

**Methodology of European labour force surveys:
(2) Sample design and implementation**

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Working Paper n. 79, January 2009

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WP 79/2009

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Abstract

This paper is the second of a set of three Working Papers the common objective of which is to provide a systematic and comparative exposition of various aspects of the methodology of labour force surveys in 27 countries of the European Union, plus the three EFTA and the two Candidate Countries. The present paper discusses the sampling designs, bringing out aspects of the sample structure including clustering and stratification. It also notes some important aspects of the data collection methodology of the EU national labour force surveys.

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Tables of contents

1 INTRODUCTION	3
2 ASPECTS OF THE SAMPLE STRUCTURE	4
3 CLUSTERING	6
3.1 NUMBER OF SAMPLING STAGES	8
3.2 ULTIMATE SAMPLING UNITS	15
3.3 PRIMARY SAMPLING UNITS (PSUs)	18
4 STRATIFICATION	20
4.1 PRINCIPLES.....	20
4.2 STRATIFICATION CRITERIA USED IN THE EU LABOUR FORCE SURVEYS.....	22
5 DATA COLLECTION	24
5.1 VARIOUS MODES OF DATA COLLECTION	24
5.2 MODES OF DATA COLLECTION IN EU LABOUR FORCE SURVEYS	26
5.3 RESPONSE RATES	30
5.4 PROXY RATES	32
5.5 COMPARABILITY OF EU LABOUR FORCE SURVEYS.....	33
REFERENCES	34

List of tables

<i>TABLE 1. SAMPLING STAGES AND TYPES OF UNITS</i>	6
<i>TABLE 2 (TABLE 1 SORTED). SAMPLING STAGES AND TYPES OF UNITS</i>	10
<i>TABLE 3. NUMBER OF SAMPLE PSUS AND ACHIEVED SAMPLE SIZE PER PSU</i>	19
<i>TABLE 4. MAIN STRATIFICATION VARIABLES: EU-LFS 2006</i>	22
<i>TABLE 5. MODE OF DATA COLLECTION</i>	28
<i>TABLE 6. RESPONSE RATES: EU-LFS 2005 AND 2006</i>	31
<i>TABLE 7. PROXY INTERVIEW RATES: EU-LFS 2005 AND 2006</i>	31

List of figures

<i>FIGURE 1. RESPONSE RATE VERSUS PROXY INTERVIEW RATE: VARIATION ACROSS COUNTRIES</i>	33
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1 Introduction

This paper is the second of a set of three Working Papers the common objective of which is to provide a systematic and comparative exposition of various aspects of the methodology of labour force surveys in 27 countries of the European Union, plus the three EFTA countries (Iceland, Norway, Switzerland) and the two Candidate Countries (Croatia, Turkey).²

The papers discuss in turn the following aspects of the methodology of European labour force surveys:

- (1) Scope and sample size³
- (2) Sample design and implementation
- (3) Sample rotation patterns⁴

The present paper discusses the sampling designs, bringing out aspects of the sample structure including clustering and stratification. It also notes some important aspects of the data collection methodology of the EU national labour force surveys. The two complementing Working Papers analyse the following aspects. The first paper describes the framework and basic characteristics of different types of household surveys of the labour force, the basic concepts and definitions used in the labour force surveys in European countries, and the choice of sample sizes in relation to the national population sizes. The third paper considers various aspects of the structure of the labour force survey over time; these include elements of temporal structure of the survey such as the reference period, the distribution of data collection over time, the pattern of sample rotation, and estimation procedures under a rotational design.

A major task involved in the research leading to these papers has been the compilation of information on national LFS methodologies from a variety of sources, both from published material and from data and documentation accessible through the internet, and the analysis of this information in a comparative context. We hope that the material presented in this set of papers can also serve as a resource for teaching purposes on the subject.

Labour force surveys are among the most important social surveys on economic activity of the general population, conducted in most countries in the world. These surveys tend to be relatively large-scale surveys of the whole population; they are often national in scope and have an official status. In EU countries, the surveys are conducted quarterly on a continuous basis. In comparison with many other types of social surveys, labour force surveys tend to be quite standardised and comparable across countries. This, above all, is because these surveys follow the common and agreed international standards laid down by the International Labour Organisation (ILO, 1982; also see technical elaboration in Hussmanns, Mehran and Verma, 1990). In EU countries, the national labour force surveys are further standardised on the basis of various framework and technical regulations laid down by the European Commission (European Commission 1998, 2000), which closely follow the ILO standards.

Section 2 of the present paper discusses basic concepts concerning sample structure, such as the concepts of probability and measurable sampling design, and common departures from simple random sampling in actual surveys.

² Throughout this document, for simplicity the term 'EU countries' is used to cover 32 countries, including EU Member States (27), EFTA (3) and Candidate Countries (2).

³ Ciampalini, Gagliardi and Verma (2008)

⁴ Verma, Gagliardi and Ciampalini (2009)

Section 3 discusses clustering or multi-stage sampling, including issues relating to the number of sampling stages and the choice of sampling units at various stages. The information relating to these aspects of the sample is tabulated and analysed. The scope in this paper is to consider only the cross-sectional aspects of the design, i.e., the sample for any one round of the LFS. Sample rotation and other aspects relating to sampling in the time dimension are considered in a separate Working Paper (Verma, Gagliardi and Ciampalini 2009).

Section 4 considers the other basic aspect of the sample structure, namely stratification, on the same lines.

Finally, Section 5 discusses some aspects of data collection methodology of the EU labour force surveys, in particular modes of data collection, and response and proxy rates. The paper concludes with an observation concerning comparability of EU labour force surveys.

2 Aspects of the sample structure

In this section some fundamental concepts concerning sample structure are introduced and explained. The main sample design features of the labour force surveys in EU countries are discussed in subsequent sections.

Probability and measurable samples

Inferences from the sample to the whole population can be drawn on a scientific basis only if the sample is composed of units selected using a randomised procedure which gives a known non-zero chance of selection to every unit in the population, that is, is a *random* or *probability* sample. The major strength of probability sampling is that the probability selection mechanism permits the application of statistical theory to examine the properties (such as variance) of the estimators of population values obtained from the sample.

The design of a random sample specifies the type of randomised procedure applied in *sample selection*. It also specifies how the population parameters are to be *estimated* from the sample results. The selection procedure and the estimation procedure form two aspects of the *sample design*.

To obtain a probability sample, certain proper procedures must be followed at the selection, implementation and estimation stages: (1) representing each element in the population explicitly or implicitly in the frame from which the sample is selected; (2) selecting the sample from the frame by an objective, randomised process which gives each unit the specified probability of selection; (3) successfully enumerating all selected units - and only those units - at the implementation stage; and (4) in estimating population values from the sample, appropriately weighting the data in accordance with the units' selection probabilities.

However, in practice, some approximations in the implementation of these ideal requirements are often necessary due to reasons such as: (1) the failure to include some units in the frame (under-coverage); (2) distortions in probabilities of selection due to other coverage and sample selection errors; (3) failure to enumerate or obtain full information on all the units selected (non-response); and (4) the use of approximate procedures at the estimation stage, in particular failure to take fully into account the selection method actually used (estimation bias).

Labour force surveys are large-scale regular official surveys, and generally are based on probability samples. In practice, however, the probability nature of the sample may be achieved only with some approximation.

It is a matter of practical judgement as to the level of shortcomings up to which a sample may still be considered effectively a probability sample.

A similar concept but more demanding than probability sampling is that of measurability. A sample is said to be *measurable* if it provides estimates not only of the required population parameters, but also of their sampling variability (Kish, 1965). Again, assumptions and approximations may be involved in the variance estimation procedures without necessarily losing measurability of the sample in the practical sense.

Under EU Commission (2000) ‘implementation regulations’ for EU-LFS, each country is required to compute and provide sampling errors for the main statistics reported. This implies that, at least in principle, the samples used are also measurable in the sense described above. However, this does not necessarily ensure that the information required for the computation of sampling errors taking into account the actual sampling design is readily available in the micro data in all cases. Accessibility of such information to researchers and other data users is an essential element of the sample’s measurability.

Departures from simple random sampling

Some labour force surveys in the EU are based on essentially simple random samples of households or persons. However, in general, the samples depart from simple random sampling due to the introduction of (1) clustering (multi-stage selection), (2) stratification, (3) unequal selection probabilities, (4) other design complexities such as multi-phase sampling, and (5) possibly also imperfections or variations during sample implementation.

Clustering or multi-stage sampling refers to the *grouping of units* before sample selection. Often it is economical and convenient to group the population elements into larger units (‘clusters’), and apply the selection procedures to such groups rather than directly to individual elementary units. In many practical situations, such clustering is in fact the only option available because the individual elements are too numerous and widely scattered to be sampled directly. The selection procedure may be more elaborate than simply selecting a sample of clusters. For example, some large units may be selected first; then each selected unit may be divided into smaller units and a sample of the latter selected; and finally, in each of the smaller units selected, a sample of individual elements may be selected. In this way we get a multi-stage design. The objective of such a design is to confine the elements appearing in the sample to larger units selected at the previous stage(s). This is normally done to reduce survey costs and improve control over the data collection operation in the survey.

Stratification refers to *partitioning the population* before sample selection. Within each part, a sample is selected separately (independently). In each part or stratum, the design may involve other complexities such as clustering or multi-stage sampling, and may differ from one stratum to another. The main objectives of stratification are to gain flexibility in sample design and allocation for different parts of the population and to increase statistical efficiency of the design.

Unequal selection probabilities is another source of departure from simple random sampling. Sometimes there are reasons to select some classes of elements with higher (or lower) probabilities than others. For instance certain strata, i.e. parts of the population such as urban areas or smaller regions of a country, may be over-sampled in the design so as to improve the precision of their results. Unequal selection probabilities may also appear because of imperfections at the implementation stage. In any case, unequal weights may also be introduced for other reasons such as to improve representativeness of the sample by *calibrating* it to some known population characteristics. Most EU labour force surveys are subject to such weighting.

The following sections describe clustering and stratification in EU labour force surveys.

3 Clustering

Table 1. Sampling stages and types of units

		number of stages	Primary sampling unit (PSU)		Ultimate sampling unit (USU)
			type of unit	selection probability	type of unit
AT	Austria	1	(Dwelling)	-	Dwelling
BE	Belgium	2	Statistical sections (average 700 households)	PPS	Household
BG	Bulgaria	2	Census EA's	PPS	Household
CY	Cyprus	2	Census EA's	PPS	Dwelling
CZ	Czech Republic	2	Census EA's	PPS	Dwelling
DK	Denmark	1	Persons (aged 15-66, 67-74, all unemployed)	Uniform for each group	Person
EE	Estonia	1	Person	Proportional to no. of adults in household	Household (of each person selected)
FI	Finland	1	(Person)	-	Person
FR	France	1 (or 2)	Geographical delimited areas (aires)	Equal within strata	1. all dwellings in selected area; 2. subsample if many new dwellings
DE	Germany	1	Sampling district (cluster of 9 dwellings; or of 15 persons if collective household)	Equal within strata	All dwellings in each selected cluster
GR	Greece	2	One or more census building blocks	PPS	Dwelling
HU	Hungary	1	Dwelling in Large 'self-representing' localities	-	Dwelling
		2	Locality if not 'large'	PPS	Dwelling
IE	Ireland	1	Cluster (15 households), one selected/block	Equal	All households in each cluster
IT	Italy	1	Large 'self-representing' localities	-	Household
		2	Municipalities if not 'large'	PPS	Household

Table 1 (cont.). Sampling stages and types of units

		number of stages	Primary sampling unit (PSU)		Ultimate sampling unit (USU)
			type of unit	selection probability	type of unit
LV	Latvia	2	Census counting areas	PPS	Household
LT	Lithuania	1	Person	Proportional to no. of adults in dwelling	Dwelling (of each person selected)
LU	Luxembourg	1	(Household)	-	Household
MT	Malta	1	(Household)	-	Household
NL	Netherland	1 (or 2)	Large 'self-representing' municipalities: PSU=mailing address	-	1.household at selected address, or 2. subsample of hhs if >1 at address
		2 (or 3)	else: PSU= municipality; SSU=mailing address	PPS	As above
PL	Poland	2	Census cluster (towns); census ED (rural areas)	PPS	Dwelling
PT	Portugal	2	Master sample area	PPS	Dwelling
RO	Romania	2	Group of census sections (from master sample)	Equal	Cluster of 3 dwellings
SK	Slovakia	2	Census administrative unit	PPS	Dwelling
SI	Slovenia	1	(Address)	-	Address
ES	Spain	2	Geographical area	PPS	Dwelling
SE	Sweden	1	(Person)	-	Person
UK	United Kingdom	1	(Postal address)	-	Postal address
IS	Iceland	1	(Person)	-	Person
NO	Norway	1	(Family unit)	-	Family unit
CH	Switzerland	1	Standard: phone number. Foreigners: person	Variable	Person, one per selected phone no.
HR	Croatia	2	Segments (1+ census areas)	PPS	Dwelling
TR	Turkey	2	Block of addresses in urban and large villages	Equal	Addresses
		2	Medium village	PPS	Addresses
		1	Small village	Equal	(all households in the village)

" - " In direct samples of dwellings, households or persons, units are normally selected with uniform probabilities, at least within strata.

The sample designs used in EU labour force surveys may be distinguished in terms of several characteristics, such as the number of sampling stages involved, the type of units used as the ultimate sampling units, the type used as the primary sampling units, stratification at various stages, and the selection methods used. In this section we consider aspects relating to clustering of units in the sample. As noted, we consider here only the cross-sectional aspects of the design.

3.1 Number of sampling stages

Mostly one-stage or two-stage designs have been used: of the 32 national surveys shown in Table 1, around one half use a single stage design, and the other half use a two stage design. In some countries different types of designs are used in different parts.

Table 2 shows the same information as Table 1, but with countries sorted according to the number of sampling stages and the type of ultimate units. This facilitates the identification of patterns of variation across countries.

Single-stage designs

A single-stage design means that the ultimate sampling units are selected directly from the frame representing the target population. These units may be individual persons, families, households, dwellings or addresses; or they may be area units or other types of clusters of addresses. The selection may involve stratification of the units by various criteria, followed by systematic or simple random selection of the units.

There is a trend in EU labour force surveys to move away from more heavily clustered sampling designs used in the past towards less clustered designs, ultimately moving to single-stage (simple or stratified) sampling of elements. The United Kingdom labour force survey provides a good and important example of moving from a two-stage sample used in the past to direct sampling of addresses.

The underlying factor for this trend is a shift in the balance between the benefits and costs of clustering (multi-stage sampling).

Benefits of clustering are primarily the reduced travel costs for a given sample size, reduction in the cost of creating the sampling frame and selecting the sample, and possibly also some improvement in control over the process of data collection. All these benefits have tended to become less important in relative terms.

Relative costs of travel have generally declined, but more importantly, these costs are essentially eliminated with the introduction of telephone interviewing. (The costs of contact by telephone are independent of whether and how the sample is clustered through a multi-stage design.) At the same time, up-to-date and complete lists for the direct selection of samples of addresses, households or individual persons are becoming available more easily and cheaply. Developments in data collection technology, most importantly in computer-assisted interviewing (CAPI, and especially CATI) have facilitated control and supervision of data collection operations even when the sample is widely scattered throughout the study population.

Hence, in general terms in European conditions, the advantages of clustering the sample have tended to become smaller. At the same time its disadvantages have tended to become larger. The main cost of clustering the sample to a limited number of area units in the population is the increase in variance resulting from it. This means that, compared to a simple random sample of elements, a larger number of interviews are needed to obtain the same degree of precision. Consequently, there is increased cost of interviewing and data treatment, and also increased response burden on the population as a whole. Rising per interview costs and response burden are an increasing concerns in surveys.

Another limitation of using multi-stage designs becomes apparent with the increasing requirement to produce disaggregated estimates, e.g. for regions or other small domains. This can be a problem if the number of PSUs in the sample with a multi-stage design is too small for some of the estimation domains. Moving toward direct sampling of elements can alleviate this problem of estimation for small domains.

Multi-stage designs

A two stage sample normally involves the selection of the area units (PSUs) from the frame representing the target population, followed by the selection of ultimate sampling units within each selected area unit.

The selection of the PSUs normally involves stratification by geographic location and other criteria, and random or, more commonly, a systematic selection of these units within each stratum.⁵ Often areas are selected with *probability proportional to some measure of their population size* (PPS sampling); alternatively, especially when the units are fairly uniform in size, their selection may be with *equal probability*, at least within each stratum.

The units used at the second stage in a two-stage sample (or at the final stage in a multi-stage sample) are called ultimate sampling units (USUs). The most commonly used units for this purpose are households or dwellings/addresses. Sometimes small clusters of dwellings (e.g. in Romania the USUs are clusters of 3 dwellings each) or even small area segments may be selected instead; there are no examples in the present EU labour force surveys of direct sampling of individual persons (rather than dwellings or households) within sample areas of a multi-stage design, though in principle it is a possible design. All existing cases involving samples of individual persons happen to be single stage designs.

The selection of the ultimate units may involve stratification by household or personal characteristics, followed by random or systematic selection.

Different designs in the same country

The sampling design may differ from one part of the population to another. (To facilitate this is one of the objectives of stratification, as described in the next section.) An example is provided by the labour force survey of Turkey. In Turkey (Eurostat, 2007b), “the sampling design is a two-stage stratified probability clustered sample of addresses. In the first stage of sampling the primary sampling units in urban areas and larger villages are defined as blocks of addresses containing approximately 100 households. These are selected with equal probability using systematic sampling. Medium sized villages are sampled with probability proportional to (population) size. All households within an address are taken into the sample. Villages too small to permit sub-sampling of households are selected directly with equal probability using systematic sampling and all households with them taken into the sample.” Thus in Turkey, villages too small to permit sub-sampling of households are selected directly with equal probability using systematic sampling and all households within each selected village are taken into the sample, resulting in a single-stage sample of (small) villages.

⁵ Stratification is discussed in the following section.

Table 2 (Table 1 sorted). Sampling stages and types of units

		number of stages	Primary sampling unit (PSU)		Ultimate sampling unit (USU)
			type of unit	selection probability	type of unit
SI	Slovenia	1	(Address)	-	Address
DE	Germany	1	Sampling district (cluster of 9 dwellings; or of 15 persons if collective household)	Equal within strata	All dwellings in each selected cluster
IE	Ireland	1	Cluster (15 households), one selected/block	Equal	All households in each cluster
AT	Austria	1	(Dwelling)	-	Dwelling
HU	Hungary	1	Dwelling in Large 'self-representing' localities	-	Dwelling
		2	Locality if not 'large'	PPS	Dwelling
LT	Lithuania	1	Person	Proportional to no. of adults in dwelling	Dwelling (of each person selected)
NO	Norway	1	(Family unit)	-	Family unit
IT	Italy	1	Large 'self-representing' localities	-	Household
LU	Luxembourg	1	(Household)	-	Household
MT	Malta	1	(Household)	-	Household
EE	Estonia	1	Person	Proportional to no. of adults in household	Household (of each person selected)
DK	Denmark	1	Persons (aged 15-66, 67-74, all unemployed)	Uniform for each group	Person
FI	Finland	1	(Person)	-	Person
SE	Sweden	1	(Person)	-	Person
IS	Iceland	1	(Person)	-	Person
CH	Switzerland	1	Standard: phone number. Foreigners: person	Variable	Person, one per selected phone no.
UK	United Kingdom	1	(Postal address)	-	Postal address

Table 2 (cont.) (Table 1 sorted). Sampling stages and types of units

		number of stages	Primary sampling unit (PSU)		Ultimate sampling unit (USU)
			type of unit	selection probability	type of unit
TR	Turkey	1	Small village	Equal	(all households in the village)
		2	Block of addresses in urban and large villages	Equal	Addresses
		2	Medium village	PPS	Addresses
RO	Romania	2	Group of census sections (from master sample)	Equal	Cluster of 3 dwellings
CY	Cyprus	2	Census EA's	PPS	Dwelling
CZ	Czech Republic	2	Census EA's	PPS	Dwelling
GR	Greece	2	One or more census building blocks	PPS	Dwelling
PL	Poland	2	Census cluster (towns); census ED (rural areas)	PPS	Dwelling
PT	Portugal	2	Master sample area	PPS	Dwelling
SK	Slovakia	2	Census administrative unit	PPS	Dwelling
ES	Spain	2	Geographical area	PPS	Dwelling
HR	Croatia	2	Segments (1+ census areas)	PPS	Dwelling
BE	Belgium	2	Statistical sections (average 700 households)	PPS	Household
BG	Bulgaria	2	Census EA's	PPS	Household
		2	Municipalities if not 'large'	PPS	Household
LV	Latvia	2	Census counting areas	PPS	Household
FR	France	1 (or 2)	Geographical delimited areas (aires)	Equal within strata	1. all dwellings in selected area; 2. subsample if many new dwellings
NL	Netherland	1 (or 2)	Large 'self-representing' municipalities:	-	1.household at selected address, or
		2 (or 3)	else: PSU= municipality; SSU=mailing address PSU=mailing address	PPS	As above 2. subsample of hhs if >1 at address

Similarly, in France, while the ‘normal’ sample is a single-stage sample of clusters, a two stage sample involving sub-sampling is used in clusters found to contain too many new dwelling units. The normal sample of the quarterly labour force survey “is made with geographically delimited areas (aires). Areas contain about 20 dwellings on the average. The sampling unit is the dwelling: in each sampled area, every private household living in its main residence is surveyed. An additional sampling stage is involved in areas containing many new dwellings: new dwellings (constructed between the date of the population census and the date of the survey) in the areas are listed by the surveyor at the time of the survey. If the area contains less than 10 new dwellings, all of them are surveyed; if the area contains between 10 and 40 new dwellings, 10 of them are selected (with simple random sampling); if the area contains more than 40 new dwellings, a quarter of them are surveyed.”.

In some countries (e.g., the Netherlands, Hungary), single stage samples are taken in the largest localities (all of which are automatically represented in the sample), while the rest of the sample is selected in two (or more) stages, starting with localities as the primary sampling units.

Cost-benefits of multi-stage sampling

Despite the above-noted tendency in EU labour force surveys to use less clustered samples (or even direct sampling of households or individuals), it must be pointed out that in many circumstances the use of single stage, direct samples of households or individuals is *not a feasible option*. Multi-stage sampling is introduced for several reasons:

- By concentrating the units to be enumerated into clusters, it reduces travel and other costs of data collection.
- For the same reason, it can improve the coverage, supervision, control, follow-up and other aspects determining quality of the data collected.
- Administrative convenience in implementation of the survey when the interviews are clustered can be another important reason.
- Selecting the sample in several stages reduces the work and cost involved in the preparation and maintenance of the sampling frame. Frames for larger units tend to be more durable.
- The work involved in sample selection can also be reduced using multi-stage sampling. It is easier to classify and stratify larger units than individual persons or households, and usually much more information is available for the purpose of stratification of larger units.

The above advantages have to be balanced against various costs of introducing multi-stage sampling:

- The major cost of clustered or multi-stage sampling is the increase in sampling error compared with that in a simple random sample of the same size (i.e. with the same number of elements enumerated). The increase in variance depends upon relative homogeneity of elements within the higher stage units, and the manner and number of units selected at each stage. If elements (e.g. persons) clustered together within a higher stage unit (e.g. areas) are rather similar to each other, each of the units gives, in a sense, less new information than what would be obtained if all elements were selected at random from the entire population. This tends to make the sample less efficient. The loss in efficiency will be higher if the number of elements selected per cluster is increased, or if the elements are more closely clustered together in compact units, or if neighbouring units are more homogeneous on the variables of interest.
- There can also be some loss in flexibility in the sample design and in targeting of the sample to populations with particular characteristics. This is because elements of different types are

generally mixed-up within higher stage units, so that the selection of ultimate units of any given type cannot be controlled separately.

- Complexity of the design also increases the complexity of analyses of the survey data. This applies in particular to the estimation of sampling errors, which must take into account the structure of the sample.

Choice of the type of area units to be used in the survey, and the number of such units to be selected for the sample are important issues. The appropriate type and size of units depends upon survey circumstances and objectives. Also, the choice is constrained by what is available in the sampling frame. It is neither necessary, nor always efficient, to insist on using units of the same type or same size as PSUs in all the population domains to be sampled. It is quite common for very different types of units to have the same administrative label. It is important not to confuse formal administrative labels with the actual type of units involved (Verma, 1991).

Effective stages

The number of sampling stages shown in Tables 1 and 2 are, more precisely speaking, the number of *effective* stages. By an effective stage is meant a sampling stage which results in *clustering* of the units coming into the sample at the (lower) stages which follow. The number of effective stages may be less than the number of stages evoked in the design and description of the sample (Verma, 1977). For instance, a sample involving the selection of area units (PSUs) at the first stage, followed by the division of each selected area into smaller segments and the selection of two segments per PSU, has two descriptive and also two effective sampling stages – the first stage results in clustering of the two second stage units within each of the selected first stage unit. By contrast, if the design involved the selection of only *one* segment per selected first stage area unit, the sample may still be described as having two stages, but it is more appropriate to view it as having only one *effective* stage. This is because the resulting sample design is essentially equivalent to a single stage selection of segments – each area selected at the preceding stage merely serves as an ‘address’ leading to the selection of a single segment, and does not itself contribute to clustering of the resulting sample of segments.

An example is provided by the labour force survey of Ireland. The sample in Ireland may be described as having two stages, but it involves only one effective stage. The two stage design comprises a first stage sample of 2,600 blocks (or small areas) selected at county level to proportionately represent eight strata reflecting population density. Each block is constructed to contain, on average, 75 dwellings and the sample of blocks is fixed for a period of about five years. In the second stage of sampling, each block is split into rotation groups each containing 15 households. Each quarter of the year, one rotation group from within a given block is surveyed to give a total quarterly sample of 39,000 households with 3,000 households interviewed every week of the quarter. As explained in the *Quality Report of the European Union Labour Force Survey 2005*, (Eurostat, 2007a): “Ireland is a special case, using a two-stage cluster design. However, theirs is a Master Sample design: the second stage is the allocation of the dwelling units within each PSU over time, so that eventually all of the sub-units within each selected PSU are covered (or would be if the sample was not revised every five years based on the five-year Census of Population) – each PSU divided randomly into 5 clusters of 15 dwelling units, each cluster participating 5 times before being replaced by the next cluster.” This means that in reality Ireland has a one stage sample – from each area in the sample, a single segment of around 15 dwellings is taken into the sample at any given times.

Finally we may note that in Irish LFS, all the persons living in the same dwelling are interviewed. Despite the survey being directed to the households, the dwellings are the ultimate sampling units.

Another example is provided by the survey in Portugal. The sample appears to involve two levels of complexity, but ultimately its effective structure is quite straightforward.

The first level of apparent complexity in the Portuguese sample is the manner in which the LFS sample areas are obtained from a master sample. The Portuguese LFS uses a sample where the first stage consists of the construction of the 2001 Master Sample (MS2001). The MS2001 consists of 1,408 'areas' and it is representative at the NUTS-3 level. The areas are selected systematically with probability proportional to size (number of private dwellings of usual residence). After the selection of the geographical areas (primary sampling units) of the MS2001 the LFS sample of private dwellings is selected sequentially in two systematic blocs. There are two systematic samples per MS area, but these are not geographically compact blocks of dwellings forming a separate sampling stage. Thus the resulting sample has only two effective stages: selection of master sample areas, followed by the selection of dwellings within each area selected.

Another apparent complexity concerns the fact that the next step may also appear to be an additional sampling stage, so that the sample may be described as having three stages but actually it still involves only two effective stages. The sample from each PSU as defined above is divided into six 'clusters' of 50 dwelling units, each participating in the survey six times before being replaced by the next cluster. Only one such cluster is included in the sample from an area at any given time, so that no additional effective sampling stage is involved.

Another situation in which a 'descriptive' sampling stage may not be an 'effective' stage occurs when in a part of the population all units are taken into the sample (i.e. no sample selection is actually involved). Typically this takes the form of the largest primary sampling units being taken into the sample with certainty. Such units are called 'self-representing'. Each such unit is actually like a stratum in which sampling only begins at the next stage.

Two examples, among others, are provided by the labour force surveys of Hungary and the Netherlands.

For Hungary (Eurostat 2007b),

"total number of strata is 275, of which 171 are self-representing localities (localities which have at least 3,975 dwellings, i.e. approximately 5,000 inhabitants). The remaining 103 strata contain 513 non-self-representing sampled localities. The former are all included in the sample with certainty, while a stratified sub-sample is selected from the latter with probability proportional to size (PPS). ... In the case of non-self-representing localities, the primary sampling units (PSUs) are localities, and the secondary (and ultimate) sampling units are dwellings. By contrast, the PSUs are dwellings in the case of self-representing localities, thus sampling has actually only one stage in this case. The final sampling units are dwellings in each case. They are selected with systematic random sampling from lists of addresses belonging to the sampled localities. ... All households residing in the selected dwelling units are surveyed. In the different strata of the LFS sample different sampling rates are used."

For the Netherlands (Eurostat 2007b),

"the sampling plan is a three stage stratified probability sample of addresses: (a) primary sampling units: the municipalities; (b) secondary sampling units: mailing addresses; (c) tertiary sampling units: households. Municipalities are selected with a probability proportional to their population. All municipalities with a population of more than 18,000 persons (of which there are about 200), are permanently represented in the survey. Mailing addresses are selected systematically out of a mailing list sorted by postal code. At addresses with more than one letterbox, all letterboxes appear in the list. If a selected mailing address includes only one household, this household is questioned. If the address includes more than one household, only half of the households are questioned, with a maximum of three households."

Thus in the larger, self-representing municipalities, the sample in Netherlands involves only one stage (effectively a direct sampling of households), or two stages in cases where a sample address contains more than one household (the selection of addresses being the first stage, followed by sub-sampling of households at the selected address as the second stage). In parts of the population involving the selection of a sample of municipalities, the sample has two or three sampling stages corresponding to the two situations above. In both situations, letterboxes do not form an *effective* sampling stage since all of those found at a selected address are taken into the sample.

3.2 Ultimate sampling units

Persons

Ultimate sampling units (USUs) refer to the lowest level units subject to the sampling process. In a survey, information may be collected and analysed for the USUs themselves; or it may be collected for other types of units associated with the selected USUs, such as individual persons within sample households.

The last column in Table 1 show the USUs used in the EU labour force surveys. See also Table 2, with countries sorted by number of stages and type of sampling units, for the pattern of variation among the surveys.

In EU labour force surveys, the main units of analysis are individual persons in the working ages, though some information may be also analysed at the household level. The simplest sample structure involves direct selection of such individuals in a single stage. This requires up-to-date lists of individuals, and the procedure is therefore used in countries with up-to-date population registers, namely Denmark, Sweden, Finland and Iceland⁶.

The actual design may be a little more complicated, for example involving more than one type of units to be included, as illustrated in the following description from Denmark:

“Persons aged 16-66 years that were registered as unemployed in a specific quarter prior to the survey quarter are selected with a higher probability than their relative proportion of the total population. Thus, Stratum 1 is drawn from the Unemployment Register, whereas other 15-66 year olds (Stratum 2) are drawn from the Population Register. Additional individuals aged 67-74 years are drawn the Population Register (Stratum 3)”.

Similar example of the use of different frames for different categories of units is provided by Finland.

“The sampling unit in the LFS is the individual. ... The selection procedure can be approximated by simple random sampling without replacement (SRSWOR). Because the continuous survey sample frame only includes persons aged 15 to 74 years, a separate sample of dwelling units was drawn to correct the frame for elderly persons. A technical sample of persons aged 75 or more was added to the file of the fifth wave after data collection.” (Eurostat 2007b).

Households, dwellings/addresses

A number of surveys use households or addresses/dwelling units as the sampling units in a single-stage design. With household as the USU, all person eligible for the LFS interviewed in the household are included (e.g. Luxembourg, Malta). With addresses/dwelling unit as the USU, normally all households at that dwelling/address and all eligible persons in those households are

⁶ Norway, as an exception among these countries, uses a sample of family units. All individuals in a selected family unit are included in the survey. Each family member aged 16-74 participates in the survey, answering questions about their situation during a specified reference week. Inhabitants in all municipalities are randomly selected, on the basis of a register of family units.

included in the sample. At an address/dwelling containing several households, only a subsample of the households may be included in the survey. Normally such a situation arises only in a small minority of the units.

When all individuals at an ultimate sampling unit are taken into the sample, the probability of selection of the ultimate sampling unit is automatically applied to each individual in it. This is a commonly used design; here is an example as described for Austria (Eurostat, 2007).

“The survey base is the Central Population Register. The sampling design is a stratified single random sample from the sampling frame. The sampling unit is the dwelling with at least one person with main residence. All the people in the selected dwellings are surveyed.”

It is worth commenting on how a sample with households as the ultimate units is usually interpreted in practice. Consider that a sample of households has been selected. The common procedure in labour force surveys of dealing with a household which between the time of its selection into the sample and its enumeration, has moved to another location, is to take into the survey the new household (if any) which now lives at the address where the original household was selected. Hence the sample may be more appropriately described as a sample of ‘occupied addresses’ where the selected households lived at the time of selection, rather than as a sample of the specific households through the selection of which the ‘occupied addresses’ came into the sample.

As is discussed more fully in another Working Paper (Verma, Gagliardi and Ciampalini, 2009), the same concept is normally applied in relation to overlaps in the sample over time in a rotational design. The sample overlap in the sample from one survey round to another is in terms of occupied addresses, rather than in terms of following up the particular households which originally lived at those addresses.

Clusters of dwelling units

In a few countries, single stage samples of small area units or clusters of dwellings have been used. Here again, the probability of selection of an household or individual is the same as that of the cluster to which the individual belongs.

This for instance is the case in Ireland and France – except that in France, subsampling may be applied in areas with too many new dwelling units (see descriptions given earlier).

In Turkey, small villages are treated in the same way.

The design is similar, but bit more involved, in Germany:

“Sampling units are the sampling districts comprising of 9 dwellings on the average.

Statistical units are the households in the sampling districts. All buildings are attributed to one of three strata, depending on the number of dwellings they comprise.

The first stratum contains a number of buildings which are close to one another (but not necessarily contiguous) and comprising fewer than five dwellings (each). In this stratum, each sampling district comprises about 12 dwellings. The second stratum comprises buildings with between five and 10 dwellings. Each of these buildings constitutes a sampling district. The buildings in the third stratum comprise 11 dwellings or more. In this stratum, the ‘sampling district’ is a subdivision of the building, the target size being 6 dwellings. An additional stratum covers the population living in collective households. It is divided into sampling units with a target size of 15 persons. All persons in a selected sampling district are interviewed.”

In some designs, subsampling of units at the last stage, within larger units themselves selected with uniform probabilities, can make the selection probabilities of the ultimate units non-uniform. Generally this makes the resulting sample statistically less efficient, and therefore is not a desirable feature of the design. Nevertheless, it is found to occur in practice.

For example, the sample for the Czech LFS consists of two parts. The main or ‘standard’ part consists of a sample of phone numbers, followed by the selection of one person per selected phone number. This makes the selection probability of individuals inversely proportional to the number of eligible persons who share their phone number. This means that if the phone numbers were selected with uniform probabilities, the selection probabilities of associated persons become non-uniform. By contrast, the extra or ‘special’ sample for foreigners selected in the Czech survey involves the direct selection of individuals from the register of foreign persons. For this part the selection probability for individuals can be expected to be more uniform.

Another example is from Estonia, where “until 2005 the sampling design was a stratified systematic two-phase sampling of individuals, whose households were included in the sample in the second phase with probability inverse to the number of persons age 15-74 in the household. Since 1st quarter of 2005 the design was changed to a stratified systematic one-phase sampling of individuals. In the new sampling design gradually implemented from 2005, the individuals are systematically sampled within each stratum and their households included in the sample.” (Eurostat 2007b). In the earlier design, the two steps in the final selection of households compensated each other so as to retain the uniform selection probabilities for households: first a household appeared in the sample with probability proportional to the number of eligible individuals in it, and then it was retained in the sample with probability inversely proportional to that number. By contrast, in the new design, a household appears in the sample with final probability proportional to the number of eligible individuals in it. The same non-uniform probability is transmitted to individuals in the selected household when all of them are taken into the sample. Incidentally, this non-uniform selection probability applies also to the person who was originally selected to bring his or her *household* into the sample.

The same as the above for the new sample for Estonia applies to the sample for Lithuania except for dwelling rather than household being the ultimate units. The sampling plan is a one-stage simple random sample of 4,000 individuals aged 15 years and over, using the Population Register as a sampling frame. All the persons living at the address of the selected person belong to the same ‘cluster’, and are taken into the sample, including persons who may not be listed in the sampling frame of persons. “The actual composition of the cluster is indicated by the interviewer when visiting the household.” (Eurostat 2007b, 2008).

To summarise, the ultimate sampling units used can be of different types; persons, households, addresses or dwelling units, area units or clusters of dwellings, or some other type of units such as families or telephone numbers. All these cases are found in EU labour force surveys using single stage samples. In cases with multi-stage designs, the final sampling units encountered are mostly single households or dwellings. Small clusters of these units are sometimes used; there are no examples at present of direct samples of individual persons as the ultimate units when multi-stage designs are involved.

As an example involving small clusters as the ultimate units: in Romania LFS 2006, “the sampling plan is a two-stage probability sampling of clusters of housing units. The primary sampling unit, corresponding to the selection of the master sample, is a group of census sections. The secondary (ultimate) sampling unit, corresponding to the selection of the survey sample, has been the cluster of 3 dwelling units. In the first stage a stratified random sample of 780 areas, and in the second stage 9,360 clusters, composed of three housing units each, are systematically selected from the initial sample of PSUs. [Hence] the final sample consists of 28,080 dwelling units each quarter. All households within each sampling unit are included.” (Eurostat 2008).

3.3 Primary sampling units (PSUs)

Type of units

In surveys involving multi-stage sampling, the PSU are normally area-based sampling units. These may be administrative units such as localities or municipalities, census enumeration areas or blocks, segments or other types of areas. In some countries (e.g. Portugal, Romania) the LFS uses all or a subsample of area units comprising a “master sample” which is designed for use for different household surveys. See Table 1.

Most commonly, area units are selected with probability proportional to measure of their population size (PPS sampling). Generally, the final units (dwellings, household etc.) within each selected area are selected with inverse of the above-mentioned probability, thus making the overall probability independent of the area’s size measure. When the size measures used in the previous stage are reasonably accurate, approximately the same result is obtained by fixing the number of ultimate units selected to be the same in all areas selected with PPS, irrespective of the area size measures.

When the areas are reasonably uniform in size, or when information on population size is lacking, an equal probability sample of area units has been taken. Thus for example in Turkey, blocks of addresses in urban areas and large villages are selected as PSUs with equal probability, while in the medium village stratum the localities are selected with PPS.

In designs involving only a single stage in which there is no subsampling within selected areas or clusters, it is common to select the areas with equal probability, so as to obtain an equal probability sample also for ultimate units (dwelling, household, persons). This is because when all the ultimate units which come from the selected area are taken into the sample, uniform selection probabilities for households are obtained by selecting the areas with uniform probabilities. Examples are provided the LFS samples of France, Germany and Ireland.

Sample size per cluster

In multi-stage designs, an important consideration is the choice of the number (a) of PSUs to take into the sample and, given a total sample size (n), the resulting average number (b=n/a) of survey respondents per PSU.

A major determinant of the effect of clustering on efficiency of the sample, measured by the so-called design effect, is the sample-take (b) per cluster.⁷

Table 3 shows the wide range of variation in the sample-takes per cluster encountered in EU labour force surveys. For instance, in Italy over 100 and in Romania nearly 70 individual interviews are taken per cluster, while in the Netherlands only a very small number (1-6) are taken per cluster. Of course, what constitutes a ‘cluster’ can be very different in different countries.

It is a regrettable fact that for a number of countries, no information has been reported in published, documents, the internet or other generally accessible sources on this important feature of the sample designs used for national labour force surveys.

⁷ The other main determinants are the size and nature of the units used as PSUs, the procedure used for subsampling within the clusters, and homogeneity of the variable within clusters.

Table 3. Number of sample PSUs and achieved sample size per PSU

	Country	Number of sampling stages	no. of clusters (PSUs) selected	Households per cluster	Persons per cluster	Sample size (Persons)
AT	Austria	1	n.a. (direct sample of addresses/dwellings)			38,400
BE	Belgium	2	480	23	45	21,700
BG	Bulgaria	2	2,250	6	12	27,800
CY	Cyprus	2	?	?	?	7,300
CZ	Czech Republic	2	5,650	5	9	49,000
DK	Denmark	1	n.a. (direct sample of persons)			10,600
EE	Estonia	1	n.a. (direct sample of households)			3,600
FI	Finland	1	n.a. (direct sample of persons)			35,900
FR	France	1	2,700	14	23	62,200
DE	Germany	1	13,000	6	10	129,200
GR	Greece	2	?	?	?	60,400
HU	Hungary					61,200
	self-representing	1	171			
	other localities	2	513			
IE	Ireland	1	2,600	12	25	65,900
IT	Italy	2	1,246	55	107	133,800
LV	Latvia	2	?	?	?	4,400
LT	Lithuania	1	n.a. (direct sample of addresses)			9,400
LU	Luxembourg	1	n.a. (direct sample of households)			4,300
MT	Malta	1	n.a. (direct sample of households)			4,200
NL	Netherland					88,900
	self-representing	1 or 2	200	1-3	1-6	
	other localities	2 or 3	?	?	?	
PL	Poland	2	?	?	?	43,400
PT	Portugal	2	1,408	12	26	36,500
RO	Romania	2	780	34	69	53,900
SK	Slovakia	2	2,050	5	11	22,700
SI	Slovenia	1	n.a. (direct sample of addresses)			14,600
ES	Spain	2	3,588	15	33	117,500
SE	Sweden	1	n.a. (direct sample of persons)			41,200
UK	United Kingdom	1	n.a. (direct sample of postal addresses)			89,200
IS	Iceland	1	n.a. (direct sample of persons)			3,100
NO	Norway	1	n.a. (direct sample of families)			21,300
CH	Switzerland	1	n.a. (direct sample of persons)			46,500
HR	Croatia	2	360	9	20	7,200
TR	Turkey	1 or 2	?	?	?	82,000

n.a. not applicable

4 Stratification

4.1 Principles

The purpose of stratification

Stratification means dividing the units in the population into groups and then selecting a sample independently within each group. This permits separate control over design and selection of the sample within each stratum. This means that segments of the population (strata) can be sampled differently, using different sampling rates and designs if required. Although not essential to the idea of stratification, the separation may also be retained at the stage of sample implementation, estimation and analysis. It is common, for instance, to pool the results from different strata to produce estimates for the whole population, or for major parts or "domains" of the population, each of which is composed of a number of strata.

In this section, we begin by noting some common purposes and practices of stratification (for further discussion, see Verma 2008).

The advantages of stratification result from the control it allows over sample design and selection within each stratum:

- Firstly, in so far as the strata represent relatively homogeneous groupings of units, the resulting sample is made more efficient by ensuring that units from each grouping are appropriately represented in a controlled way.
- When data of specified precision are required separately for sub-divisions of the population, it is desirable to treat each subdivision as a "population" in its own right, and to select a sample of the required size and design from each independently. Stratification makes this possible. A sample clearly controlled and distributed proportionately (or in accordance with some other specified criterion) across different parts of the population has the public-relations advantage of appearing more "representative" and hence more acceptable to the users. In any case, control through stratification reduces the danger of getting a poorly distributed sample by chance.
- Sampling requirements and problems - as concerning sample size, design, availability of frame for sample selection, travel conditions, costs etc. - may differ markedly between different parts of the population. Stratification permits flexibility in the choice of the design separately within each part.

Stratification in practice

In practical sampling, normally a lot of care and effort is warranted in stratifying the list or frame before sample selection. This is for the following reasons.

- Stratification often reduces sampling variance at little additional cost. Furthermore, the costs tend to be lower and the advantages larger in the stratification of higher stage units in a multi-stage design, compared the advantages of stratification of lower stage units or in an element sample (Kish, 1965; also see below). It is often desirable to pursue stratification to the limit, where only one or two PSUs are selected per stratum. Indeed, special techniques known as "controlled selection" can be employed to create even more strata than the number of units to be selected, linking the selections in different strata so as to achieve the required distribution of the sample.
- Insofar as the samples are selected independently, and where they are of sufficient size, the results from the individual strata can be analysed and presented separately. More commonly,

the results are aggregated over several strata to produce estimates for major domains of the population. Efficiency is improved by defining strata to lie within (i.e. not cut across) the reporting domains.

- A major use of stratification is to provide flexibility in the choice of sample allocation, design, and procedures in different parts of the population. Strata can provide natural partitions for organising, controlling and phasing the survey work. Generally, stratification in no way complicates field operation at the data collection stage. Instead, any added complexity is confined to the operation of sample selection, which is usually more centralised and hence more easily controlled.
- Geographical-administrative location is among the most convenient, common and useful criteria for stratification for all types of units.
- Systematic sampling from ordered lists is a cheap and efficient means of achieving the effect of stratification. In addition, this procedure tends to be much simpler to implement than selection with the use of random numbers.

Stratification in multi-stage sampling

Stratification is generally useful in any type of sampling design, including single-stage sampling of addresses, households or persons. Nevertheless, the argument for careful and elaborate stratification becomes much stronger when we consider multi-stage designs:

- The essential point is that the gain in precision due to stratification is usually much more important in multi-stage sampling than it is in element sampling.
- Usually, much more information is available for the stratification of large units, such as for census enumeration areas or localities serving as PSUs and other higher-stage units in a multi-stage design.
- It is easier to stratify the larger, higher-stage units, because such units tend to be much fewer in number compared to the number of elements in the population.
- Insofar as the number of higher-stage units selected is small, it can become critical to ensure that distribution of the sample is controlled. This is achieved by sampling separately within strata.
- In multi-stage sampling, it is more necessary, and also more feasible, to vary the sampling procedure in different parts of the population.

4.2 Stratification criteria used in the EU labour force surveys

Table 4. Main stratification variables: EU-LFS 2006

	NUTS regions	Other
Austria	"Bundesland" NUTS2	
Belgium	Region NUTS2	
Bulgaria	Region NUTS3	urban/rural
Cyprus	"Eparchies" (District) NUTS4	urban/rural areas within each district
Czech Republic		Register of Census Areas
Denmark		Population and Unemployment Register age groups 15-66, 67-74; all unemployed
Estonia	Region (Counties) NUTS4	
Finland	Region NUTS1	
France	Region NUTS2	type of urban unit (21 regions x 9 types of urban unit geographical delimited areas)
Germany	Administrative districts NUTS3	
Greece	Region NUTS3	degree of urbanisation
Hungary	Administrative units NUTS3	size categories of localities
Ireland	County NUTS4	towns, mixed urban-rural, rural areas
Italy	Region NUTS2	size categories of municipalities within region
Latvia		7 largest towns; degree of urbanisation
Lithuania		Population Register
Luxembourg		Cantons; number of house classes
Malta		Household Register - Water services corporation database
Netherlands	Region NUTS3	employment exchange regions
Poland	Region NUTS2	urban/rural division of voivodships (provinces), as well as division within voivodships depending on the size of the place, with rural areas included in the smallest ones
Portugal	Region NUTS3	
Romania	Region NUTS3	urban/rural
Slovakia	Districts NUTS4	
Slovenia	Region NUTS3	type of settlement (size and proportion of farmers)
Spain	Province NUTS3	population size of municipality
Sweden	County NUTS3	Register (sex, age)
United Kingdom		geographical location
Iceland		
Norway	County NUTS3	
Switzerland	Region NUTS3	Standard sample: population size group Foreign persons: above by nationality group
Croatia	Counties NUTS3	City of Zagreb and 20 counties
Turkey	Region NUTS2	urban/rural (5 strata by locality size)

In European labour force surveys using multi-stage sampling, the most common type of stratification used for the selection of PSUs is geographic: most commonly stratification according to NUTS regions, followed by stratification by the type of place (urban-rural, or several categories by the degree of urbanisation, or size of locality), or by other types of administrative divisions. Demographic characteristics (age, sex) may be used in surveys employing direct sampling of persons.

For instance, the Belgian sample areas are stratified by district (28 administrative districts at NUTS-3 level), cross-classified by urban/rural.

In Ireland, a two-stage sample design is used. This comprises a first stage sample of blocks (or small areas) selected at county (NUTS4) level to proportionately represent eight strata reflecting population density. The strata are:

- 1 County Boroughs
- 2 Suburbs of County Boroughs
- 3 Environs of County Boroughs
- 4 Towns 10 000 +
- 5 Towns 5 001 - 10 000
- 6 Towns 1 000 - 5 000
- 7 Mixed Urban/Rural Areas
- 8 Rural Areas

Similarly in Poland, the sample is drawn in two stages. “The sampling frame for both stages of the sample is based on the Domestic Territorial Division Register. The primary sampling units are stratified by urban/rural division of “voivodships” (provinces), as well as division within voivodships depending on the size of the place, with rural areas included in the smallest ones.”

As another example, in Luxembourg a sample of households is selected directly, with stratification described as follows.

“The Central Population Register (RGPP) is used to draw the sample. The strata result from the crossing of the canton and the household size class. There are 13 cantons in Luxembourg. The household size is divided into 4 classes: 1, 2, 3, and 4+. So, the product of the number of cantons (13) and the number of size classes (4) gives 52 strata.”

Where direct samples of households or persons are used, characteristics of these unit (household size, person’s age and gender, socio-economic characteristics of the units, etc.) form useful stratification variables.

Within sample areas, households may also be stratified according to size, socio-economic status, employment of the head, etc., to the extent such information is available. The available survey reports on EU labour force surveys do not contain sufficient information on this aspect of the sample design.

Systematic sampling from lists of units ordered in some meaningful way (often by geographic-administrative order) is often used to obtain implicit stratification.

Here is an example from the German micro-census from which the labour force survey is drawn as a subsample.

“The sampling districts [clusters of dwellings or similar units used as PSU’s] are stratified by region and size of the buildings. The stratification by size of the buildings is based on the size classes used to work out the sampling units. ... Within each stratum, an effect similar to stratification is obtained by systematic sampling in a list classified by geographical entity. The regions comprise an average of 350,000 inhabitants. The list of sampling districts is sorted within each stratum by sub-region, Kreis (administrative district), the size class of the

commune, commune and number of the sample district. This list is divided into groups of 100 consecutive sampling districts. A sample of 1% is drawn at random for the micro-census in each of these groups and allocated to each month of the year. The average quarterly sample in 2005 comprises about 165,000. respondents.” (Eurostat 2007b).

Similarly, for the LFS in Hungary, the following description has been provided.

“From 2003 the LFS sample is a multi-stage stratified sample of dwellings based on the 2001 Population and Housing Census. The LFS sample is stratified by administrative units (i.e. the capital city and 19 counties) and by size categories of the localities. In the case of non-self-representative localities, design strata are defined as cross-classes of four size categories and 19 administrative units (counties). Prior to selection, the lists are properly sorted for the purpose of implicit stratification. As a result, the different parts of the localities (downtown areas, suburbs, etc.) will be properly represented.”

Denmark and Sweden, involving direct sampling of persons, provide examples of stratification by age and sex. The use of different sampling frames for different parts of the population automatically provides stratification by those parts, as for example in the case of Denmark where the unemployment register provides a separate sample to that from the general population register.

5 Data collection

5.1 Various modes of data collection

Four types of data collection methods are commonly used in labour force surveys in EU countries. The first two involve face-to-face interviewing (normally at the respondent’s home), and the other involve interview by telephone.

Face-to-face interview

(1) Paper and pencil interview (PAPI). This refers to the conventional face-to-face interview using printed questionnaires, where the questions are personally administered by the interviewer.

(2) Computer assisted personal interview (CAPI). This mode uses questionnaires which have been programmed into a laptop or handheld computer. The next relevant question for the particular respondent being interviewed is automatically displayed on the screen depending on the responses given previously during the interview. The computer programs normally also check internal consistency and completeness of the responses as they are recorded during the interview.

Interview by telephone

(3) Ordinary telephone interview (“TELI”). This is conducted by the interviewer personally just like the conventional face-to-face interview, but from a distance using the telephone. The respondents participate in a survey either via a fixed-line telephone or through mobile phone. Sampling problems in telephone surveys are being increased by the rising number of people abandoning fixed-line telephones in favour of mobile phones.

Telephone surveys of nationally representative samples can also be carried out using Random Digit Dialling (RDD). In large-scale official surveys such as the LFS, however, samples are generally pre-selected using more conventional methods.

(4) Computer assisted telephone interview (CATI). This involves interview by telephone as above, but using computer assistance like in CAPI. The interview may be automated to various degrees depending on the technology used.

Other modes

In principle, various other modes of data collection are possible such as the following.

(5) Compiling information from registers and other administrative sources. This mode is used - mostly in Scandinavian countries where well-developed registers exist - for supplementing the information collected through the LFS interview.

(6) Mail survey. This mode can be a very economical way of collecting information, but generally suffers from high rates of non-response, and from poor and delayed responses even when they are obtained. It is hardly ever used for regular labour force surveys, except marginally for collecting limited information, such as for a part of the sample for the second interview in Belgian LFS (this interview is of limited content compared to the first, the main, interview). In Denmark, where the primary mode of data collection (accounting for over 90% of the interviews) is by telephone, persons who cannot be reached by telephone receive a mailed questionnaire.

(7) Self-administered questionnaires (SAQs). This mode is used in some social surveys, but its use has not been reported in any of the EU labour force surveys. When used in official surveys requiring representative samples, it takes the form of the interviewer personally visiting the respondent to request participation in the survey, explain the survey objectives and procedures, and leave with the respondent the questionnaire to be completed. The completed questionnaire may be personally collected by the interviewer or posted back by the respondent. The self-administered mode may be applied in different forms. For instance, it may be a part of a mail survey, or even involve a questionnaire hosted on the Internet (sometimes referred to as web-based computer-assisted self-interviewing or web-CASI).

(8) Data collection using new technologies. Advances in information and communication technology have expanded the range of options, such as computer-assisted self-interviewing (CASI); audio-CASI (or A-CASI) in which the questions are pre-recorded and played back to respondents who enter their data into the computer; touchtone data entry (TDE), a form of telephone interviewing, in which respondents enter their answers using the keys on their handset; web-cam interviewing using “Voice over Internet Protocol” (VOIP); and so on.

New possibilities are being provided by web surveys. While the development of the internet as a tool for data collection has revolutionised the speed with which survey “fieldwork” can be carried out, there are significant costs of programming, software development and support in web surveys. Above all is the problem of obtaining a representative sample in such surveys. At present, the use of web surveys using random samples tends to be restricted to special populations, such as students or employees of particular organisations having access to and interest in using the internet - though some reasonably representative Internet Panels have been successfully established, and this mode is likely to become an increasingly popular method of collecting survey data in the future. Its use in official labour force surveys is, however, likely to remain very limited.

Choosing one data collection mode over another involves an assessment of the strengths and weaknesses of each mode with respect to a range of different factors. Data collection modes vary along a number of dimensions making them more or less suitable to the needs of particular surveys. Modes vary in the extent to which they provide access to different survey populations. The choice of mode is guided also by the extent to which each involves different administrative and resource costs.

The various data collection methods vary in the extent to which they are suited to the administration of questionnaires of different types, lengths and complexity. The various modes can be ranked in terms of their relative costs, starting with face-to-face interviewing as the most expensive option. Telephone interviews generally offer a cheaper solution, especially as call costs have decreased over time. Long questionnaires have generally been avoided in telephone interview surveys, with some survey organisations restricting interview length in order to minimise the burden on

respondents and avoid high refusal rates. However, the empirical evidence to support the negative impact of interview length on cooperation in telephone surveys is mixed.

The negative impact of the length of interview is more obvious in other modes such as self-administered and web surveys.

Computer-assisted interview can facilitate the handling of diversity of respondent characteristics and circumstances, complex question sequences and consistency requirements. This mode of interviewing has enabled survey questionnaires and questions to become considerably more complex than they were in the past.

Self-administered questionnaires can be efficient and - if properly implemented – can even yield good quality data, but they cannot be used in many circumstances; also, many countries lack a tradition in their use, especially for official surveys such as the LFS.

Perhaps by tradition, the use of self-administered questionnaires seems to be more common in some countries than in others – for example in Germany in comparison with that in United Kingdom.

5.2 Modes of data collection in EU labour force surveys

Table 5 summarises the mode of data collection used in the EU labour force survey. Several patterns may be identified.

(1) In a large number of countries, the primary mode is face-to-face (as distinct from telephone) interview for all waves of the LFS. This could be PAPI or CAPI. These include nearly a third of all countries: Bulgaria, Estonia, Greece, Ireland, Latvia, Malta, Portugal, Romania, Croatia and Turkey.

(2) In a number of countries in the North, in particular Scandinavia, the primary mode is telephone (as distinct from face-to-face) interview for all waves of the LFS. These include: Denmark, Finland, Luxembourg, Sweden, Iceland, Norway and Switzerland.

Most of the other surveys use a mixture of data collection modes.

(3) A common arrangement is to use face-to-face interview (whether PAPI or CAPI) for the first contact with the respondent, and conduct the interview by telephone on subsequent occasions where possible. Below are a number of examples, taken from the methodological descriptions published by Eurostat.

In Austria, data are collected with face-to-face interviews using paper and pencil in the first wave (PAPI) and mostly computer assisted telephone interviewing (CATI) in the second to fifth wave. The relative magnitude (burden) of the two modes is indicated by the fact that for the 2005 LFS, the field staff comprises 140 PAPI and 80 CATI interviewers.

Similarly in Cyprus, Hungary, Slovakia, the Netherlands and Spain, the first interview is face-to-face, while the subsequent interviews can be carried out by telephone. The relative importance of the two modes in the Netherlands is indicated by the fact that for the 2005 LFS, the field staff comprised 220 PAPI and 95 CATI interviewers. In Slovenia the corresponding figures are 30 field workers for face-to-face interviewing and 10 for telephone interviewing. In this survey, all repeated interviews are carried out by telephone if the household has a telephone; repeated interviews in the households without telephone are done face-to-face. In Spain as well, the first interviews are face-to-face, and interviews in the second and subsequent waves are carried out by telephone, except when the family wants a face-to-face interview or there is no telephone.

(4) In many countries, interviewing for second and subsequent waves in special circumstances is still conducted face-to-face, rather than by telephone, in a vast proportion of the cases.

For instance, in Czech Republic, data are collected in first visits with face-to-face interviews, while repeated interviews are made by telephone for a part of the sample (amounting to only 20-25% of

the total interviews). By contrast, in the 2nd quarter, when ad hoc module is surveyed, almost all interviews are face-to-face. In France, the collection method is a face-to-face interview for the first and the last (6th) interrogations, and a telephone interview for the intermediate (2nd to 5th) interrogations. In Lithuania, it is stated that the first interview must be carried out face-to-face, while the subsequent interviews could be conducted according to the situation – by telephone or face-to-face; in Poland repeated interviews are “sometimes” carried out by telephone according to published methodological reports. In Italy, personal interviews concern not only the 1st wave interviews, but also all interviews made in particular periods such as summer or Christmas holidays, and 2nd, 3rd and 4th waves interviews to households with no telephone. Telephone interviews are conducted in all other cases. The relative magnitude (burden) of the two modes in Italian LFS is indicated by the fact that for the 2005 survey, the field staff comprises 310 PAPI and only 35 CATI interviewers.

(5) By contrast, in the UK, a few of even the first interview are conducted by telephone, though the general mode is face-to-face for the first interview. This applies to the far north of Scotland (north of the Caledonian Canal). Similarly, in Belgium, the detailed information (related to individuals aged 15 years and over) is collected by means of face-to-face interviews, but in households of retired persons interviews can be conducted by telephone.

(6) The use of mail survey method is very uncommon. It is only mentioned in the LFS surveys of Belgium (for some of the second interviews, which are limited in content in any case), Denmark (for persons not contacted by telephone), and Germany (where for 15% the cases, questionnaires are sent by post and a hotline is offered).

(7) Apart from their use in mail surveys such as Germany, self-enumerated questionnaires do not seem to be used in EU labour force surveys.

(8) In countries with well-developed registers, part of the information is completed from administrative sources, without involving an interview. This practice is reported in Denmark, Finland, Sweden, Norway and Iceland.

Another feature of the surveys noted in Table 5 is whether the survey is compulsory or voluntary. This is a formal distinction and is commented on in the next section below.

Table 5. Mode of data collection

Country	Mode of collection	PAPI	CAPI	Tel	CATI	MAIL	Admin. sources	Participation
Austria	1° wave: face-to-face interview (PAPI) Subsequent waves: by telephone (CATI)							Compulsory
Belgium	1° Interview: face-to-face (with retired persons, interview by telephone accepted) 2° Interview: by mail or by telephone (3 months later, only on ILO labour situation)							Compulsory
Bulgaria	Face-to-face interview (PAPI)							Voluntary
Cyprus	1° wave: CAPI 2° to 6° wave: CATI							Compulsory
Czech Republic	Face-to-face interview (CAPI) (23% of repeated interviews by telephone CATI)							Voluntary
Denmark	Mix of modes. Main part of interviews (92% in 2005) by telephone (CATI) Persons not reached by telephone receive mailed questionnaire Demographic information and level of education from administrative sources							Voluntary
Estonia	Face-to-face interview First 3 quarters PAPI (90%), CAPI (10%); from 4th quarter mostly by CAPI							Voluntary
Finland	By telephone (CATI) Demographic information and level of education from administrative sources							Voluntary
France	1° and last interview: face-to-face 2° to 5° interviews: by telephone							Compulsory
Germany	Face-to-face interviews (CAPI) For 15% cases questionnaire sent by post and a hotline offered							Compulsory. Some items voluntary
Greece	Face-to-face interview (PAPI)							Compulsory
Hungary	1° interview: Face-to-face interview (PAPI) The subsequent interviews could be carried out by telephone.							Voluntary
Ireland	Face-to-face interviews (CAPI)							Voluntary
Italy	Information collected through CAPI or CATI							Compulsory
Latvia	Face-to-face interviews (PAPI)							Voluntary
Lithuania	1° Interview: Face-to-face The subsequent interviews: by telephone or face-to-face							Voluntary
Luxembourg	All by telephone							Voluntary

Table 5 (cont.). Mode of data collection

Country	Mode of collection	PAPI	CAPI	Tel	CATI	MAIL	Admin. sources	Participation
Malta	Face-to-face or telephone interviews							Compulsory
Netherland	1° wave: face-to-face interview (CAPI) Subsequent four waves: by telephone (CATI)							Voluntary
Poland	1° wave: face-to-face interview (PAPI) Subsequent interviews are sometimes carried out by telephone							Voluntary
Portugal	Face-to-face interview (CAPI)							Compulsory
Romania	Face-to-face interview (PAPI)							Voluntary
Slovakia	1° interview: face-to-face (PAPI) Subsequent interviews: by telephone.							Compulsory
Slovenia	1° interview: face-to-face (CAPI) or by telephone Subsequent interviews: by telephone if available, otherwise face-to-face.							Voluntary
Spain	1° Interview: face-to-face interview (CAPI) 2° and subsequent interviews: by telephone (CATI)							Compulsory
Sweden	By telephone (CATI) Demographic information and level of education from administrative sources							Voluntary
United Kingdom	1° Interview: CAPI 2° to 5° Interviews (and all in north of Scotland): CATI							Voluntary
Iceland	By telephone (CATI) Demographic information from administrative sources							Voluntary
Norway	By telephone (CATI) Demographic information from administrative sources							Compulsory
Switzerland	Telephone interview (CATI)							Voluntary
Croatia	Face-to-face interview (PAPI)							Voluntary
Turkey	Face-to-face interview (CAPI)							Compulsory

Notes: see next page

Notes to Table 5.

PAPI: Conventional face-to-face ('paper and pencil') interview.

CAPI: Computer assisted personal interview (face-to-face).

TELL.: Interview by phone.

CATI: Computer assisted telephone interview.

MAIL: Questionnaire sent by mail.

The information in Table 5 has been compiled from various Eurostat methodological and working papers. Main source: Labour force survey in the EU, Candidate and EFTA Countries - Main Characteristics of the national surveys 2005.

5.3 Response rates

Response rate can be define as the number of eligible sample members for whom a questionnaire is completed, divided by the total number of eligible members selected into the sample. The word *eligible* is an important one in this definition, because all non-eligible persons whether or not they respond to the survey must be excluded from the computation of response rates.

Table 6 show the countries ranked according to the response rate achieved in the national labour force survey. Apart from Luxembourg, which is an outlier with very low (33%) response rate, the response rates for the 2005 LFS vary from 63% in Denmark and 66-67% in the United Kingdom and the Netherlands, to as high as 96-97% in Germany, Romania and Cyprus.

The figures for 2005 are also compared in the table with the response rates in the next (2006) survey. Mostly, of course, the rates for a given country are quite stable from one year to the next. However, there are some significant changes to be noted. It is very likely that these changes are connected with some change in the fieldwork organisation and procedures.

In order to display the pattern more clearly, the countries have been grouped according to the range of the 2005 LFS response rate: <60, 60-79, 80-89 and 90+ per cent. Countries where the response rate moved to a different group between the 2005 and 2006 surveys are shown in bold in the table. The most marked change is in Luxembourg where the reported response rate is doubled from 33% in 2005 to 65% in 2006: the survey is no longer an outlier concerning the response rate. Other noteworthy changes are the improved response rates in the Netherlands from 67% in 2005 to 85% in 2006, a smaller improvement in the United Kingdom from 66% to 71%, but a decline in Switzerland from 82% to 77%.

A majority (around 60%) of the labour force survey are voluntary. The remaining (40%) are compulsory in the sense that individuals selected into the sample are legally obliged to respond under the threat of possible prosecution. In practice, of course, such compulsion is rarely (perhaps never) imposed in social surveys.

But does this distinction between voluntary versus compulsory survey have an influence on the response rate achieved? From Table 6 it appears that there is a correlation between a survey being formally compulsory and achieving a higher response rate. For example, one-half of the compulsory surveys are in the top one-third of the distribution by achieved response rate in the EU surveys. Correspondingly, roughly one-half of the voluntary surveys are in the bottom one-third of this distribution by achieved response rate.

However, it is not necessarily correct to interpret this correlation in terms of a causal relationship. Both the response rate and the decision to make the survey voluntary or compulsory may be influenced by some other common characteristics or circumstances of the country concerned.

Table 6. Response rates: EU-LFS 2005 and 2006

	Participation	Response rate	
		2005	2006
Luxembourg	Voluntary	33	65
Denmark	Voluntary	63	62
United Kingdom	Voluntary	66	71
Netherlands	Voluntary	67	85
Estonia	Voluntary	75	71
Latvia	Voluntary	79	71
Poland	Voluntary	79	77
Belgium	Compulsory	79	78
Czech Republic	Voluntary	80	80
Spain	Compulsory	80	80
France	Compulsory	81	81
Malta	Compulsory	82	80
Switzerland	Voluntary	82	77
Iceland	Voluntary	82	83
Norway	Compulsory	82	87
Sweden	Voluntary	82	82
Finland	Voluntary	83	80
Bulgaria	Voluntary	83	82
Slovenia	Voluntary	84	84
Croatia	Voluntary	84	82
Turkey	Compulsory	85	86
Portugal	Compulsory	87	85
Hungary	Voluntary	88	88
Lithuania	Voluntary	88	87
Austria	Compulsory	89	90
Ireland	Voluntary	90	91
Italy	Compulsory	90	90
Greece	Compulsory	92	90
Slovakia	Compulsory	93	93
Germany	Compulsory*	96	95
Romania	Voluntary	96	95
Cyprus	Compulsory	97	97
MEAN		82	83

*Germany: some items in the survey are voluntary.

Table 7. Proxy interview rates: EU-LFS 2005 and 2006

	Proxy interview rate	
	2005	2006
Switzerland	1	1
Iceland	1	1
Norway	1	15
Sweden	3	3
Denmark	3	2
Finland	7	4
Estonia	15	18
Belgium	23	22
Germany	27	27
Austria	28	20
Romania	28	29
Cyprus	30	31
France	32	32
United Kingdom	34	34
Croatia	38	40
Italy	40	16
Latvia	40	41
Bulgaria	42	43
Poland	42	41
Hungary	43	43
Ireland	43	48
Lithuania	43	45
Greece	44	43
Portugal	46	45
Netherlands	47	47
Malta	48	50
Czech Republic	48	48
Luxembourg	52	52
Spain	53	54
Slovenia	58	58
Slovakia	62	61
Turkey	na	59
MEAN	33	33

5.4 Proxy rates

An interview is considered a proxy when it is not obtained directly from the respondent, but from other persons. There can be different kinds and degrees of proxy; for instance, proxy interview can be obtained by obtaining information from:

- other persons of the same household, themselves included in the survey;
- other persons in the household, but not themselves included in the survey; or
- other people outside the household, such as neighbours or relatives living separately.

Using proxy can be expected to affect the quality of the data obtained.

The effect is also likely to depend on how the proxy respondent providing the information is related to the target person to be interviewed. For instance, a close relation such as a partner or spouse may be more reliable, at least for certain types of information, than someone who is not a member of the target person's household.

The quality of the data obtained through proxy depends above all on the nature of the information sought. Some relatively simple factual or behavioural questions may be answered quite reliably by one person on behalf of another, while questions concerning attitudes and opinions can be answered only by the person concerned.

Experiences shows that most questions in labour force surveys of the type under discussion can be answered by proxy. However, it is not clear to what extent proxy interviewing would affect the quality of the information obtained.

Country practices in allowing proxy responses in their labour force surveys differ widely, as shown in Table 7.

Firstly there is a major difference between surveys using samples of individuals where generally only one person is selected from any household, and the majority of the surveys using samples of complete households with all working-age persons in the household included in the sample. The former case applies to countries with population registers (Switzerland, Iceland, Norway, Sweden, Denmark, Finland). In these surveys a more persistent attempt is made to obtain information directly from the selected individuals, resulting in a very low proxy interview rate.

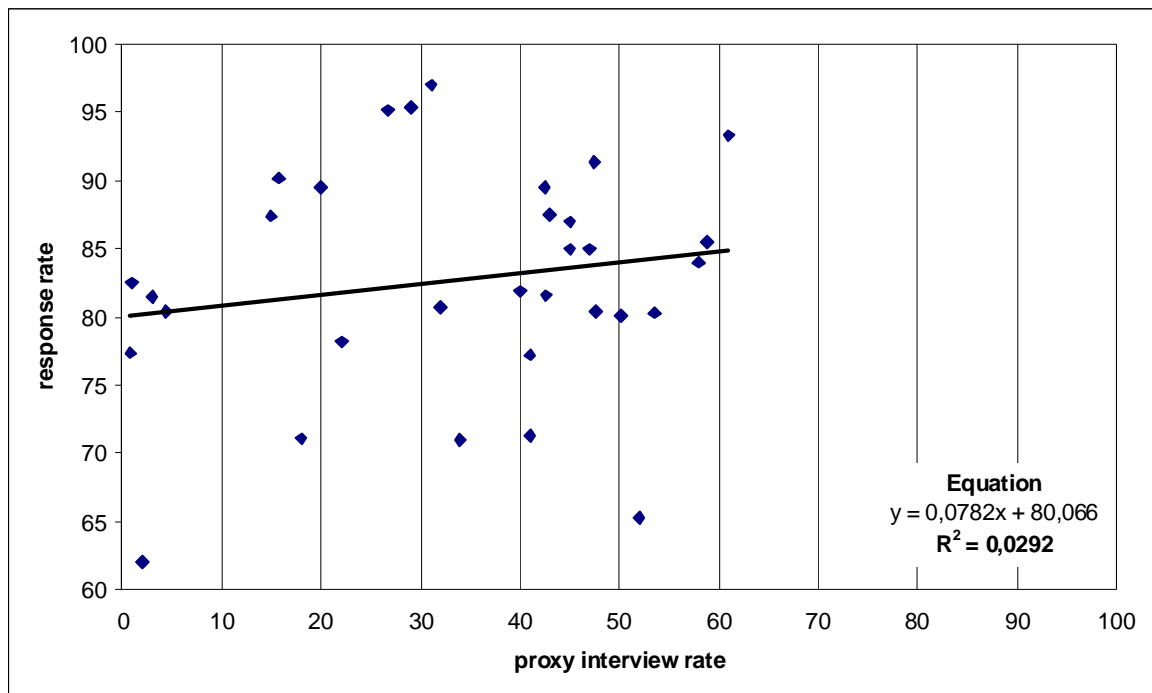
Among the other countries using samples of complete households, proxy rates vary from around 25% in Belgium and Germany to around 60% in Slovenia and Slovakia.

The table also compares the 2005 and 2006 proxy rates. Generally for a given country, there is little change in this survey practice from one year to the next, except in a couple of cases. The proxy rate has been reduced from 28% to 20% in Austria. The most remarkable change, however, is reported from Italian LFS. Proxy rate has been reduced from 40% in 2005 to only 16% in 2006. This is most likely to be the result of some sharp change in the survey procedures.

Proxy interviews are allowed to save time and costs. This can reduce the extra call-backs required to catch respondents who may be temporarily away from the household. It may also be expected that allowing proxy interviewing would help in improving response rates, in so far as information on persons who cannot be contacted can now be provided by other individuals. However, empirically we have not found much correlation between the proxy and response rates in EU labour force surveys, as shown in Figure 1.

There is a great deal of scatter (very low R^2) but nearly zero slope of the regression line. Again it may be the case that high rates of proxy occur in situations where response rates tend to be low for other reason, so that the any positive effect of proxy on response rates cannot be identified on the basis of these data.

Figure 1. Response rate versus proxy interview rate: variation across countries



5.5 Comparability of EU labour force surveys

The EU labour force surveys are highly standardised, above all because they follow the common 'labour force' approach (ILO, 1982; Hussmanns, Mehran and Verma, 1990), and the various framework and technical regulations laid down by the European Commission (Eurostat 2004, 2007, 2007a, 2008, etc.). A number of steps are taken to improve cross-country comparability of these surveys: the use of common definitions and classifications; the recording of the same characteristics in each country; close correspondence between the common list of items and the national questionnaires; synchronisation of survey timing; and central processing of the common data by Eurostat.

Nevertheless, it remains a fact that, while the EU labour force surveys are standardised in terms of the concepts used and the variables generated, they lack the same standardisation in many other aspects affecting comparability: (i) the design of questionnaires; (ii) basic structure such as the pattern of sample rotation over time; (iii) the mode, organisation and other 'essential conditions' of data collection; (iv) the response rates achieved and the methods of dealing with non-response; and more generally, (v) the procedures for weighting and other aspects of the statistical analysis of the results.

The lack of standardisation in how the basic concepts are operationalised in the form of actual questions is perhaps the most important aspect limiting comparability of the surveys (Bastelaer 1992; Verma 1993). Subsequent directions of harmonisation of EU-LFS have emphasised two additional aspects. (vi) consolidation of the existing surveys by "establishing a system of quality control whose essential aim is to determine the extent to which the national questionnaires and trans-coding of data to Community format actually provide comparable data conforming to ILO recommendations and Community specifications ...", and (vii) defining a 'target structure' to ensure convergence of future developments: "a target structure for a more frequent LFS, with an improved measure of the annual volume of work and of underemployment, and computation of the annual mean of unemployment rates", the target structure setting out "organisational ways and means for

the survey (reference period, sample rotation, periodicity of results) together with the content and presentation of questionnaire" (Eurostat 1995).

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