the 1993 EVS.

Table 7.2 shows by way of example the allocation of the sample size to household types, social status of the reference person and monthly household net income classes in Germany. The sample sizes represented were obtained by adding up the quota cell sample sizes. Among household types, "lone parents" and "other households" had rather large sampling fractions. As regards the social status of the reference person and the household net income class, it was especially households of self-employed and public officials and high-income households that had to be covered over-proportionately. For reasons of length, the entire quota plan is not presented here.

For the 1993 EVS, additional quota were formed for households with a foreign reference person and for farmer households. The goal was to obtain detailed results for such households, too. Although the statistical offices made particular efforts in this context, only some 50 % of the target for farmer households and just 47 % for households with a foreign reference person could be recruited at the time. Due to the small readiness to respond, it was not possible to present separate results for those groups. Consequently, no separate quota were formed for such households in the 1998 EVS. However, a target number of participants per Land was defined for them, too, so that sufficient participation could be envisaged through special recruiting measures. What was predefined per Land, however, was just the total number of households to be recruited, rather than - as in the 1993 EVS - a combination with further quota characteristics, which might have put at risk the success of recruiting efforts. Defining the desired number of households with a foreign reference person was based on the Land sampling fractions. The target number of farmer households was obtained by multiplying the share of farmers in the class of "self-employed + farmers" in the 1995 microcensus by the target determined for that class in any Land.

The 1993 EVS showed that household readiness to respond decreased in the course of the year. To ensure an even distribution of recordings of all households across the four quarters of the reference year for the 1998 EVS, the sample sizes within any quota cell were distributed disproportionately across the quarters - based on the rates of response readiness of the 1993 EVS. The sample size $n_{h,q}^L$ of quarter q in quota cell h of Land L was then obtained through the formula

$$n_{h,q}^L = \frac{n_h^L}{t_q^L \cdot \Sigma_{i=1}^4 1/t_i^L} \tag{7.8}$$

with t_q^L : rate of response readiness of the 1993 EVS of Land L in quarter q

n_h^L : sample size of Land L in quota cell h

Table 7.2: Target sample size by quota characteristics

Value	Number of households (micro-census, 1995)	Number of sample house-holds	Sampling fraction in %
Household type:			
One-person household	128,915	18,146	0.14
Married couple/consensual union without children	100,646	19,750	0.20
Lone parents	11,709	3,226	0.28
Married couple/consensual union with children	80,173	18,498	0.23
Including:			
Married couple/consensual union with children, not more than one partner engaged in economic activity	40,065	8,608	0.22
Married couple/consensual union with children, both partners engaged in economic activity	30,831	6,572	0.21
Other household	47,934	14,270	0.30
Social status of the reference person:			
Self-employed	24,908	11,990	0.48
Public officials	16,870	5,693	0.34
Salaried employees	87,938	16,939	0.19
Wage earners	76,018	13,466	0.18
Pensioners	122,284	17,301	0.14
Other persons not engaged in economic activity	41,359	8,501	0.21
Household net income from ... to under ... DM:			
0 -1,400	44,801	6,466	0.14
1,400 - 2,500	96,957	14,342	0.15
2,500 - 5,000	156,992	30,308	0.19
5,000 - 7,000	44,351	11,823	0.27
7,000 - 35,000	26,276	10,951	0.42
Households, total	369,377	73,890	0.20

The goal of that allocation was to obtain a realistic representation of seasonal fluctuations in purchases and services and to avoid that the households themselves chose their recording quarter. The sample sizes for the quarters were first of all calculated with decimal places, that is without rounding. For rounding, the Niemeyer technique was applied, which ensures that the total of quarter sample sizes equals the total sample size for any quota cell. Table 7.3 shows the allocation of Land sample sizes to the quarters.

Table 7.3: Allocation of the sample size to the Länder

Land	Target sample size				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Total
Baden-Württemberg	2,197	2,250	2,276	2,303	9,026
Bavaria	2,480	2,518	2,550	2,570	10,118
Berlin-West	578	597	621	638	2,434
Berlin-East	341	348	365	376	1,430
Brandenburg	570	587	611	622	2,390
Bremen	202	209	220	229	860
Hamburg	477	495	507	523	2,002
Hesse	1,334	1,360	1,386	1,416	5,496
Mecklenburg-Western Pomerania	423	433	440	454	1,750
Lower Saxony	1,665	1,689	1,710	1,739	6,803
North Rhine-Westphalia	3,538	3,661	3,698	3,717	14,614
Rhineland-Palatinate	899	916	940	964	3,719
Saarland	286	297	311	319	1,213
Saxony	1,037	1,053	1,065	1,086	4,241
Saxony-Anhalt	636	653	670	685	2,644
Schleswig-Holstein	659	680	696	717	2,752
Thuringia	581	593	605	619	2,398
Germany	17,903	18,339	18,671	18,977	73,890

The target sample size of the sub-sample for detailed recording was a total of 15,000 households. Allocating that sample size to Länder and quota cells was performed following

the procedure described above for the overall sample. The sub-sample was allocated to all 12 months of the year, in analogy to allocating the sample size to the quarters. It was ensured that the quarterly values of the quota cells were maintained.

7.6 The Weighting Procedure

From the aspect of pure sampling theory, it is not possible for a quota sample to calculate selection probabilities for the sample units because selection is not performed at random but depends on subjective factors. However, when disregarding such methodological reservations, a quota sample may be compared to a stratified sample, with households selected at random in the individual strata (quota cells). What is different from random samples, however, is that usually no sampling population is available that can exactly be defined in terms of time; consequently, it is assumed that the sample is drawn from the present population. For estimation, information on the current distribution of quota characteristics must therefore be obtained from other sources. If such information is available - as in this case from the microcensus -, the estimation formulas correspond to those of a Horvitz-Thompson estimator (expansion estimator), which generally is applied to random samples. What is done here is practically an adjustment to the current common distribution of quota characteristics. That adjustment corrects the different probabilities resulting from the disproportionate quota specifications and from such quota specifications not being fulfilled.

The weight per quota cell h is N_h/n_h, with N_h indicating the number of units in quota cell h of the population at the reference date and n_h indicating the number of usable sample units in quota cell h. For each quota cell, the frequency obtained through estimation from the sample will then be identical with the overall value. In order to avoid larger biases, it should be ensured that N_h and n_h refer to approximately the same current point in time. Also, the sample may include quota cells with very small or zero frequencies. Before estimation, such cells must be combined with neighbouring cells. In the following, the estimation method described here is referred to as "expansion estimation with a current frame". This is the method that was applied in earlier Surveys of Income and Expenditure.

In many cases, estimates may be improved if additional information on current population totals of characteristics is available at the time of estimation that could not be used for the formation of quota and that probably is related to the values to be estimated. Such additional information may be used to perform an adjustment to the common distribution of several characteristics. The disadvantage involved in this method, however, is that many adjustment groups formed through the combination of the values of those characteristics have no values at all in the sample. What is done to avoid this is to combine usually neighbouring adjustment groups, which in turn means that the frequencies for the adjustment variables that were obtained through estimation from the sample will not be identical with the values in the population.

This is why a different adjustment method was applied for estimation in the 1998 EVS, that is the "estimation according to the principle of minimal information loss" (see: Merz, 1983, p. 342ff). The advantage of that method is that it allows a detailed breakdown of adjustment characteristics, without involving the problem of groups with small or zero

frequencies. This is because the method provides the possibility of adjusting only to benchmark breakdowns of several characteristics (marginal distributions) of the population. The values of benchmark breakdowns generally have sufficient frequencies.

When estimating according to the principle of minimal information loss, the sample data are adjusted simultaneously to the marginal distributions of several characteristics. Adjustment is done by means of weights w_k, which are defined in a way so that the estimated totals for the adjustment variables equal the known population totals:

$$\sum_{k=1}^{n} w_k \mathbf{x}_k = \mathbf{X} \tag{7.9}$$

Here, $\mathbf{x}_k = (x_{k1}, \ldots, x_{kj}, \ldots, x_{km})^T$ indicates the vector with the values of m adjustment variables of the k^{th} household in sample s, while $\mathbf{X} = (X_1, \ldots, X_j, \ldots, X_m)^T$ indicates the vector of the known population totals of m adjustment variables.

Provided that the applied information on the adjustment variables are of good quality, the adjustment will reduce both the systematic error which is due to nonresponse or other reasons and the sampling error for all correlated characteristics, i.e. the accuracy of estimates for correlated characteristics is improved when compared with the Horvitz-Thompson estimates.

The principle of minimal information loss is the following: The weights after adjustment are determined in a way that they differ as little as possible from the original weights based on the inclusion probabilities. For this purpose, a distance function is defined which is derived from information theory and, more specifically, from the entropy of a discrete distribution $\mathbf{p} = (p_1, \ldots, p_n)$ of probabilities p_k ($p_k > 0$ for $k = 1, \ldots, n; \sum_{k=1}^{n} p_k = 1$). The entropy is defined as

$$H(\mathbf{p}) = \sum_{k=1}^{n} p_k \cdot log\tfrac{1}{p_k} \tag{7.10}$$

The distance function derived from it

$$I(\mathbf{p}, \mathbf{q}) = \sum_{k=1}^{n} p_k \cdot \log \tfrac{p_k}{q_k} = \sum_{k=1}^{n} p_k \cdot (\log p_k - \log q_k) \tag{7.11}$$

describes the information loss occurring when replacing the original distribution $\mathbf{q} = (q_1, \ldots, q_n)$ by the distribution $\mathbf{p} = (p_1, \ldots, p_n)$. The loss of information is not negative and is zero if, and only if no new information becomes available through the replacing distribution $\mathbf{p}(p_i = q_i)$ (see: THEIL, 1967, p. 28). In our case, the original weights are applied for distribution $\mathbf{q}$, which are standardized in a way that their sum equals $1/p_i$ are the standardized weights after adjustment. The weights w_i are then obtained through

$w_k = p_k N$ (N: Number of sampling units in the population). The distance function (7.11) is minimised, while fulfilling condition (7.9). Solving the optimisation problem by means of the Lagrange approach results in the following non-linear set of equations. Since p_k and q_k are defined as relative frequencies (probabilities), the pre-defined total values are also relativised (X/N).

$$\sum_{k=1}^{n} q_k e^{(\lambda \mathbf{x}_k - 1)} \mathbf{x}_k = \mathbf{X}/N \tag{7.12}$$

with $\lambda = (\lambda_1, \ldots, \lambda_m)$ indicating the vector of the Lagrange factors. The desired new weights are obtained by solving the set of equations (7.12) from the equation:

$$p_k = q_k e^{(\lambda x_k - 1)} \text{ for all } k \; \epsilon \; s \tag{7.13}$$

As it is generally not possible to indicate a closed solution for non-linear sets of equations, numerical methods must be used instead. The numerical solution of the non-linear set of equations (7.12) is done iteratively until the difference between the solution values and the corresponding pre-defined benchmarks falls below a pre-defined tolerance limit.

For the numerical solution of the optimisation problem, the ADJUST programme may be used, which was developed by Prof. Merz. Using the modified Newton-Raphson method, that programme minimises the objective function with a fairly small number of iterations. Applying the Newton-Raphson method means, that based on a non-linear set of equations with m unknowns, the m functional equations are linearized through a Taylor development, and the problem is solved iteratively. Using the modified Newton-Raphson method means that variable sampling intervals are used to solve the linearised equations. (For details on the numeric solution see Merz, 1994)

1998 EVS estimation was done separately for the three survey parts, that is introductory interview, detailed recording and rough recording. Also, the EVS data were estimated separately for Germany and for the sub-populations "former territory of the Federal Republic" and "new Länder incl. Berlin-East", so that the estimation would provide representations of the microcensus results with corresponding structures both for the Federation and the sub-territories. The weights obtained for the two sub-territories were also used for the representation of Länder results.

About 93 % of the pre-defined target sample size of 73,890 households could be recruited for participation in the introductory interview. Quarterly recordings (rough recordings) with usable data were available from just about 84 % of the sample size households. Response readiness was quite different across the quota cells, so that quota targets could not exactly be met. With regard to many characteristics for which a connection with the spending behaviour is probable, the sample structure differed from the population structure, which was due to nonresponse and the non-randomness of the selection.

What was chosen as adjustment variables was the quota characteristics of household type, social status of the reference person and household net income. The breakdown of values

for adjustment was more detailed - corresponding to the representation of the 1998 EVS results - than for quota formation. For instance, household net income was broken down for adjustment by 10 classes instead of 5 classes and households of persons not engaged in economic activity were further broken down by students and other persons not engaged. It would not have been possible to form quotas with such detailed breakdowns, because first, many quota cells would have had zero frequencies and, second, it would have been much more difficult to meet the quota targets. Neither would it have been meaningful to perform the adjustment according to the common combination of quota characteristics with the desired breakdown because many groups in the sample would have had zero frequencies. To avoid this, the above estimation method "estimation according to the principle of minimal information loss" was applied.

First of all, expansion estimation with a current frame was performed, i.e. weights were calculated for each quota cell by means of the ratio N_h/n_h, with N_h indicating the number of households estimated from the microcensus and n_h indicating the number of usable households in quota cell h (see 7.1). The estimation frame used for the sample data of the introductory interview was the 1997 microcensus, while that used for the annual recordings was the 1998 microcensus.

Then the estimated results were adjusted to the population by means of estimation according to the principle of minimal information loss. More specifically, the data of the introductory interview were adjusted to the marginal distribution of the following variables. (An asterisk between two adjustment variables means that adjustment to the common distribution is performed, i.e. for any combination of values, the expanded frequency is identical to the microcensus figure. The number of values of adjustment variables is indicated in brackets).

1) For federal results

   - Household type (6)
   - Social status of the reference person (9)
   - Household net income class (10)
   - Land (17) * household type (6)
   - Land (17) * economic activity (2)
   - Land (17) * household net income class (5)
   - Household type (6) * household net income class (10) * social status of the reference person (9)

2) For Länder results and for results broken down by former territory of the Federal Republic and new Länder

a) Former territory of the Federal Republic

   - Household type (6)
   - Social status of the reference person (9)
   - Household net income class (10)
   - Land (11) * household type (6)

- Land (11) * social status of the reference person (4)
- Land (11) * household net income class (6)
- Household type (6) * household net income class (10) * social status of the reference person (7)

b) New Länder including Berlin-East

- Household type (6)
- Social status of the reference person (9)
- Household net income class (10)
- Land (6) * household type (6)
- Land (6) * social status of the reference person (4 or 5)
- Land (6) * household net income class (7)
- Household type (6) * household net income class (9) * social status of the reference person (7)

The quarterly recordings for the territories mentioned under 1) and 2) were adjusted in addition to the following variables:

- Quarter (4) * household type (6)
- Quarter (4) * social status of the reference person (4)
- Quarter (4) * household net income class (4)
- Quarter (4) * household type (6) * household net income class (8) * social status of the reference person (6)

No additional adjustment variables were used, because when estimating according to the principle of minimal information loss, there is: the more adjustment variables are used, the wider is the expected range between the smallest and the largest adjusted weight. A wide range, however, is not desired as this would make the expected random errors larger and outliers might get too large a weight. For some variables, values had to be grouped, because even the values of benchmark breakdowns in the sample had to small frequencies.

As explained above, there is no solution to the minimisation problem if the values of a specific variable can be calculated through linear combination of other values. While fulfilling this condition of the solution, for the estimation of the introductory interview (and of the quarterly recordings) a specific number of microcensus benchmarks were predefined, to which the sample data had to be adjusted, that is: 385 (671) for Germany as a whole, 323 (624) for the former territory of the Federal Republic and 214 (473) for the new Länder. Up to a difference of less than 100 in any case, the estimates corresponded to the predefined population totals. The original weights were modified by means of factors which were mainly within the range of 0.4 to 2.5.

7.7 The Nonsampling Error

The quota sampling method used in the EVS is different from the quota method commonly used mainly in market and opinion research, because the selection of the sampling units is not done by the interviewers. The participating households are recruited through indirect and direct "advertising", where it is paid attention that these volunteers fulfill the quota restrictions.

Therefore the nonsampling error, which is connected with the selection of the survey units by the interviewers (see: QUATEMBER, 1996, p. 25ff) is excluded from this sample. The percentages of nonresponses and not-at-homes etc. are not calculated in a quota sample, but this source for a nonsampling error still exists. This may cause a systematic error of these estimators if the participation-readiness is correlated to the survey variables. This error also exists in every survey of opinions by opinion researchers.

7.8 The Sampling Error

If it can be assumed - upon mature consideration -, that the sample is representative for the universe of Microcensus-households, this sample may be retreated as a stratified random sample with a more dimensional strata-variable. Then we may use the formulas for this sampling method for the calculation of the sampling error of the quota sample in the EVS (see: QUATEMBER, 1996, p. 57ff). For some variables this is done by the "Statistisches Bundesamt".

But there is one more point, that must be considered: The estimators are - if at all - unbiased estimators for the parameters in the Microcensus-population and therefore unbiased for the German households-population only, if the Microcensus-parameters are unbiased estimators for the latter. This also may raise the sampling error of the EVS-results.

In fact the sampling error was calculated, assuming that the sample is a random sample of households, for different categories of both, expenditures and incomes. Using the principle of minimal informations loss no formula can be given for the calculation of the sampling error of totals and means, because of the calculation of weights using numerical methods. DEVILLE and SÄRNDAL (1992) show, that the variance of such estimatiors can be estimated using a regression-function (see: KÜHNEN, 2001, p. 28ff).

Applying this to the EVS-results it can be shown that the relative standard error for most variables lies below 5 % (see: KÜHNEN, 2001, p. 30ff).

7.9 Summary

The Sample Survey of Income and Expenditure is a nationwide survey with voluntary participation of about 74,000 households, that is conducted in Germany every five years. The Microcensus-households constitute the sampling frame and serve as survey units.

The sample is a quota sample with combined quotas. Within each federal state, the quota variables are “type of household”, “social status of the main income earner” and “the household’s net income”. The sample sizes for each quota cell are calculated by the “principle of comparable precision for structured results”. The data records are weighted firstly to compensate nonresponse in the quota cells and secondly using “the principle of minimum information loss” with the Maximum Entropy method to adjust them to the population structure.

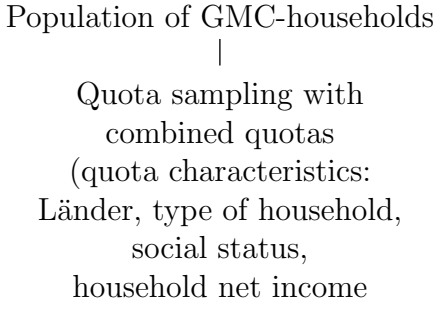

Figure 7.1: The characteristic of the sample-design for the German EVS

Chapter 8

The Swiss Household Budget Survey

8.1 Introduction

In 1998, the Swiss Federal Statistical Office (=SFSO) conducted a nationwide survey on income and consumption, the Household Budget Survey (=HBS) of 1998. Households were asked to keep housekeeping notebooks (during one month) in which they entered income and expenditure. Computer aided telephone interviews (CATI) were made before (recruitment period), during the period under review (to help and support the households) and after this period to collect additional information about the members of the households particularly on the topics of living conditions and travel patterns.

Efforts have been made to produce results fully comparable with the corresponding surveys conducted in European countries and taken over by Eurostat, the Statistical Office of the European Communities.

8.2 The Target Population

The population of interest for which the consumption serves as reference is the resident population inside the border of Switzerland. Seasonal workers, people who cross the border every day to work and foreign visitors do not belong to the resident population and are not included in the sample.

The survey unit is the private household. The definition of a private household excludes the collective households (community home, jail, etc.) and non-profit-making organizations (health and social security institutions, political parties, arts centres, etc.).

To get the characteristics of the households and persons that form the household, the role of reference person is attributed to one member of the household. This reference person is by definition the person with the highest income in the household. This particular status allows to define socio-economic categories and classify a given household according to its social group. To measure the consumption and income of the HBS of 1998, a nomenclature is used, based on the COICOP (Classification of Individual Consumption by Purpose). The use of that nomenclature allows classifying those products at different

levels of aggregation. Level 1 is the more aggregated level with 14 positions and level 5 is the most refined level with 459 positions for expenditure and 69 positions for income.

8.3 The Survey Process

For each of the twelve waves (months) of the year 1998, SFSO delivered the addresses with the corresponding telephone number of the households selected at random to participate in HBS 98. A joint venture of two market research institutes was appointed to lead the field work. About one month prior to the period under review, the addresses are activated meaning that an official letter of SFSO was sent presenting the objectives of HBS 98. A few days after the letter was sent, the households were contacted by telephone. If the household agreed to participate in the survey, a recruitment interview was conducted. This interview consisted of asking general information about the structure of the household (sex, age, nationality, education, etc.) and determining the reference person (member of the household with the highest income). The recruitment phase for one wave lasted about three weeks. A few days before the beginning of the month under review, the survey's documents were sent to the households who participated in the recruitment interview. All consumption expenditures and whole income of the household must have been recorded during the month under review. During this period, several telephone calls are made to support the household and to answer questions to fill in the questionnaire. At the end of the month under review a final CATI interview was conducted to collect additional information about housing, durable goods, etc.

8.4 The Sampling Frame

The sampling frame for the HBS of 1998 is the Swisscom's telephone register (TERCO) as the majority of private households own at least a connection of one's phone.

Table 8.1 below gives the number of private households in the census 1990, and the number of telephone connections in the sampling frame (updated respectively in October 97, January 98 and April 98) for each of the seven strata (composed of cantons) as described in the sample design of the following Section 8.5.

8.5 The Sample Design

The HBS of 1998 is a survey in which 9295 private households participated during the year 1998 and in which 12 successive monthly independent stratified random samples were drawn from the sampling frame, one for each "wave". For each wave, a simple random sample was drawn in each stratum where the strata were defined as the geographical regions in Switzerland corresponding to the EUROSTAT-NUTS2. The seven regions are composed from cantons in the following way (for the meaning of the abbrevations, see Table 8.1):

Table 8.1: Number of private households (census 1990) and telephone connections

Strata (Cantons)	Number of private households	Number of telephone connections in TERCO	Number of telephone connections in TERCO	Number of telephone connections in TERCO
	Census 1990	(Updated Oct 97)	(Updated Jan 98)	(Updated Apr 98)
Stratum 1: Plateau central				
Bern (BE)	397407	432619	433260	420771
Solothurn (SO)	93693	102014	102200	101002
Fribourg (FR)	79332	93657	94541	91821
Neuchâtel (NE)	70921	74477	74687	74599
Jura (JU)	25435	27493	27607	27079
Subtotal: stratum 1	666788	730260	732295	715272
Stratum 2: Région lémanique				
Vaud (VD)	260060	282757	284054	280676
Genève (GE)	170361	178589	179274	179023
Valais (VS)	93948	132069	132907	132891
Subtotal: stratum 2	524369	593415	596235	592590
Stratum 3: Zürich				
Zürich (ZH)	523685	562741	564667	562439
Subtotal: stratum 3	523685	562741	564667	562439
Stratum 4: Suisse du Nord-ouest				
Aargau (AG)	197224	220224	221225	220584
Basel-Stadt (BS)	99926	98848	98610	98009
Basel-Landschaft (BL)	95817	110799	111173	111267
Subtotal: stratum 4	392967	429871	431008	429860
Stratum 5: Suisse orientale				
St. Gallen (SG)	167611	184415	185317	185039
Thurgau (TG)	80543	89736	90088	90030
Graubünden (GR)	67486	104614	105287	104837
Schaffhausen (SH)	30455	32457	32525	32504
Appenzel A. Rh. (AR)	20261	22654	22693	22731
Glarus (GL)	15069	16738	16783	16624
Appenzel I. Rh. (AI)	4745	5207	5203	5104
Subtotal: stratum 5	386170	455821	457896	456869
Stratum 6: Suisse centrale				
Luzern (LU)	122978	139972	140372	140442
Schwyz (SZ)	40246	49856	50133	48108
Zug (ZG)	32254	39555	39880	39983
Nidwalden (NW)	12273	14836	14917	14966
Uri (UR)	12013	14102	14155	14205
Obwalden (OW)	10123	14130	14195	14217
Subtotal: stratum 6	229887	272451	273652	271921
Stratum 7: Tessin				
Ticino (TI)	117984	151587	151589	150280
Subtotal: stratum 7	117984	151587	151589	150280
TOTAL (SWITZERLAND)	2841850	3196146	3207342	3179231

Stratum 1: Plateau central [BE, SO, FR, NE, JU]
Stratum 2: Région lémanique [VD, GE, VS]
Stratum 3: Zürich [ZH]

Stratum 4: Suisse du Nord-Ouest [AG, BS, BL]
Stratum 5: Suisse orientale [SG, TG, GR, SH, AR, GL, AI]
Stratum 6: Suisse centrale [LU, SZ, ZG, NW, UR, OW]
Stratum 7: Tessin [TI]

The objective of the HBS of 1998 was to obtain 9000 respondent households over the 1998 year, that is to say 750 households per wave on average. In case of proportional to size sampling, the absolute number of households in stratum 7 (Tessin, italian speaking part of Switzerland) would only be about 31 on average per month as can be seen in Table 8.2 below. This was not considered as sufficient to produce regional results in this case. It was thus decided to make a disproportional to size sampling as described in the two last columns of Table 8.2.

Table 8.2: Stratification and sample size in each stratum for a given month

Geographical regions NUTS2 Strata	Census 1990		Sample size per wave		
	Number of households	in %	Proportional to size sampling	Disproportional to size sampling	In %
1. Plateau central [BE,SO,FR,NE,JU]	666'788	23.46%	176	167	22.30%
2. Région lémanique [VD, GE, VS]	524'369	18.45%	138	132	17.63%
3. Zurich [ZH]	523'685	18.43%	138	131	17.51%
4. Suisse du Nord-Ouest [AG, BS, BL]	392'967	13.83%	104	99	13.19%
5. Suisse orientale [SG, TG, GR, SH, AR, GL, AI]	386'170	13.59%	102	97	12.95%
6. Suisse centrale [LU, SZ, ZG, NW, UR, OW]	229'887	8.09%	61	61	8.03%
7. Tessin [TI]	117'984	4.15%	31	63	8.39%
Total	2'841'850	100.00%	750	750	100.00%

For time, efficiency and survey organization reasons, a substitution strategy has been implemented in the survey process. To better manage and control the total number of addresses activated for each wave, each monthly sample drawn according to the sample design consisted of basis addresses (B) and complementary addresses (C). Each month, short before the recruitement period, the basis addresses were activated (letter in advance in name of SFSO sent to the households). Then, as soon as one of the following events occured (explicit reason for non-participation), a basis address was substituted by a complementary address (in the same canton of the same stratum and in the same type of town) by sending the official SFSO letter to the complementary address:

- Addresses problems: address corresponding to a holiday home or second home etc., address no more valid (move, decease, unknown, etc.).
- Telephone number no more valid/false.
- Definitive refusal or incapacity (for language, age, illness reasons) of the household.

Note that this substitution strategy consists in adding a sample with indeterminate size to the basis sample. So the effective sample size is the sum of basis and complementary activated addresses. It was checked that a comparable effort was made to contact the

households from the basis and complementary addresses. For this reason, the complementary addresses were activated only in the first three days of the recruitement period (who lasted about three weeks). Having regard to the substitution strategy, the repartition of the activated addresses is not exactly the same as the one defined in the last column of Table 8.2.

8.6 The Weighting Procedure

The weighting for the Swiss HBS is done in the following way (Office fédéral de la statistique Suisse; Office fédéral de la statistique Suisse; Office fédéral de la statistique Suisse; Office fédéral de la statistique Suisse, 1997; 1998; 1999; 2000, Peters and Hulliger, 1994, Deville *et al.*, 1993, Renfer, 1997). To simplify the notations, let k be a household of the sample (without using subscripts for the wave and stratum to which this household belongs to). There are two response probabilities to calculate:

- Random process 1: response probability at level 1 (for the definition of level 1: see Section 8.7)

  Let $X_k = 1$ if k responds at level 1 and 0 otherwise.

  $\Pr(X_k = 1)$ = probability that k responds at level 1 = τ_k

  $\Pr(X_k = 0) = 1 - \tau_k$

  So $X \sim$ Bernoulli (τ) where τ is to be estimated.

- Random process 2: response probability at level 2 (for the definition of level 2: see Section 8.7)

  Let $Z_k = 1$ if k responds at level 2 and 0 otherwise.

  $\Pr(Z_k = 1)$ = probability that k responds at level 2 = ρ_k

  $\Pr(X_k = 0) = 1 - \rho_k$

  So $Z \sim$ Bernoulli (ρ) where ρ is to be estimated.

If we suppose that the response probabilities at level 1 and 2 are independent, then the response probability of household k is:

$$\Pr(k \text{ responds to the survey}) = \tau_k * \rho_k$$

The weight w_k of household k is equal to the inverse of his probability to participate in the survey. Suppose further that the events "be selected to participate in the survey" and "respond to the survey" are independent. Then the weight w_k of household k is:

$$w_k = \frac{1}{\pi_k * \tau_k * \rho_k}$$

π_k is the inclusion probability of household k;

τ_k is the response probability of household k at level 1;

ρ_k is the response probability of household k at level 2.

With the weights described above, an estimate of a total is given by the Horvitz-Thompson estimate:

$$\widehat{T}_\pi = \sum_{k \in s} w_k y_k$$

where y_k is a variable of interest. Most of the estimates in the HBS98 are means. The Horvitz-Thomson estimate of a mean is given by:

$$\widehat{M}_\pi = \frac{\sum_{k \in s} w_k y_k}{N}$$

where N = size of the private households population.

N had to be estimated with the households weights in the following way:

$$\widehat{M}_\pi = \frac{\sum_{k \in s} w_k y_k}{\widehat{N}} = \frac{\sum_{k \in s} w_k y_k}{\sum_{k \in s} w_k}$$

In the following, the estimation of the three probabilities involved in the calculation of the weights w_k are described.

The inclusion probability π_{khl} of a household is calculated as:

$$\pi_{khl} = \frac{n_{ahl}}{N_{hl}}, \quad h = 1, ..., 7 \text{ and } l = 1, ..., 12$$

Where: k is a household belonging to stratum h and wave l;

n_{ahl} = number of activated addresses (sample size) in stratum h for wave l;
N_{hl} = number of addresses in the telephone register (TERCO) in stratum h for wave l.

The response probability τ_{khl} can be estimated by a response rate at level 1 in the following way:

$$\tau_{khl} = \frac{n_{(r)hl} + n_{(nr)hl}}{n_{ahl}}, \quad h = 1, ..., 7 \text{ and } l = 1, ..., 12$$

Where: k is a household belonging to stratum h and wave l;

n_{ahl} = number of activated addresses (sample size) in stratum h for wave l;
$n_{(r)hl}$ = number of respondent households in stratum h for wave l;
$n_{(nr)hl}$ = number of nonrespondent households in stratum h for wave l.

The response probability ρ_k at level 2 can be estimated by a logit model in which auxiliary variables are known for both respondent and nonrespondent households. Let k be a household that responded at level 1 and $\mathbf{x}_k = \begin{pmatrix} x_{1k} & \dots & x_{pk} \end{pmatrix}'$ a vector of p auxiliary variables known for household k. The model can be written as:

$$\log\left(\frac{\rho_k}{1-\rho_k}\right) = \sum_{j=1}^{p} x_{jk}\beta_j$$

So that:

$$\rho_k = \frac{\exp\left(\sum_j x_{jk}\beta_j\right)}{1 + \exp\left(\sum_j x_{jk}\beta_j\right)}$$

After analysis, it appears that the following variables are significative:

- SA (= 1 if the household belongs to strata 1, 3, 4, 5 or 6 and 0 otherwise);
- $N1$ (= 1 if the reference person is Swiss and 0 otherwise);
- $NBPERSON$ (= size of the household);
- $G13$ (= 1 if the reference person is salaried and 0 otherwise).

The final logit model is given by:

$$\log\left(\frac{\rho_k}{1-\rho_k}\right) = \beta_0 + \beta_1 SA_k + \beta_2 N1_k + \beta_3 NBPERSON_k + \beta_4 G13_k$$

where the parameters β_j are estimated for each of the twelve waves.

Finally, this model has been used to estimate the response probability at level 2 by:

$$\rho_k = \frac{\exp\left(\beta_0 + \beta_1 SA_k + \beta_2 N1_k + \beta_3 NBPERSON_k + \beta_4 G13_k\right)}{1 + \exp\left(\beta_0 + \beta_1 SA_k + \beta_2 N1_k + \beta_3 NBPERSON_k + \beta_4 G13_k\right)}$$

To compute the weights effectively see the tables in the Cornali (2000)-paper.

8.7 The Nonsampling Error

During the survey process described above, part of the households leave the survey without giving the required information. The main reasons explaining the erosion of the sample are:

- Addresses problems: when the letter in advance was sent, the following addresses were not valid for the survey : address corresponding to a holiday home or second home etc., address no more valid (move, decease, unknown, etc.).

- Households not contacted (after at least 11 calls): during the recruitment phase, part of the households cannot be contacted during those three weeks.

- Once contacted, part of the households refuse or declare themselves unable to participate (too old, sick, do not understand one of the official languages in Switzerland, etc.).

- During the month under review, some households are again lost because they give up (main reasons are lack of time, too difficult, lack of interest, etc.).

- After the month under review, some households cannot be reached to realize the final interview. Several attempts are made to contact them again during the following three months. When it turns out that the household cannot be reached anymore, it is considered as lost.

The different losses described above show that the available information for the households who did not participate in the survey can vary from one household to the other, depending at which level of this dynamical process they were lost. For example, the household who gave up after the recruitement interview, has given several information about the structure and members of the household. This is not the case for the households who couldn't be contacted. Let us now define the respondent and nonrespondent household: a nonrespondent household is defined as a household who didn't participate in the survey but gave information for the following variables: the size of the household (number of persons), the socio-economic group and the nationality of the reference person. A household will be called a respondent household if it participated at the whole survey. With these two definitions we have two different levels of response:

- Level 1: Those households who gave the mentioned information about the size, the socio-economic group and the nationality of the reference person. In other words, the respondent and not respondent households as defined above.

- Level 2: The second level of response is equivalent to the complete participation of the household at the survey. Only the respondent households as defined above responded at the second level.

The unit response rates at level 1 (nonrespondent and respondent households divided by the total activated addresses) and 2 (respondent households divided by the total activated addresses) are represented for each of the twelve waves in Figure 8.1 below. These rates vary over time (for example the unit response rate at level 1 is 44.3 % in March and 54.5 % in October). The unit response rate at level 2 was particularly poor in April with only 26.8 % (while this rate is 32.6 % for the January and November waves).

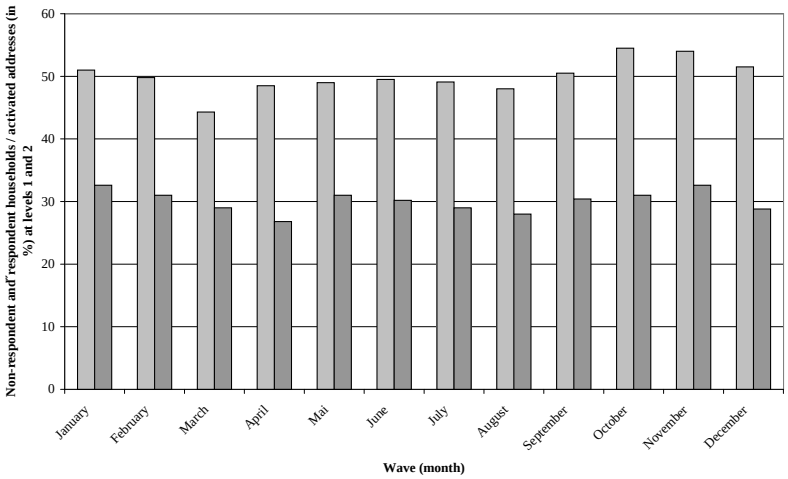

Figure 8.1: Unit response rates at level 1 and 2 respectively for the 12 waves (January to December) of HBS 98

light ··· response at level 1 dark ··· response at level 2

8.8 The Sampling Error

Until now no variance estimation has been done for the HBS 98.

8.9 Summary

The Swiss Household Budget Survey of 1998 was a voluntary survey of over 9,000 households, in which they had to record income and expenditure for one month. The Swisscom's telephone register was chosen as the sampling frame for this survey.

12 successive monthly independent stratified random samples were drawn from the sampling frame, where the 7 strata were defined as geographical regions.

To produce regional results too, it was decided to make a disproportional to the size sampling. For the weighting of the sample data one inclusion probability and two response

probabilities have to be calculated for each household. The unit-nonresponse was up to 70 %.

Population of households
|
Stratified random sampling
(stratification variable: 7 regions)
disproportional to size

Figure 8.2: The sample design of the Swiss HBS

Chapter 9

Comparison of the National Surveys

9.1 Population Characteristics

For a final comparison of the five surveys of the national labour markets and the two of the household budgets, which are included in the DACSEIS-project, we will start with a comparison of some population characteristics, that might be interesting with regard to our surveys.

In 1999 the size of the population of the six countries, in which these surveys take place (these are in alphabetic order Austria, Finland, Germany, the Netherlands, Switzerland and the United Kingdom), varied from 5.165 millions in Finland to 82.087 millions in Germany (see: Statistik Austria (ed.), 2001, p. 508 or `www.europa.eu.int/eurostat.html`). The Austrian population-size was 8.093 millions, the Netherlands' population-size was 15.810 million. Switzerland had approximately 7.140 millions of inhabitants, whereas in the UK there lived about 58.744 million people.

Comparing next the age structure of these populations, we find the following distribution of population by age-groups:

Table 9.1: Population by age-groups (see: Statistik Austria (ed.), 2001, p. 510f; source: UN)

Country	under 15	15 - under 30	30 - under 45	45 - under 60	60 and older
Austria	17.0	19.5	24.7	18.9	19.9
Finland	18.4	18.7	22.1	21.2	19.6
Germany	15.8	17.9	24.6	19.3	22.4
Netherlands	18.5	19.8	24.1	19.5	18.0
Switzerland	17.5	18.5	24.3	19.6	20.0
United Kingdom	19.2	19.4	22.6	18.4	20.4

The proportions of the female population of these six countries lie within an interval from 50.6% (for the Netherlands) to 51.5% (in Austria). The share of foreigners living in these six countries is shown in Figure 9.1 below. These proportions differ very much starting with Finland and 1.6%. The next two countries are the UK and the Netherlands with 3.6 and 4.2%. Germany and Austria have proportions of foreigners of about 9%. The highest proportion is that of Switzerland with 19.4%.

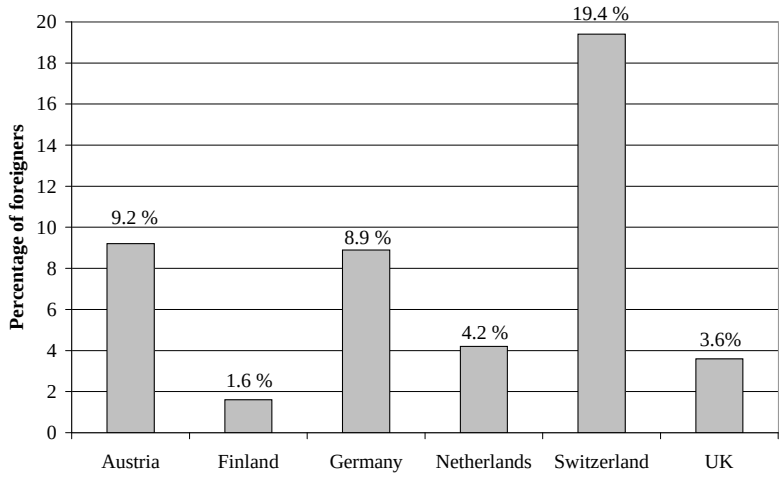

Figure 9.1: The share of foreigners, as of January, 1^{st}, 1999 (UK: January, 1^{st}, 1997) (see: STATISTIK AUSTRIA (ed.), 2001, p. 516; source: EUROSTAT)

With regard to our surveys the number of private households within the six countries is interesting, too. In Table 9.2 we show these numbers, the proportion of single-households and the mean value of the variable persons per household.

The mode of the variable persons per household had value 1 (=single-household) in Austria, Finland, Germany and Switzerland, whereas in the Netherlands and in the UK it had the value 2 in 1991.

Next, we take a look at some population characteristics regarding the international labour markets: If we count the number of employed and unemployed persons of these six countries, we can find that in 1999 there were 3.856 millions in Austria, 2.642 millions in Finland, 39.595 millions in Germany, 7.890 millions in the Netherlands, 3.995 millions in Switzerland and finally 28.889 millions in the UK (see: STATISTIK AUSTRIA (ed.), 2001, p. 527; source: EUROSTAT and for Switzerland: VON BARATTA (ed.), 2001, p. 27).

Another fact that is interesting with respect to these labour markets is the proportion of women in employment within the female population of age 15 to 65. These ratios of earnings were in 1998 as shown in figure 9.2. The highest percentage could be found in Finland, whereas the lowest was that of Austria.

The distribution of the employment with regard to the three sectors of employment - the agricultural, the industrial and the service-sector - is another important aspect for the

Table 9.2: The number of private households in 1990/91, the percentages of single-households and the average value of persons per households (see: Statistik Austria (ed.), 2001, p. 516; source: EUROSTAT)

Country	Households (in millions)	% of single households	mean of persons per household
Austria	3.013	29.7	2.5
Finland	2.037	31.7	2.4
Germany	35.256	33.6	2.5
Netherlands	6.162	29.9	2.4
Switzerland	2.842	32.4	2.3
United Kingdom	22.422	26.7	2.5

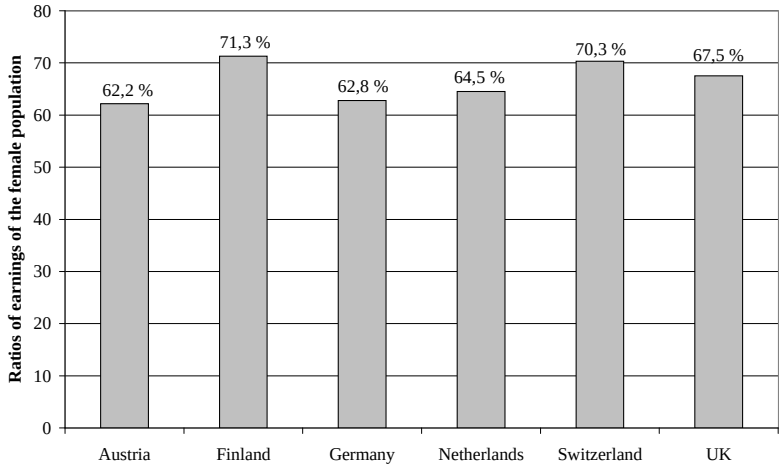

Figure 9.2: Ratios of earnings 1998 for the female poulation of age 15 to 65 (see Von Baratta (ed.), 2001, p. 27).

comparison of the national labour markets. These distributions differ more or less strong in the six countries (see Table 9.3).

Before we finally look at the unemployment-rates of these countries to get an impression of the amount of social problems with regard to these facts, we might at first have a look at another influential variable for the social policies. This is the percentage of part-time employment. These numbers differ very much from country to country.

Table 9.3: The distribution of employment among the economic sectors of agriculture (=A), industry (=I) and service (=S) (see: VON BARATTA (ed.), 2001, p. 27)

Country	A	I	S
Austria	6.2	31.9	61.9
Finland	6.3	27.9	65.9
Germany	2.8	34.5	62.6
Netherlands	3.0	21.1	75.9
Switzerland	4.7	25.8	69.5
United Kingdom	1.6	26.0	72.4

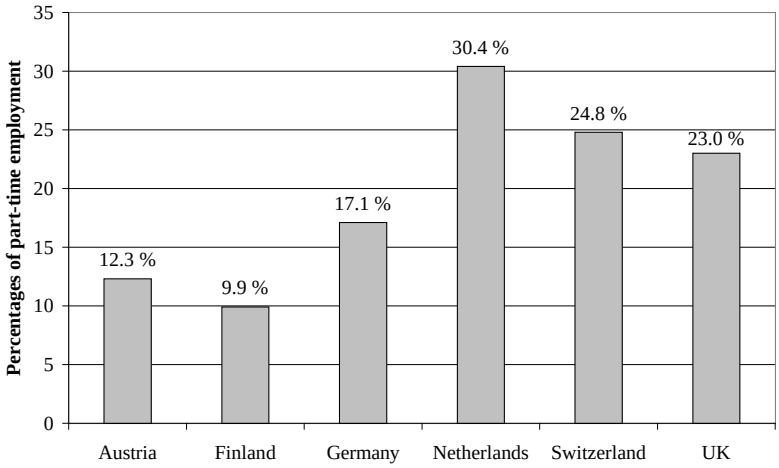

Figure 9.3: Percentages of part-time-employment in 1999 (see: VON BARATTA (ed.), 2001, p. 27

As you can see in Figure 9.3, the percentages of part-time employment lie within an interval from 9.9% (in Finland) to 30.4% (in the Netherlands). Depending on whether the part-time employment is voluntary or not, these percentages indicate very different social situations of the employees, that have to be taken into account, when we interpret the following unemployment-rates of our countries. These were calculated according to the ILO-definition of unemployment: Unemployed persons aged 15 years and over who are without work, are available to start work within the next two weeks and have actively sought employment at some time during the previous four weeks (see:`www.europa.eu.int/eurostat.html`) and refer to June of the year 2001 (source: `www.oestat.gv.at`; for Switzerland: `www.statistik.admin.ch`). So in that month this rate was 3.8% for Aus-

tria, 9.0% for Finland, 7.9% for Germany, 2.3% for the Netherlands, 2.5% for Switzerland and 5.4% for the United Kingdom. Comparing these rates with the part-time-employment rates, we can see, that in countries with higher part-time-employment there are lower unemployment rates with the exception of Austria, where both are relatively low. This proves, that the unemployment rate is just one of many perspectives to look at the working of the national labour force policies.

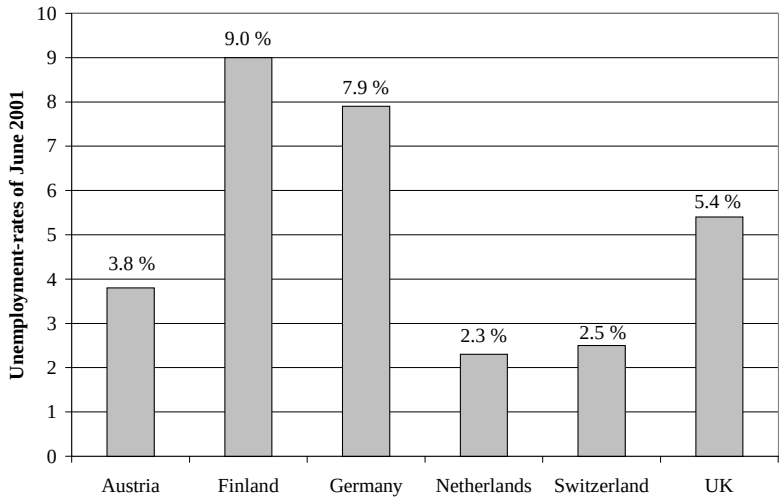

Figure 9.4: The unemployment-rates of June 2001

Comparing the part-time-employment rates with the unemployment rates, we can obtain, that in countries with higher part-time-employment-rates there are lower unemployment rates with the exception of Austria where both rates are relative low. This points out that the unemployment-rate is just one of many indicators of the working of the national labour force policy (see figure 9.5).

9.2 The Labour Force Surveys

Labour market data are important in an international as well as in a national context for the assessment of the working of the national social and economic policies and as an indicator for social trouble spots. The European Union is therefore very much interested in the harmonization and standardization of the national Labour Force Surveys of the EU with the object of having comparable data of high quality.

Before reaching this goal various problems have to be solved. We may categorize them in at least three fields: At first there are survey problems. It should be guaranteed that the same person with the same labour market position should give the same answers independently of the country, in which the LFS is conducted. Alois van Bastelaer has pointed out in an article, published in the Journal of Official Statistics in 1994, that

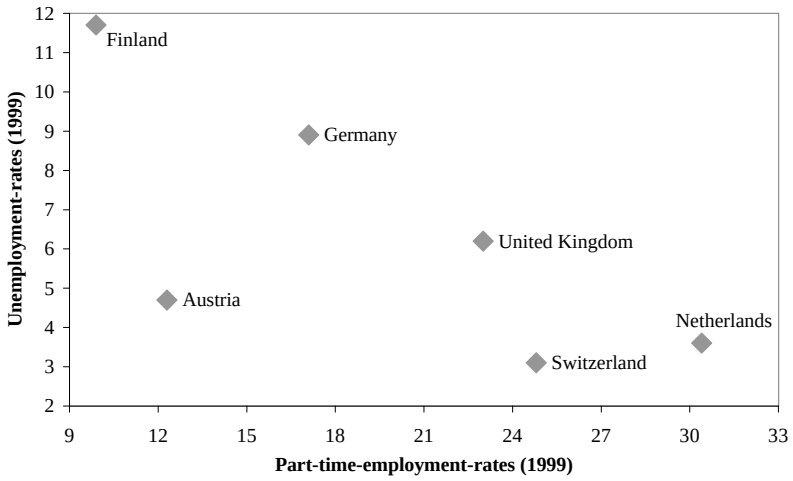

Figure 9.5: The scatterplot of the part-time-employment-rates and the unemployment-rates of the "DACEIS-countries" in 1999 (see: STATISTIK AUSTRIA (ed.), 2001, p. 529, and VON BARATTA (ed.), 2001, p. 27)

the structure of the questionnaire or the method of interviewing influences the choice of answers (see: VAN BASTELAER, 1994). And he states, that these characteristics of the survey design are not standardized in the various EU Labour Force Surveys.

The second domain of problems is of – let´s say – structural nature. This point refers for example to the fact, that within the same unemployment rate (according to the ILO definition of employment) there may be hidden social phenomena of different quality and quantity, depending on the percentage of minor employment (see: LITZ, 2000, p. 80). The social and economic policies of countries with high percentages of minor employment have to be very much different to the policies of countries with low percentages (see figure 9.5).

The third field concerns the question of accuracy. Are the national EU Labour Force Surveys comparable from this point of view, too? With this question we get in the middle of the statistical sampling theory. This problem is the subject of the DACSEIS-project, where partners of academic and official statistics from six countries are working together. One of the main goals of the project is to look at the accuracy of the sample results of different national surveys. The Labour Force Surveys to be investigated are the surveys of

- Austria
- Finland
- Germany
- the Netherlands and

- the United Kingdom.

At first sight these five surveys look as different as possible. But a closer look makes clear, that in countries of very different geographical and social structures not only the economic or the governmental systems but also the survey and sample designs for labour force data have developed differently. Realizing this, the equalities of the surveys are much more surprising than the inequalities.

In Austria and Germany currently there is no continuous survey of the labour force, but the EU LFS is part once a year of the so called "microcensus". The data therefore refer to a very short time period. In Austria the microcensus will be converted into a continuous survey in 2003. In Germany this will happen in 2005 (see: Bihler, 2001). The other three Labour Force Surveys are conducted continuously, in Finland and the Netherlands each month, whereas in the UK it is conducted quarterly. The sampling frames out of which the actual samples are drawn are very different (see Table 9.4).

Table 9.4: The sampling frames of the national EU-Labour Force Surveys

Austria	Dwellings of the Housing Census
Finland	Persons of the Population Register
Germany	West: Buildings of the Population Census East: Buildings of the Population Register Statistics
Netherlands	Households of the Geographical Base Register
United Kingdom	Households of the Postcode-Address File / Telephone directory / Valuation List for Rating Purposes

In Austria and Western Germany the basis from which the sampling frame for the micro-census is built is essentially the dwellings or – for Germany – the buildings stock of the Population Census and the Census of buildings and housing. This basis is supplemented annually by the rise in dwellings and buildings, which is summarized in the "statistics of the building activities" of each year. For Germany East a comparable sampling frame was constructed from the Population Register Statistics. The Finnish LFS sampling frame comprises all inhabitants included in the quite up-to-date "Central Population Register", which contains in principle all resident persons. The Dutch sampling frame is based on the households of the "Geographical Base Register", from which the non-private households have to be excluded.

In the UK the main sampling frame for the most of Great Britain is taken from the "small users"-Subfile of the Postcode Address File from the Post Office. In the sparsely populated northern part of Scotland the sampling frame is the published telephone directory of that

territory. The source of the sample in Northern Ireland is the "Valuation List", which is used for rating purposes.

Before we will compare the sample methods used, let us have a look at the actual sample-sizes (after nonresponse) and at the number of waves of the rotational pattern of the surveys.

Table 9.5: Actual approximate sample-sizes and number of waves of the national EU-Labour Force Surveys

Country	Interval	Actual appr. sample-size			Waves
Austria	quarterly	24,000 dws	resp.	53,000 ps	8
Finland	monthly	10,000 ps			5
Germany	annually	370,000 hhs	resp.	800,000 ps	4
Netherlands	monthly	5,000 hhs	resp.	11,000 ps	4
United Kingdom	quarterly	60,000 hhs	resp.	140,000 ps	5

(dws: dwellings, ps: persons, hhs: households)

The quarterly sample of the Austrian population therefore includes approximately 0.7 % of the entire population. In Finland this percentage is 0.2 per month. 800,000 persons in Germany mean that about 1 % of the entire population is included annually. In the Netherlands 0.07 % of the population is sampled monthly. At last for the UK a sample size of 140,000 persons quarterly give 0.25 % of the UK population.

In each country a rotating panel system is used, which means that the survey units stay in the survey for several times. For Austria we have to add, that each dwelling (or household or person) stays in the survey for eight times, but only for two Labour Force Surveys, because the LFS is conducted only once a year as a part of the quarterly microcensus.

If we look at the sample methods, that are used for the different Labour Force Surveys, we find the similarities and differences summarized in Table 9.3.

Two countries use rather simple methods: By means of a systematic selection out of the sampling frames, in Finland we get a stratified random sample of persons with proportional allocation of the sample-size using a geographical stratum variable. In the UK it is the same with the exception, that there we have a sample of households, which – for person-related data – gives a sample of clusters of persons.

For the Dutch LFS we have – like in the UK – a geographically stratified sample of households, but within the strata there is no unrestricted sample design used. What

Table 9.6: The sample methods of the national Labour Force Surveys

Austria	Stratified random sampling (of dwellings) with stratified random resp. two stage sampling within the strata
Finland	Stratified random sampling (of persons)
Germany	Stratified random sampling (of clusters of households)
Netherlands	Stratified random sampling (of households) with two stage sampling within the strata
United Kingdom	Stratified random sampling (of households)

is used, is a two stage sample procedure with the municipalities at the first and the households at the second stage.

In advance of the selection, the German sampling frame is rearranged by region and size of building. Within these strata clusters of households (= buildings, parts of buildings or several buildings) are built. These clusters are selected by a semi-systematic procedure. So this leads to a stratified random sample of household clusters.

The most complex sampling procedure is used in Austria. The sampling frame is rearranged in various ways. After allocating the total sample number disproportional to the stratum of dwellings in large (urban) and the stratum of dwellings in small (rural) municipalities, within the first stratum a systematic selection of dwellings leads therefore to a stratified random sample with federal state and some dwelling characteristics as strata variables. Within the second stratum a two stage method is applied with a stratified random sample of municipalities (strata variables: municipality characteristics) at the first and a systematic sample of dwellings within the selected municipalities at the second stage. Because of the ordering of the dwellings within each sample municipality due to dwelling characteristics, this sample becomes a stratified random sample of dwellings according to these dwelling characteristics on the second stage.

Now we look at the weighting procedures used in the different surveys: In Austria this process starts by calculating a basic weight for each record. This basic weight for each person depends on the stratum and the domain (part A or B), to which the person belongs. So each person's weight can be thought of as the number of people that person represents in this subgroup (post-stratification). In a further step, the adjustment to the population distribution takes place. This calibration is done by an iterative process. This raking adjustmentöf the basic weights is done in four steps. In step 1 the weights are adjusted so that the grossed up distribution concerning the variable federal state by age and sex equals the population projection. In step 2 this is continued for the variable federal state by nationality. In the third step the mean value of all persons living in one dwelling is computed, because it is wishful to have the same weights in one dwelling. Because of

the possibility that by this calculations the adjustments in steps 1 or 2 are ruined, step 4 checks, if the distribution in any cell corresponds sufficiently to the structure of the population. In the case of not liing between some predefined ranges, further iterations are necessary. Anyway, the procedure stops after 100 iterations.

For the finnish LFS at first the calculation of post-stratified weights for each person according to the variables sex, age and region is done. Then the calibrated weights are calculated according to sex, age, region, reference week (In the case of a continous survey, response rates vary weekly, so that they must be balanced on monthly level) and register-based job-seeker status taken from a register maintained by the Ministry of Labour. For the calibration procedure a linear distance function is used available in the CLAN program.

In the German Microcensus in the nonresponse compensation step different so-called compensation typesäre formed by the combination of the following characteristics: household size, nationality, for Germans: place of residence, for one-person households: sex and age. For each household of these types at a regional level with at least 100,000 inhabitants the nonresponse is compensated. In the calibration step of the weighting procedure nationality in combination with sex is used as auxiliary variable. The adjustment is performed within regional strata with at least 500,000 inhabitants. Multiplying the household-related weight of step 1 by the person related weight of step 2 results in the respective person weight. In addition to the person weight, for household data a household weight is calculated as the mean value of all person weights of one household.

In the Netherland the weighting procedure for the Dutch LFS starts with deriving inclusion weights for the responding persons, that take into account the oversampling of addresses, which occur in the register of the Employment Exchange, the undersampling of addresses with only persons aged 65 and more, the month of interview and the differences in response rates between geographical regions. These inclusion weights are the starting weights for a regression estimator using various combinations of the auxiliary variables area, age, sex, marital status and ethnicity. The method of LEMAÎTRE and DUFOUR (1987) is applied in order to obtain equal weights for members of the same household.

Finally for the UK LFS, stage 1 of the weighting process corrects for nonresponse at a local area level. The raking adjustment in stage 2 grosses to national population estimates amongst young people for age and sex and in addition for all respondents for sex, region and age. The iteration of these estimates ceases, when all factors lie within some predifined range.

Looking at the sample methods and weighting procedures it becomes quite clear, that the estimation of variances for the sample results in a job, that is very different for the different surveys under investigation. Not only the various stratification and cluster schemes have to be taken into consideration. The different weighting procedures effect also the variance estimators differently.

At the present, the accuracy of the sample outcomes is estimated in Austria with the formulas for unrestricted random sampling in consideration of the different sample fractions in the federal states. In Germany and the United Kingdom a multiplier is added to the variances of unrestricted random sampling, which is called the “design-effect”. In Finland, the sampling variance is estimated by the variance estimator for the generalized regression estimator. Finally in the Netherlands no variance estimation is done in the LFS.

In the end of this comparison let us go back from the theory to the practice of sampling. Nonresponse may effect the accuracy of sample results if the variables are differently distributed within the responding resp. the nonresponding survey units. We look at this potential source for the presence of a nonsampling error by obtaining the nonresponse-rate for each of the five national surveys: Two of them have nonresponse rates of about 15 %: Austria and Finland. In Germany this percentage is significant lower, whereas in the UK it is beyond 25 % and in the Netherlands it is between 40 and 50 %. All surveys being voluntary (the Austrian and German microcensus have a mandatory core program, but the LFS questions are included in the voluntary special program), we have also to add some item-nonresponse to this unit-nonresponse. So it seems, that the comparability of the national LFS-results is doubtful from this point of view, too.

9.3 The Household Budget Surveys

There are two surveys of the family of surveys of the household budget in the DACSEIS-project. The purpose of both, the German Survey of Income and Expenditure (SIE) and the Swiss Household Budget Survey (HBS), is to investigate the social and economic situation of private households by looking at their income use. Both surveys were conducted in 1998 for the last time.

The sampling frames, which build the basis for the selection of the sample households are very different: The frame for the SIE in Germany is built from the private households of the German microcensus sample with a monthly net income of less than 35,000 DM (appr. 17,500 Euro). For the HBS in Switzerland the Swisscom's telephone register serves as sampling frame. So in Germany a sample of the population of the German private households builds the sampling frame for the SIE sample.

Looking at the sample methods more interesting differences occur, because in Germany a method of purposive selection – the quota method – is used, whereas in Switzerland a probability method is used – stratified random sampling. The quota method used for the SIE is unusual, because the interviewers get the actual addresses of sample households from the office. So the search for households meeting the quota requirements is not the duty of the interviewers as it is in most cases of opinion and market research applications of the quota method. The used quota method with combined quotas is related to stratified random sampling with the difference, that the sampling units are not selected at random but purposive. As quota variables in Germany region, type of household, social status and the household's net income are used. In Switzerland only a regional stratification is applied (7 regions).

Both surveys use disproportional to size selection with a total number of sample households of appr. 74,000 households in Germany and 9,000 in Switzerland.

The weighting procedure for the SIE is done in two steps: In the first, nonresponses in the quota-cells are compensated, whereas in the second, the weights are calculated according to the "principle of minimal loss" using the adjustment characteristics region, household type, social status and household's net income. For the Swiss HBS the weighting procedure starts with the calculation of inclusion probabilities. Then response probabilities are calculated for the two different levels of response with level 1 households, which gave only

Table 9.7: Characteristics of the German SIE and the Swiss HBS 1998

Country	Sampling frame	Sample method	Sample-size
Germany	Microcensus households	Quota method	74,000 hhs
Switzerland	Telephone directory	stratified random s.	9,000 hhs

(hhs: households)

information about size, socio-economic group and nationality of the reference person, and level 2 households, which completely participated in the survey.

The percentage of nonresponse is not calculated for the SIE. It is never done with the quota method. In the Swiss HBS the nonresponse rate was about 50 % at level 1 and about 70 % at level 2. The participation of course was voluntary in both surveys. For the Swiss HBS no variance estimation has been done so far. For the German SIE for some variables their variances have been calculated using the formulas for stratified random sampling based upon the assumption that this quota sample can be treated like a random sample. For most variables the relative standard error of estimators of their total or mean was below 5 %.

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