LABOUR AND EDUCATION STATISTICS

BACKGROUND FACTS 2015:3

Statistiska centralbyrån Statistics Sweden

# Measurement errors study in the Swedish labour force surveys

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BACKGROUND FACTS

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Labour and Education Statistics 2015:3

Statistics Sweden
2015

Background Facts
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*Producer* Statistics Sweden, Population and Welfare Department
SE-701 89 Örebro
+46 19 17 60 00

*Enquiries* Krister Näsén +46 8 506 949 08
krister.nasen@scb.se



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# Foreword

Statistical data based both on registers and surveys are associated with uncertainty and various types of error. Data from surveys are normally associated with sample error, non-response error, coding error, measurement error, etc. It is important to be able to quantify non-response and measurement error but it is a cost-demanding process.

The Labour Force Surveys (LFS) are a societally important system of surveys that form the basis of the Government's financial, monetary and employment policies. They must therefore be of a consistently high quality. Within the temporary appropriation available to Statistics Sweden for quality issue initiatives, extra funding has been given to the LFS to perform a measurement error study.

The main aim of the study has been to estimate the size of the measurement errors in the survey's most central variables: labour force status and degree of attachment to the labour market. The estimated measurement errors give users of the statistics more knowledge as to the reliability of the data. Another aim of the study has been to identify possible improvements to the questionnaire and the interviewer instructions.

The study shows that the data from the LFS are not associated with any major (net) measurement errors. It has also identified the sources of the measurement errors and the improvements that could be made to the survey and its labour market data.

Martin Axelsson, Anette Björnram, Therese Karlsson, Karl-Erik Kristiansson, Krister Näsén and Andreas Persson have performed the study and produced the report. A reference group, consisting of Elisabet Andersson, Jan Hörngren, Peter Lundquist, and others, has also been co-opted to the working group. We would like to thank the interviewer organisation and the interviewers who performed the reinterviews.

Statistics Sweden believes that the study can also form the basis of improvements in other surveys and will also disseminate the results internationally.

Statistics Sweden, February 2014

Inger Eklund

Hassan Mirza

**A note of thanks**
We would like to express appreciation to our survey respondents – the people, enterprises, government agencies and other institutions of Sweden – with whose cooperation Statistics Sweden is able to provide reliable and timely statistical information meeting the current needs of our modern society.

# Contents

# 1. Summary

The Labour Force Surveys (LFS) make up a societally important survey that must maintain high quality. This is the reason why a measurement error study was performed during the last quarter of 2012, the primary purpose of which was to estimate the size of the measurement errors in the survey's most central variables: labour force status and degree of attachment to the labour market, and to identify possible improvements to the questionnaire and the interviewer instructions.

The method used to estimate the measurement errors was reinterviewing with reconciliation, in which both the original interview and the reinterview were recorded. It involved a sample of those individuals who had just participated in the LFS being contacted again for a second interview. So that the results were comparable, both interviews referred to the same time period (reference period).

The measurement error study was basically performed according to plan. It was noted, however, that the interview times in the LFS were much longer for those who had been selected to participate in the measurement error study than for other LFS respondents. A possible explanation for the observed phenomenon is that the interviewer has a tendency to prolong the interview because he or she knows that the interview might be recorded, as a result of having to ask for the interviewee's consent. The response data have been analysed in order to study whether the observed difference in the interview time has led to the measurement error study underestimating the measurement error problems. There is no evidence to suggest that this is the case, however.

The study shows that the LFS are not associated with any major measurement errors. As regards labour force status, which contains three study domains, there are no statistically significant measurement errors for the two groups: employed persons and unemployed persons, although the number of persons not in the labour force is slightly overestimated. This means that the number of persons in the labour force (employed and unemployed persons together) is underestimated. Persons who are actually employed or unemployed have been incorrectly classified in the "Not in the labour force" group. A significantly smaller number of persons have been incorrectly classified as employed or unemployed despite the fact that they should have been classified as "not in the labour force". This has led to an overestimation of the total number of persons not in the labour force.

One reason why persons who are actually employed being misclassified as "not in the labour force" is the definition of the word "work" used in the LFS. It is sufficient for a person to work one hour for remuneration or for the purpose of generating income for it to be considered "work" in the LFS. It is however easy for the interviewee to not consider very small jobs or jobs that are not perceived as regular employment as "work". The study showed that it was often the extent or nature of the work that led some respondents to not consider themselves as employed despite them being so in accordance with LFS definitions.

The fact that persons who should be classified as unemployed are in some cases classified as "not in the labour force" depends to a large extent of the way the question is worded. In the interview, the respondents are asked whether they have looked for work in the last four weeks. This, in some cases, is interpreted as the respondent having applied for work, which is not the same thing.

If we break down the measurement errors for labour force status to the more detailed level of "degree of attachment to the labour market", we can study the measurement errors more comprehensively. The measurement error study showed that the number of persons who are long-term ill for 12 months or more is overestimated in the LFS. These persons belong to the main group: "Not in the labour force" but should actually be classified as old-age pensioners, not as long-term ill persons. The reason for the overestimation of long-term ill persons is partly the way the people are classified, with a self-assessing question, but also the way the survey deals with those who are classified as long-term ill. Long-term ill persons are not contacted every quarter but only once a year and they are considered to be long-term ill in the quarters that come in between. When they are contacted next time, they receive the question whether they believe they are going to be ill for at least the next 12 months, which is a leading question.

On the more detailed classification level, we can also see another two interesting deviations: 1) persons classified as self-employed although they should be classified as permanently employed and 2) persons classified as permanently employed although they should be classified as temporarily employed. These discrepancies do not give rise to any statistically significant differences in the groups: permanently employed; temporarily employed; or self-employed, and in fact provide useful information regarding improvements to the survey.

In cases where persons have been classified as self-employed instead of employed, the measurement error is due to the fact that, under certain circumstances, it is up to the respondents themselves to decide whether they are to be considered as self-employed or employed.

The reason why persons have been classified as permanently employed instead of temporarily employed is because some respondents have not completely understood the question. The concepts of permanent and temporary employment are not entirely clear to all respondents. Furthermore, some respondents answer based on assumptions they make about their future situation. For example, a respondent may have temporary employment but has been promised a permanent position later on.

In the "Not in the labour force" group, there are two discrepancies that should be mentioned; 1) persons who have worked the past 12 months are in certain cases classified as not having worked the past 12 months and vice versa.

The fact that respondents who were not in the labour force were classified incorrectly in accordance with when they had last worked had two primary reasons. Concerning those who had been incorrectly classified as not having worked the past 12 months, despite having done so, the reason was often that they had left out shorter jobs. The misclassification of respondents as having worked the past 12 months, despite it being over 12 months since they had done so, was mainly due to the interviewer instructions. The instructions are not sufficiently clear as regards what is to be considered as previous work experience.

The probabilities of the population being misclassified in the LFS have also been calculated. The probability of respondents being incorrectly classified regarding their labour force status is generally speaking very low. For the population as a whole, this probability is between 1 and 3 percent. Foreign born persons are more likely to misclassified. The explanation for this can be the fact that the concepts used are difficult to understand if the respondent does not have a good command of the language.

# 2. Introduction and background

The aim of the Labour Force Surveys (LFS) is to describe the current employment conditions for the entire population aged 15-74 and to give information on labour market trends. The LFS is the only source of continuous data on total unemployment and these data represent the official unemployment rate.

It is a sample survey based on individuals conducted every month. The interviewees answer questions about their employment situation during a specific week in the reference month. The data are mainly collected via telephone interviews and the sample is about 29 500 people every month. The results of the monthly surveys are published shortly after the end of the reference period.

The LFS is one of Statistics Sweden's most societally important studies and it is very important that the measurements maintain high quality. Statistics Sweden has an obligation to perform quality controls and to work to improve the survey. The last measurement error study was performed in 1994. Results from that study have been previously used to improve the questionnaire and the interviewer training and to assure the quality of the statistics. But the results from 1994 are no longer applicable to the current LFS. First of all, a new questionnaire was introduced in 2005 as part of EU adaptation and secondly the labour market has undergone changes over the years. Furthermore, the sample was expanded from 2010 onwards by about 8 000 persons per month in order to make it possible to present the section of the population who are not in work.

As part of the quality improvement initiatives at Statistics Sweden, funding was made available in 2012 to perform a measurement error study in the LFS. The aim of this study was to make users more aware of the size of the measurement errors for the most important variables in the LFS and to provide information on the causes of the errors in order to improve the measuring instruments and the interviewer instructions. The study was performed as a project at Statistics Sweden.

The report starts with an introduction to the LFS and a description of the survey design in Chapter 3. The planning of the measurement error study is dealt with in Chapter 4 and its implementation is described in Chapter 5. Chapter 6 looks at how the interviews have been assessed. Chapters 7 and 8 contain the results of the study: estimates of measurement errors and proposal for improvements to the survey.

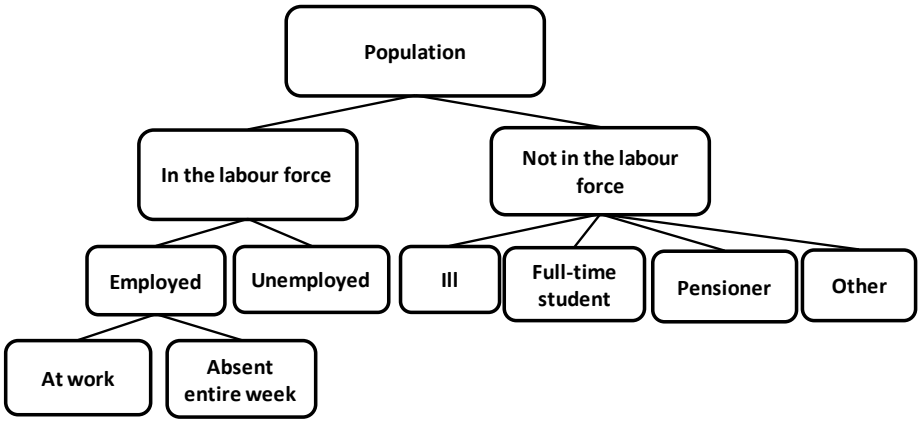
# 3. Introduction to LFS

The LFS has a long history at Statistics Sweden. The survey started at the agency as far back as 1961. In over 50 years of performing the survey, its design and the questionnaire have changed significantly.

Since October 2007, the statistics from the LFS have been presented in accordance with directives from the International Labour Organization (ILO) and EU regulations. In order to be able to present the statistics in accordance with these directives, the LFS implemented major changes to the questionnaire. The new questionnaire came into use in April 2005. The new way of presenting the statistics involved, for example, recording full-time students without work but who were looking for and were able to start work as unemployed and hence part of the labour force. These persons were not previously included in the labour force. The target population was also changed, from the population aged 16-64 to the population aged 15-74.

## 3.1 Definitions and concepts

Each person in the target population belongs to one, and only one, category during a given reference week. These categories are: employed persons, unemployed persons, or persons not in the labour force. These three main categories can then be divided in to various sub-categories. The tree diagram below shows how the categories relate to each other.




**The labour force**
The labour force is made up of persons who are either employed or unemployed.

**Employed persons**
Employed persons include the following groups:

- Persons who during a certain week (reference week) did some work (at least one hour), either as a paid employee, a self-employed person (including freelancers) or unpaid worker in a business owned by one's husband/ wife or another member of the same household (=employed, in work).

- Persons who did not do any work according to the above, but who had employment, work as a family worker or as a self-employed person (including freelancers) and were temporarily absent during the entire reference week. Absence is included, regardless if it was paid for or not (=employed, absent from work). Reasons for absence includes illness, holiday, leave of absence (such as care of children or studies), military duty, labour dispute or leave for other reasons.
- Persons participating in certain employment policy programmes are counted as employed persons. This can include publicly protected work, employment programmes for disabled persons, programmes to start a business or employment with wage subsidies or employment support.

**Employed persons can also be divided into:**

– **Permanently employed persons**
Persons with a permanent employment.

**– Temporarily employed persons with an underlying permanent position**
Persons with a permanent job who temporarily have fixed-time employment, e.g. someone who is on leave of absence in order to try another job.

**– Temporarily employed**
Persons deputising for someone else, those employed using employment support, seasonal workers, trial employment or project employment as well as other forms of fixed-time employment.

**– Self-employed**
Persons who are sole proprietors, freelancers or run their own limited company.

**– Family worker**
Persons working unpaid in a company or farm run by a member of the same household.

**Unemployed persons**
Unemployed persons are those who were without work during the reference week but have applied for work during the last four weeks (reference week and three weeks back in time) and were able to work during the reference week or begin within 14 days from the end of the reference week. Unemployed persons also include persons who have obtained a job that will begin within three months, on the condition that they could have worked during the reference week or begin within 14 days from the end of the reference week. To be unemployed, a person must be at the disposal of the labour market, and have applied for or be waiting to start a job.

**Not in the labour force**
Not in the labour force includes individuals who are neither employed nor unemployed. The group covers students, pensioners, housewives/ husbands, military conscripts and long-term ill persons.

The above classifications of the population into different categories depending on their relation to the labour market can be summarised in the two variables “labour force status” and “degree of attachment”. Labour force status denotes whether a person is employed, unemployed or not in the labour force, while degree of

attachment is a categorisation that reflects how close a person in a certain labour force status category is to the labour market.

This report uses the following definitions of the concepts "labour force status" and "degree of attachment":

Labour force status:
- Employed
- Unemployed
- Not in the labour force

Degree of attachment:
- Permanently employed
- Temporarily employed
- Self-employed and family workers
- Unemployed, has worked the last 12 months
- Unemployed, has not worked the last 12 months
- Not in the labour force, has worked the last 12 months, not long-term ill
- Not in the labour force, has not worked the last 12 months, not long-term ill
- Not in the labour force, long-term ill for 12 months or more (EX)

The above classifications are used in the design stage of the measurement error study, as well as for planning and drawing samples, in the estimation stage, for choosing the auxiliary information and for classifying into study domains. For more information, see Chapter 4 and its pertaining appendices. Even though the above definitions of labour force status and degree of attachment differ slightly from the definitions of the LFS variables "Grad (Degree)" and "Arbstatus (Labour force status)" (see Appendix 1), the latter can be used to derive the former.

## 3.2 Survey design

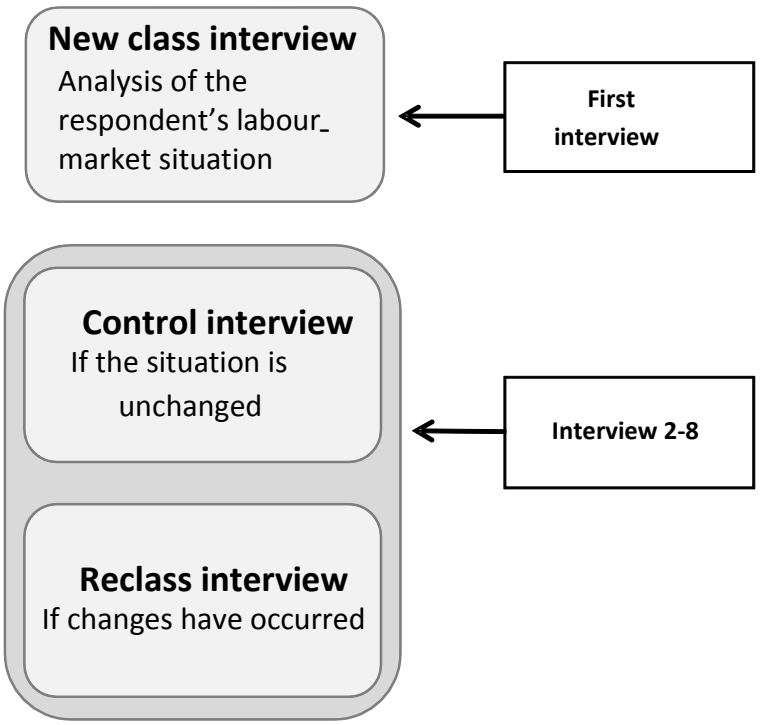
The sample of persons selected for the LFS during a given month is an amalgamation of two separate sub-samples. The total sample comprises about 29 500 persons, 21 500 of whom belong to sub-sample 1 and about 8 000 belong to sub-sample 2. Both sub-samples are drawn in accordance with the stratified independent random sampling procedure, but with different stratification principles.

For sub-sample 1, a total of 144 strata based on the variables region, sex and age are created with the help of the Total Population Register (TPR). Sub-sample 2 was introduced in order to be able to present the statistics on persons not in work due to unemployment, illness or other reason in a better way. The population for sub-sample 2 consists of persons aged 16-66. Sample strata are created by combining information from TPR, LISA (Longitudinal integration database for health insurance and labour force studies) and IoT (Register of income and tax assessment). A total of 105 strata are formed. For persons aged 25-66, 80 percent of the sample is drawn so that it is aimed at persons who are not in work according to the above registers.

The LFS is based on reference weeks, where each reference week corresponds to one calendar week (Monday to Sunday). One month in the LFS is four or five reference weeks. The sample of persons to be interviewed in the LFS during one month is randomly divided into the same number of groups as there are reference weeks during the month in question. Each group member is then asked in the

interview to state their relation to the labour market during the reference week to which the sub-sample is linked.

Data for the LFS are retrieved via computer assisted telephone interviews (CATI) performed by Statistics Sweden interviewers. Three different types of questionnaire are mainly used for data collection: New class, control and reclass. Each type of questionnaire is used under different circumstances, depending on whether the respondent has answered previously and whether they have changed their situation on the labour market. The following diagram illustrates the procedure:




On the first occasion, a new class interview is performed based on the new class form. Before the interview, the interviewer is given information about the interviewee's most recent workplace from the Statement of Earnings Register (KU Register) to allow the interview to run smoothly. In conjunction with the first interview, a thorough analysis of the sample person's labour market situation is carried out, both the general situation and the situation for the specific reference week.

Subsequent interviews are performed with the help of control interviews (dependent interviewing). These interviews do not have the same level of detailed analysis. Instead, the sample person is asked whether their labour market situation is the same as it was at the last interview, as regards labour market attachment, workplace, profession, etc. If the situation in these respects is unchanged, the interview continues with clarification of the person's labour market situation during the reference week. Control interviews are used to relieve the burden on the survey participants. If, on the basis of the control interview, a change in the interviewee's degree of attachment to the labour market, workplace or profession has occurred, the interviewee receives questions from the reclass questionnaire instead. The reclass questionnaire is very similar to the new class form, apart from the information that does not refer to the person's current labour market situation being reused from previous interviews.

Examples of data that are reused include family situation and union membership status.

The LFS is performed as a "panel survey", which means that each person participates several times. When a person participates for the *k*:th time, they are said to belong to the *k* rotation group or wave. Each selected person is interviewed once a quarter for two years, i.e. a total of eight times. Some exceptions to this rule are made in practice, however. A person who, at one interview, (i) is not employed or looking for work and (ii) states that they are long-term ill, and that this situation will continue for at least 12 months, will not be interviewed in the next three survey rounds for which the person in question is part of the sample. For these rounds, the value from the most recent interview is imputed instead. The same procedure applies to old-age pensioners who state that they are not employed or looking for work.

# 4. Planning of the study

## 4.1 Reinterviewing as a method

A systematic measurement error will occur if the expected measurement value according to a given method deviates from the value one would observe if the measurement could be taken using an error-free method. In this report, this non-error-related value is termed a true value. In order to be able to estimate discrepancies from a true value (the measurement error) in a statistical survey, the true value must be known. This is seldom the case - if the true value were known, a survey would not be necessary in the first place. There are situations in which we can use data from another survey or from administrative registers that can represent "true values" but this is not possible in many cases. What do we do then? One way is to obtain the true values, or values in which we have greater confidence than those in the original survey, e.g. via a separate data collection. Performing "reinterviews" is such a method.

Reinterviewing methodology was developed at the United States Census Board in the 1940s (Biemer & Forsman, 1992). The methodology has been used at Statistics Sweden for e.g. the Living Conditions Survey (ULF), Household income survey (HINK) and LFS (Wärneryd, 1989; Eriksson, 1989; Karlsson &Thudin, 1989). The last reinterview study for the LFS was performed in 1994.

Reinterviewing involves, just as the name suggests, interviews being performed a second time in addition to the original data collection. The reinterview may have several purposes, e.g. to check that interviews have taken place or to evaluate fieldwork (Forsman & Schreiner, 1991). More often than not, however, the purpose is to evaluate the measurement.

There are two basic types of reinterview study for evaluating measurement (Biemer & Lyberg, 2003):

1) Replication
2) Gold standard

### 4.1.1 Replication

The purpose of the replicating interview is to *estimate reliability and random measurement error*. In order to be able to estimate reliability properly, the response process needs to be more or less identical for the two measurements. The aim of the replicating reinterview is hence to recreate the regular interview. It therefore often follows the principles below:

1) the reinterviewers must be on the "same level" as the interviewers in the original interview
2) the procedure has to be identical as far as possible
3) the questionnaire is also to be exactly the same as far as possible
4) the respondents must be the same
5) the original interview and the reinterview are both to be independent

The time between the interviews must be short enough to avoid memory error but long enough to avoid "learning effects", e.g. the respondents not only remember the questions but also their answers to them (Forsman, 1987; Biemer & Lyberg, 2003).

Replicating interviews can be of two types: *test-retest* and *repeated measures*. The principle is the same, although test-retest places greater demands on performing the reinterview in exactly the same way as the original. Repeated measures is not such a controlled and strict variation, although does require more advanced statistical models in the analysis stage (Biemer & Lyberg, 2003).

### 4.1.2 Gold standard

The reinterview can also be close to a validity assessment - striving for higher quality in the responses, in order to obtain more reliable, less error-strewn values with which to compare the regular responses (Bergman & Wärneryd, 1982). This variation is known as gold standard and the aim is to implement a measurement that provides true values, or at least values in which we have greater confidence than the original measurement, in order to be able to estimate systematic error.

To achieve a gold standard, the reinterview must be implemented using better procedures than the original interview. In contrast to the replicating variation, the reinterviews are not to be as similar to the original interviews as possible but, on the contrary, be improved (Biemer & Lyberg, 2003; Biemer & Forsman, 1992). This may involve using more qualified interviewers or giving the interviewers special training. The framework of the interview can also be improved by having a longer period of fieldwork and longer interview time. It may also involve deviating from the original questionnaire in order to obtain a more reliable measurement. Forsman (1987) writes:

"A reinterview does not necessarily mean asking the same questions as in the first interview. For example, we can replace one question with two or more other questions with the aim of eliminating the risk of misunderstanding and hence obtain an answer that is probably closer to the truth."

Neither is it necessary to include the entire original interview in the reinterview. On the contrary, the focus can be on a few key variables.

### 4.1.3 Reconciliation

The gold standard variation can be supplemented with reconciliation. This involves the interviewers analysing the causes of any discrepancies between the answers in the original interview and the reinterview (Morton, Mullin & Biemer, 2008; Biemer & Lyberg, 2003). Reconciliation is hence an independent part of the interview, which is implemented after the reinterview is completed and only if the answers in the latter deviate from the original interview. The main aim is to analyse the causes of the observed discrepancies, which is valuable information in the drive to improve the survey, but it can also be a way of further guaranteeing that the reinterview really is correct - a gold standard (Forsman & Schreiner, 1991).

Reconciliation requires the interviewers to have access to the answers from the original interview, but preferably not before the reinterview has been concluded as this can influence execution and hence the results of the survey. The reconciliation interview is often a "softer" interview, more in the form of a conversation rather than a standardised procedure (Forsman, 1987; Bergman & Wärneryd, 1982), which puts extra demands on the interviewer. There are variations in which the interviewers do not have access to the answers in the

original interview when reconciliating, which is known as independent reconciliation. The aim is then different and is more reminiscent of a debriefing (Forsman, 1987).

There are a number of risks associated with reinterviews with reconciliation:

1) respondents can deliberately and systematically answer incorrectly,
2) respondents can also try to "defend" their original answers to show themselves in a better light.
3) problems with communication between the respondent and the person doing the reconciliation,
4) learning effects - respondents try to answer the same as they did last time,
5) discrepancies are "played down", intentionally or unintentionally, by the reinterviewer.

Many of these risks can be prevented by designing the survey correctly, making the right preparations and training the interviewers.

Reinterviewing as replication and gold standard therefore has different purposes and procedures. If the purpose is to *estimate systematic measurement error*, the reinterview should be performed using a better method than the original interview, in order to get closer to the truth. In order to *estimate random measurement error*, the reinterviews should be performed using exactly the same method as in the original interview.

Sometimes reinterview studies focus on one of the variations (Wärneryd, 1989), but there are also examples in which they are combined (Biemer & Forsberg, 1992).

## 4.2 Choice of methodology in this study

As mentioned previously, the aim of this measurement error study is to quantify the size of (systematic) measurement errors for the most central variables in the LFS, and to identify causes of measurement error and provide a basis for possible improvements to the questionnaire, the instructions and interviewer training. To fulfil the first aim - to estimate systematic measurement error - the gold standard method was chosen. The study was built on original interviews in the LFS, which were followed up by reinterviews. Choosing the gold standard meant that the reinterviews were to strive for better measurements that probably were closer to the truth than the original interviews. In concrete terms, this involved the reinterviews being performed by a small group of interviewers who were given special education and training. The reinterview was performed using a new class form, as it was thought that this would provide a better and more reliable measurement than the control form. The questionnaire in the reinterview was an abridged version of the regular new class questionnaire in which questions not directly linked to, or providing an explanation for, any discrepancies that may occur in degree of attachment or labour force status were removed.

To further assure ourselves that the reinterview was correct, the interview was supplemented with a number of control questions which were not only put to those whose answers deviated from the original interview (which happens in

some reinterview studies), but to all the respondents in the reinterview. The control questions were asked all at once after the regular questions, instead of continually during the interview. Both methods have their benefits and drawbacks, but the reason why the choice was made was mainly to enable more statistical comparisons to be drawn between the two interviews, e.g. regarding reliability, and the reinterview should therefore be as similar to the original interview as possible. For the same reason, neither was it desirable for the interviewers to go back and correct things in the reinterview if they discovered something wrong in the reinterview after having asked the control questions.

The reinterview was also supplemented with *dependent reconciliation*. This involved the interviewers trying to analyse the reasons for discrepancies in cases where the original interview and reinterview differed. The exception was interviews in which answers from previous rounds had been imputed, as described in Section 3.2. The respondents were included in the reinterview study but no reconciliation was performed since it could be up to 12 months since the respondent had originally been interviewed and it would hence be difficult to work out why the interviews differed.

Reconciliation was a way to further guarantee that the reinterview really did maintain gold standard. It also provided valuable information regarding how to improve the questionnaire, the instructions and the interviewer training. Reconciliation was performed at the same time as the reinterview. Respondents whose answers in the original interview differed to those they gave in the reinterview were investigated further, which meant that the interviewers had to have access to the answers from the original interview. In order not to affect the quality of the reinterview, the interviewers were only able to access the answers given in the original interview after the reinterview had been completed. The interviewer then saw the answers from both interviews side by side and could easily see what differed and what the possible causes might be. Since reconciliation is by nature more qualitative than the reinterview itself, other demands were put on the interviewer. For example, the reconciliation form did not contain any standardised questions, as it was basically impossible to design any since there can be an infinite number of reasons for discrepancies. To support the interviewers, the form did however contain proposals for feasible follow-up questions (probes). There were both customised probes based on different types of discrepancies and more general probes. The reconciliation questionnaire also had some space where the interviewer could describe what they thought might be the reasons for the discrepancy, and say which of the interviews they thought was correct.

To further ensure that both the aims of the measurement error study were fulfilled, both the original interview and the reinterview were recorded. LFS experts then listened to the interviews, with the task of a) making a final assessment as to which of the interviews was correct (in the rest of the report, this value is referred to as “true value”) and b) collecting information on the causes of measurement error. The recordings were an important prerequisite for both of the study aims. During the interview, there is often considerable discussion between the interviewer and the respondent and this is information that is not possible to fully capture unless the interview is recorded.

## 4.3 Table plan

In Section 4.2, it was stated that one of the aims of the measurement error study is to quantify the size of the errors for the most central variables in the LFS. In more concrete terms, each respondent included in the measurement error study will be classified according to their labour force status and degree of attachment to the labour market based both on the original interview and on the established value after reinterview (true value). For the definition of labour force status and degree of attachment in the report, see Chapter 3.1.

Based on the cross-classification resulting from each classification criterion, gross and net error regarding the expected number will be estimated. Gross error refers to the expected number of misclassified individuals, while net error refers to the difference between the expected value for the estimator used in the regular LFS and searched parameter. Net error will also be estimated for the relative unemployment and employment rates. For more detailed information on how the gross and net errors that are of interest are defined, see Appendix 3. Finally, the expected share of misclassified persons will also be estimated. All the quantities will be estimated for the following population groups:

- Total, 15–74 years
- Men, 15–74 years
- Women, 15–74 years
- Total, 15–19 years
- Total, 20–24 years
- Total, 25–64 years
- Total, 65–74 years
- Swedish born persons, 15–74 years
- Foreign born persons, 15-74 years.

## 4.4 Sample and estimation

Before the sample was planned, the following constituted important preconditions:

– It must be possible to select persons who are to be included in the reinterview study for a specific reference month before starting to collect data for the LFS.
– Selected individuals who do not participate in the LFS must not participate in the reinterview study.

To achieve this, we decided to draw a sub-sample from those who are to participate in the LFS during the reference months October to December 2012. When drawing samples, individuals were stratified according to the Substratum variable, which is defined as follows:

**Table 1.**

**Classification into measurement error study substrata according to sub-sample, rotation group and degree of attachment**

| Substratum | Sub-sample | Wave | Degree of attachment in previous round |
|---|---|---|---|
| 1 | 1 | 1 | Data missing |
| 2 | 1 | 2–8 | Data missing |
| 3 | 1 | 2–8 | Employed, permanently employed |
| 4 | 1 | 2–8 | Employed, temporarily employed |
| 5 | 1 | 2–8 | Employed, self-employed or family worker |
| 6 | 1 | 2–8 | Unemployed, has worked the last 12 months |
| 7 | 1 | 2–8 | Not in the labour force, has worked the last 12 months |
| 8 | 1 | 2–8 | Unemployed, has not worked the last 12 months |
| 9 | 1 | 2–8 | Not in the labour force, has not worked the last 12 months |
| 10 | 1 | 2–8 | Not in the labour force, long-term ill for 12 months or more |
| 11 | 2 | 1 | Missing |
| 12 | 2 | 2–8 | Missing |
| 13 | 2 | 2–8 | Employed, permanently employed |
| 14 | 2 | 2–8 | Employed, temporarily employed |
| 15 | 2 | 2–8 | Employed, self-employed or family worker |
| 16 | 2 | 2–8 | Unemployed, has worked the last 12 months |
| 17 | 2 | 2–8 | Not in the labour force, has worked the last 12 months |
| 18 | 2 | 2–8 | Unemployed, has not worked the last 12 months |
| 19 | 2 | 2–8 | Not in the labour force, has not worked the last 12 months |
| 20 | 2 | 2–8 | Not in the labour force, long-term ill for 12 months or more |

When determining the size of the sample per substratum, it is desirable that

- the number of persons who actually participate in the reinterview study be reasonably evenly spread over the rotation groups,
- the number of persons who actually participate in the reinterview study be spread over sub-samples 1 and 2 in relation to the relative size of the sub-samples,
- the number of respondents be reasonably evenly spread by degree of attachment in accordance with the response in LFS for the reference month in question.

Furthermore, it was assumed that the probability of a person participating in the reinterview study, given that he or she had participated in LFS, was 0.75. This figure is based on an assumption that the proportion of those who choose to participate in the reinterview study is approximately the same as the proportion

who respond in the LFS. This relationship was also observed in the measurement error study performed in the LFS at the beginning of the 1990s.

Appendix 2 goes into more detail about how the size of the sample per substratum is determined. The sample sizes eventually used in the measurement error study are:

**Table 2.**

**Sample size per substratum and reference month**

| Substratum | Number chosen from the LFS monthly sample | | |
|---|---|---|---|
| | October | November | December |
| 1 | 120 | 115 | 115 |
| 2 | 150 | 150 | 150 |
| 3 | 30 | 30 | 30 |
| 4 | 30 | 30 | 30 |
| 5 | 80 | 80 | 80 |
| 6 | 205 | 185 | 185 |
| 7 | 115 | 105 | 105 |
| 8 | 135 | 120 | 120 |
| 9 | 30 | 30 | 45 |
| 10 | 80 | 80 | 80 |
| 11 | 40 | 45 | 40 |
| 12 | 150 | 150 | 150 |
| 13 | 30 | 30 | 30 |
| 14 | 30 | 30 | 30 |
| 15 | 30 | 30 | 30 |
| 16 | 50 | 50 | 50 |
| 17 | 40 | 40 | 30 |
| 18 | 35 | 40 | 40 |
| 19 | 30 | 30 | 30 |
| 20 | 30 | 30 | 30 |
| Total | 1440 | 1400 | 1400 |

To estimate net and gross error, a point estimator is used, $\tilde{t}_{v_{dd'},\gamma}$, which is based on the results in Andersson (1994). Those interested in mathematics are referred to Appendix 4, which provides a detailed theoretical account of how the estimator is constructed. To implement the estimator in practice, ETOS, a SAS program has been used that was developed by Statistics Sweden for point and standard error estimation in sample surveys. For more information on ETOS, see Andersson (2012).

Even though ETOS has not been explicitly constructed to estimate standard error in the event of measurement errors, it is true that the variance estimator used by the program is associated with relatively little bias based on the

conditions that apply for the measurement error study. For more information on the variance estimation in the measurement error study, see Appendix 6.

## 4.5 Interviewer training

As previously mentioned, gold standard is the method selected in this study. This involves, among other things, providing the interviewers chosen to do the reinterviews with special training, the focus of which was on repetition and review of the instructions, definitions and concepts that are important in the LFS. The reinterviews were furthermore supplemented by reconciliation, which required extra education and training. The fact that reconciliation is a form of analysis, where there are no standardised questions for support, put high demands on the interviewers. They needed to have good knowledge about the LFS questionnaire and instructions, and the definitions and concepts that are central to the survey.

A precondition of success with the reinterviews was that the interviewers could concentrate more on the reinterviews and did not need to switch too much to and from interviews in other surveys. The best thing was therefore to have a relatively small group of interviewers. At the same time, the group must be large enough to be able to perform the reinterviews within the given time limit. Sickness absence, leave and other absence must also be considered in the calculations. In light of this, it was determined that about 20 was a suitable number of interviewers to be involved in the study.

All the interviewers were selected from the central telephone group in Örebro. No field interviewers, who are stationed all over the country, participated in the reinterview study. There are both advantages and disadvantages of just having one group with centrally placed interviewers, although this was done mostly for practical reasons. It is helpful if everyone works at the same physical workplace, e.g. when people gather for education and training or for regular contacts and meetings.

The training comprised one full day and was led by a subject expert. The course was both theoretical and practical. To start with, the interviewers were given a review and repetition of important definitions, concepts and instructions in the LFS, as well as information on which questions on the form are the key ones as regards classification of degree of attachment and labour force status and what the idea is behind each question respectively. This is why the course director went through the construction of the reinterview for the measurement error study, with different types of forms (reinterview form, different types of control questions and reconciliation questions). It was particularly important that the interviewers were given a review of the intended reconciliation process, and that they were given the opportunity to practice the reconciliation section themselves. It was this part of the reinterview that was considered to be the most difficult to perform since the design was more open and there were no standardised questions to keep to. A great deal of responsibility was put on the interviewer who, with the help of response data from both the original interview and the reinterview as well as general support points with feasible causes of discrepancies, was to try to analyse why discrepancies had arisen. The interviewers were to, with the help of collected data to which they had access via a diagram on the computer screen, pursue a dialogue with the respondent and

try to work out which response was correct (or whether both responses were wrong). The information shown to the interviewers varied, depending on what the differences consisted of.

After the training itself, the interviewers also had time to practice and do trial reinterviews themselves.

## 4.6 Planning/logistics

An important decision in a reinterview is to determine how long after the original interview the reinterview is to take place. If the reinterview is too close to the original interview, the risk is that the reinterview will be affected by the fact that the respondent will remember what he or she said in the original interview. If, on the other hand, it is too long after the original interview, problems may arise with the respondents' memories. This is a particular worry in surveys that have a predetermined reference period, as is the case in the LFS. There is no optimum time for when reinterviews should be performed; it is more a matter of judgement. In this study, it was decided that the fieldwork for the reinterview would start 9 to 15 days after the original interview had been performed.

The fact that the time between the original interview and the reinterview was allowed to vary was due to the survey team for practical reasons wanting to collect data from an entire week of original interviews before starting the reinterviews. The regular LFS production team has an efficient system in which the previous day's interviews are delivered from the interview unit each morning but it was not possible to efficiently incorporate the reinterview study into this system. The reinterviews therefore had to be dealt with in a particular order. Substantial manual work was required, with three to four people from different departments involved, and it would have been far too costly and taken too much time to do this on a daily basis.

The logistic process for the reinterview sample therefore had several stages and activities. The original interviews were processed firstly by the LFS IT officer, who created a special data file with the questions and variables needed as background data in the reinterview. This was done once a week. The file with the reinterview sample was then sent back to the interview unit, where it was uploaded and distributed to the interviewers. The sample was distributed to the interviewers manually in the form of lists of sample members.

The reason why the interviewers called from lists was primarily to ensure that the reinterview was not performed by the same interviewer who had done the original interview. There is no automatic support in the Statistics Sweden interview system to ensure this, the only way being to manually make lists of sample members that the interviewer in question has not interviewed before. After the reinterview had been performed, the relevant officer at the interview unit delivered the response data to the IT officer, who saved it in a table that was accessible for those compiling data for the measurement error study.

Since the measurement error study involved many activities that were not standardised or properly tested, it was decided to conduct a pilot study to see whether everything worked as planned. A small pilot study with about 50 sample members was therefore performed at the end of August/ beginning of

September 2012. Prior to the pilot study, four interviewers, who would later participate in the main study, received training. The aim was not only to test the logistics of uploading, distributing and delivering reinterviews, but also to detect errors or deficiencies in the programming of the control questions and the reconciliation forms, and to get an idea of how the intended interviewer training structure worked.

The results from the pilot study showed that most things worked as intended, but that some things needed to be adjusted and corrected. Some deficiencies in the forms were detected, for example. Furthermore, some proposals were identified for improvements to the interviewer training prior to the main study. The pilot study also indicated the need for a logistics framework, which is why a list of activities was produced containing detailed information week by week about the activities that need to be performed and who was responsible.

It was considered important to keep a constant eye on the inflow in the reinterview study and to bring attention if something did not work as intended. A production manager was therefore appointed at the interview unit whose task was to manage the contact with the interviewers, monitor the inflow and be the contact person for the project group. To ensure a constant information exchange, weekly meetings were planned with members of the project group, the IT officer and the production manager at the interview unit.

# 5. Data collection – implementation

This chapter describes how data collection in the measurement error study worked in practice. What went according to plan and what deviated from the plan? What worked well and what could have been improved or done differently?

It is primarily the reinterview part of the study that is described, but in certain cases the results also concern the original interviews.

## 5.1 Number of contact days

The intention has been to design the measurement error study so that it would reflect the normal design of the LFS. This involved e.g. having an equally high level of ambition to contact respondents in the reinterview part as in regular LFS fieldwork. The regular LFS has a fieldwork period of about 15 days and there is an established strategy for how the material is to be processed based on the number of contact days. A contact day is defined as a day when a attempt to contact has been made. Each respondent in the regular LFS is processed for a maximum period of 12 contact days, at least one of which is during a weekend, with the emphasis on the first 15 days of the fieldwork period. It is therefore not a question of how many days in a row an attempt is made to contact the respondent, but rather a question of how many days in total they are processed.

As a rule, one or a maximum of two attempts to contact are made each of the twelve contact days during which the respondent is being processed. The number of attempts to contact and days is automatically logged in the interview system.

In the reinterview study, the ambition was to mimic the normal LFS contact strategy as far as possible, but since it was also important to reach an adequate number of respondents in all study domains, the requirements placed on the maximum number of contact days were not as tough. This led, among other things, to the respondents not being automatically coded as “not available” if they could not be contacted within twelve contact days. Instead, the processing could continue if need be.

Table 3 shows how many contact days the respondents were processed for before they were assigned a final code. A final code means that either an interview has been performed or that the interviewer has not continued to try and contact the respondent for some other reason, e.g. because the respondent did not want to participate, or because the interviewer had not managed to contact the respondent before the fieldwork had to be brought to a close.

**Table 3.**

**The sample by final code and number of contact days before final coding**

| Respondents by final response code | Contact days | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
| Direct interview | 0 | 1124 | 580 | 268 | 151 | 70 | 53 | 30 | 17 | 15 | 12 | 5 | 3 | 0 | 4 | 2332 |
| Prevented participation | 17 | 15 | 12 | 9 | 1 | 3 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 60 |
| Not reached | 20 | 72 | 59 | 50 | 69 | 58 | 62 | 63 | 35 | 15 | 19 | 13 | 10 | 20 | 1 | 566 |
| Refused participation | 1 | 68 | 27 | 17 | 10 | 3 | 8 | 0 | 1 | 0 | 3 | 0 | 2 | 0 | 2 | 142 |
| Overcoverage | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Total assigned final code | 38 | 1282 | 679 | 344 | 231 | 134 | 123 | 93 | 53 | 32 | 34 | 19 | 15 | 20 | 7 | 3104 |
| Total number of contact days | 0 | 1282 | 1358 | 1032 | 924 | 670 | 738 | 651 | 424 | 288 | 340 | 209 | 180 | 260 | 98 | 8454 |

The most number of contact days that passed before respondents were assigned a final code was 14. About 40 percent were assigned a final code as early as after the first contact day, and after two contact days, almost two-thirds (about 65 percent) had been given one. The number of contact days was on average slightly fewer for the participants in the measurement error study reinterviews than in the normal LFS. On average, 2.7 contact days passed per respondent who received a final code. This can be compared to the regular LFS during the same period when the number of contact days per respondent was 3.4. It was therefore easier to contact the respondents for reinterviews which is not that strange since they had only recently participated in the original interview.

## 5.2 Response percentages

In the sample design that was created for the measurement error study, it was assumed that 75 percent of the respondents in the regular LFS would also participate in the reinterview. To a large extent, this assumption was based on experience from the measurement error study performed in 1994, in which the percentage of respondents in the reinterview part was approximately the same as in the regular LFS (see Section 4.4). Since the persons had recently been interviewed in the original interview, it was also assumed that it would be possible to contact a relatively large proportion of them again, something which (according to Section 5.1.1 above) proved to be the case. There was one reflection - and misgiving - concerning how the respondents would react to being interviewed so soon after the original interview and furthermore outside the normal data collection procedure. Would they be willing to participate to the same extent as in the regular LFS?

The outcome proved to be basically in concordance with the assumptions made when planning the study sample.

**Table 4.**

**Percentage of respondents by sex and degree of attachment, weighted and unweighted values. Percent**

| Degree of attachment | Weighted | | | Unweighted | | |
|---|---|---|---|---|---|---|
| | Men | Women | Total | Men | Women | Total |
| Permanently employed | 79.5 | 69.0 | 74.5 | 76.5 | 70.3 | 73.4 |
| Temporarily employed | 65.6 | 75.6 | 72.0 | 70.8 | 75.7 | 73.6 |
| Self-employed or family worker | 77.0 | 76.2 | 76.8 | 79.2 | 77.1 | 78.6 |
| Unemployed, has worked the last 12 months | 63.5 | 80.7 | 71.5 | 74,0 | 78.9 | 76.1 |
| Not in the labour force, has worked the last 12 months | 77.8 | 78.9 | 78.4 | 86.3 | 77.7 | 81.3 |
| Unemployed, has not worked the last 12 months | 64,0 | 72.7 | 68.5 | 73.0 | 70.9 | 72.0 |
| Not in the labour force, has not worked the last 12 months | 87.0 | 77.3 | 81.9 | 82.5 | 76.8 | 79.5 |
| Not in the labour force, long-term ill | 61.1 | 68.0 | 65.4 | 58.3 | 70.5 | 66.3 |
| Total | 78.2 | 72.6 | 75.4 | 75.8 | 74.4 | 75.1 |

Table 4 shows the response percentages both unweighted as well as weighted. The unweighted percentages show the actual outcome in the reinterview part of the measurement error study and indicate that the percentage of actual respondents are very much in line with the assumptions made in the sample planning stage, where the percentage of respondents was adjudged to amount to 75 percent.

Non-response is always problematic in a statistical survey. It is difficult to know the distribution of the individuals who have chosen not to respond. The weighted response percentages in Table 4 can be seen as how representative the respondents are over the categories in the degree of attachment variable for each sex respectively. In general, the representation is good for the total number of respondents; it differs slightly between men and women, however. Women are in general slightly less well represented than men, while the percentage of women respondents is more evenly distributed over the respective categories.

For men, the categories long-term ill and unemployed are less well represented than the other groups. So even if men are generally better represented, the study's results are not as striking for these categories.

Appendix 7 shows data for the different population groups which the study aims to highlight (see Section 4.3).

## 5.3 Length of fieldwork period

As is clear from Table 3 and Table 4, it was not too much of a problem to come into contact with the interviewees, and neither was it difficult to get them to participate in the reinterview. So in principle, the outcome here was basically as planned. But this does tell us much about the quality of the reinterviews. An important factor in this context is the time lapse between the original interview and the reinterview. As mentioned previously, the respondents should preferably have had time to "forget" the responses they gave in the original interview. At the same time, the time lapse between the interviews could not be too long as it might then have been difficult for the respondents to remember the circumstances during the reference period in question. In this case, the assessment was made that the fieldwork period for the measurement error study should start 9 to 15 days after the original interview. Table 5 below presents how it turned out in practice.

**Table 5.**

**Percentage of reinterviews by time lapse between original interview and reinterview Percent**

| Weeks | Time lapse between interviews | |
|---|---|---|
| | Percentage | Cumulative |
| 0 | 0.3 | 0.3 |
| 1 | 2.3 | 2.6 |
| 2 | 11.2 | 13.9 |
| 3 | 31.7 | 45.6 |
| 4 | 21.8 | 67.3 |
| 5 | 13.0 | 80.4 |
| 6 | 8.3 | 88.6 |
| 7 | 5.7 | 94.3 |
| 8 | 3.7 | 98.0 |
| 9 | 1.5 | 99.5 |
| 10 | 0.4 | 99.9 |
| 11 | 0.1 | 100.0 |

The majority of reinterviews were performed three to six weeks after the original interview. Only around 14 percent were interviewed during the first two weeks, and bearing in mind that most of the reinterviews (73 percent) were performed within two contact days (see Section 5.1), we can draw the conclusion that the fieldwork for the reinterviews actually started later than the planned 9 to 15 days. The time gap between the interviews may be of significance for the quality of the reinterviews. Certain questions became more difficult to answer after a time due to memory effects. The time lapse can, in other words, be of significance for whether the reinterview can be seen as a "better" measurement than the original interview, which was the idea behind the design of the measurement error study.

It is not just the time lapse between the original interview and the reinterview that is of significance in the context, however. Even the time lapse to the reference period is extremely significant. This is true not just regarding the reinterviews but

also the original interview. If the original interview is a long time after the reference week, but the time lapse between the original interview and the reinterview is relatively short, it is highly likely that the measurement of the reinterview is of a higher quality than that of the original interview. If the opposite is true, however, it is more doubtful whether the reinterview really is of a "gold standard". Table 6 below shows the time lapse, measured in number of weeks, between the interview and the reference week for both the original interview and the reinterview.

**Table 6.**

**Number of reinterviews by time lapse (measured in number of weeks) from the reference week in original interview and reinterview**

| Reinterview | Original interview | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
| 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 3 | 86 | 14 | 0 | 0 | 0 | 0 | 0 | 100 |
| 4 | 575 | 111 | 23 | 4 | 0 | 0 | 0 | 713 |
| 5 | 360 | 109 | 25 | 4 | 3 | 0 | 0 | 501 |
| 6 | 231 | 104 | 37 | 28 | 3 | 0 | 0 | 403 |
| 7 | 118 | 41 | 23 | 16 | 10 | 2 | 0 | 210 |
| 8 | 106 | 50 | 17 | 10 | 1 | 2 | 0 | 186 |
| 9 | 70 | 24 | 16 | 10 | 8 | 1 | 0 | 129 |
| 10 | 32 | 15 | 2 | 9 | 5 | 1 | 0 | 64 |
| 11 | 8 | 3 | 1 | 0 | 0 | 0 | 1 | 13 |
| 12 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| 13 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 1596 | 473 | 144 | 81 | 30 | 6 | 1 | 2331 |

Table 6 shows that the vast majority of the original interviews were performed the week after the reference week. Since the table is based on week numbers and not number of days, it means that the interview was held between one and eight days after the reference week, which is considered to be very good when we bear in mind memory effects. After two weeks about 89 percent of the original interviews has been performed.

Regarding the reinterviews, however, the picture is less positive. It is not just that most of them were performed later than planned, but the table above also makes it clear that in many cases there is a major difference in the gap to the reference period between the original interview and the reinterview.

This means therefore that the reinterview is not necessarily of a higher quality (gold standard) compared to the original interview, which was the idea behind the design. This has had an impact on how the true value has been assessed. In some cases, more trust has been put into the original interview than in the reinterview (see more about this in Section 6.2). Even though the reinterviews are to be

performed in the best possible way, there is generally a limit to what the respondents can remember.

## 5.4 Deviations from the plan

Before the measurement error study was started, guidelines were established for how the fieldwork and data collection process were to take place. In the planning stage, there was an expectation as to what response percentages were to be achieved in the different groups. Even though a great deal went according to the plans and expectations, there are some cases where deviations from the plans do occur.

### 5.4.1 Fieldwork period

As has previously been ascertained, the representation for each sub-group was relatively good (see Section 5.2). Achieving these response percentages required the fieldwork period to be extended several times. This was deemed necessary as a certain number of interviews were required to perform the necessary calculations in accordance with the existing table plan. To some extent, the problem was due to the project that performed the study at the beginning was not clear enough as regards conveying the "status" of the measurement error study in relation to other ongoing LFS-related interview activities. This led to the reinterviews not being prioritised in the way the project intended. When it became clear, measures were implemented by the Interview Unit.

On a few occasions, it was noticed at a late stage that the material had been poorly processed. As described in Section 4.6, the interviewers called from paper lists as this was the only way to guarantee that the reinterview was not performed by the same interviewer who had done the original interview. A drawback of working with paper lists, is that they make it more difficult to check whether the material has been properly processed. It may for example be a question of the interviewer being ill or someone misplacing the lists. On a small number of occasions, therefore, the material was not processed as planned, although measures were implemented once this was detected.

All in all, this has led to longer fieldwork periods than intended from the start, which is one of the things shown in Table 6. Something else that can be noted from Table 6 is that the length of the fieldwork period was also sometimes considerably longer in the regular LFS than the normal 15 days. It is clear, however, that the fieldwork period in certain cases was too long bearing in mind the time lapse to the original interview and to the reference period. A clearer fieldwork design had been necessary, with better control over the processing and clearer rules and priorities regarding what the participating interviewers were to work on.

### 5.4.2 Interview times

When planning the study, we anticipated an average interview time for the reinterviews of about ten minutes. The outcome was almost exactly as expected - 8.34 minutes on average.

Regarding the original interviews, we had estimated half a minute longer interview time due to a question being asked about the interviewees giving their consent to the interview being recorded. So that the interviewers would not know which of the interviewees were included in the measurement error study, twice as

many interviewees were asked the question about consent to the interview being recorded as in reality were included in the sample. For this reason, quite a few interviewees had a longer interview time due to the consent question. This was considered in the planning process from the start, however, and did not come as a surprise.

Something that was unexpected, however, was a marked increase in the interview time otherwise. On average, the original interviews in which the consent question was asked were three minutes longer than the interviews in which the question was not asked. The reason for this is thought to a large extent to be the interviewers being unaccustomed to being recorded and monitored. The interview monitoring system was supposed to be in place well before the measurement error study began, but its installation was delayed. The measurement error study was therefore performed while the monitoring system was being installed system and its was the first study in which recording and monitoring were used on a larger scale. Those installing the monitoring system at Statistics Sweden also confirmed that the average interview time increased. The general feeling is that the effects on the interview time will diminish the more accustomed to being recorded the interviewers become.

But for the measurement errors study, this was an unexpected effect. One misgiving was that the longer interview time would lead to more thorough original interviews compared to the regular LFS. This might suggest that the original interviews were of a higher quality than normal. Had this been the case, the original interviews in the measurement error study had not been representative of a normal original interview in the LFS.

In order to analyse whether the longer interview time could be expected to result in the measurement error study underestimating the measurement error problems in the LFS, a more detailed study of the response data was carried out. More specifically, the response data from original interviews in which the consent question was asked were compared to the response data from original interviews in the measurement error study in which the question was not asked. The main reason why interviews were performed in which the consent question was not asked is the fact that not all the interviewers have an efficient recording system installed when the measurement error study began. When interviewers who did not have access to the monitoring system did interviews, the consent question was not asked. These interviews were later used as reference material to study whether original interviews in which the consent question was asked were associated with lower misclassification probabilities.

In order to take into account the fact that neither of the two response datasets that form the basis of the comparison is representative of the 15-74 year-old population, it was decided that the comparison should be based on conditional misclassification probabilities. As the null hypothesis, we chose:

$$H_0 : P_F \geq P_{EF}$$

where $P_F$ denotes the misclassification probability of interviews in which the consent question was asked and $P_{EF}$ denotes the misclassification probability of interviews in which the consent question was not asked. Tables 26 - 29 in Appendix 8 show that the probability of misclassification in the LFS was not

statistically significantly lower[1] for sample members who were asked the consent question. This was regardless of whether we refer to labour force status or degree of attachment. Since there was no reason to believe that recorded interviews are of a higher quality, we decided to process the data in accordance with the original plan.

### 5.4.3 Refused recording

Since the study was performed during the implementation phase of the interview recording and monitoring system at Statistics Sweden, there was no information regarding the extent to which the respondents would consent to being recorded.

Seven percent (155 persons) refused to be recorded in the reinterviews. The outcome was different in the original interviews, however. The percentage that refused to be recorded in the original interview was significantly higher than was expected beforehand. During the first three months of the study, the percentage of original interviews in which the respondent did not consent to being recorded but accepted being interviewed was 15.8 percent. This caused problems not least regarding the monitoring of interviews in which there were discrepancies between the original interview and the reinterview with regard to the variables labour force status and degree of attachment. More information on this can be found in Chapter 6.

## 5.5 Experiences and comments from interviewers

In order to know how the interviewers experienced the reinterview work, *debriefing* sessions have been held with the interviewers who participated in the study. In general, participation in the measurement error study has been a positive and instructive experience that has provided a new insight into LFS issues and definitions. The interviewers have, for example, gained a greater understanding of the questions that are central to a person's classification in the LFS and they have learnt more about the need to follow up different situations that can occur during the interview.

As regards the training that interviewers received prior to the measurement error study, it was generally perceived as providing a good theoretical foundation. The interviewers feel that it is something all interviewers should receive once they have worked for a while with the LFS, as further training. They would have preferred more training in performing reconciliations, however. The interviewers felt that it was sometimes difficult to know which follow-up questions to ask based on the reconciliation diagram they had on their computer screens during the interview. The exercises done as part of the training did not feel sufficient and comprehensive enough for the situations that occurred in "real life". The interviewers also feel that it would have been a good idea to have a get-together with the course directors 3-4 weeks afterwards, at which they could have discussed problems that they had encountered and received help from subject experts. At the same time, however, they have had considerable support from both each other and their supervisor, which they perceived as positive. Since all of them belonged to the central telephone group, they always had the opportunity to discuss different situations in which they found themselves with

[1] One-sided test on 5% significance level, rejection limit -1.64.

their colleagues or the supervisor, and get tips from them on what may have caused the discrepancy. It can sometimes be just as rewarding to discuss with a colleague, to check things and share experiences with each other.

Even though reconciliation was difficult sometimes, the interviewers generally felt that it was both fun and rewarding to do. It was often stimulating to work out problems and was also perceived as an advantage to be able to "talk freely". Since the reconciliation was not as structured as the regular reinterview form, there was more scope for being creative.

Before the study started, the interviewers were somewhat worried that it might be difficult to get the respondents to participate in a reinterview when they had just been interviewed as part of the regular LFS. In general, however, the interviewers had the impression that it was easy to convince the respondents to participate outside the regular interview cycle. The vast majority of respondents understood that it was a question of studying quality, and most of those that could be contacted agreed to a reinterview. The most difficult persons to motivate were those who had been interviewed in the original interview for the first time. They had still not become accustomed to Statistics Sweden interviewers coming back and asking to do more interviews and they were somewhat sceptical to the idea. For those who belonged to the later rotation groups, arguments such as "You've been involved several times" or "We're nearly done" could be used, which made the whole thing easier.

Towards the end of the fieldwork period, it was more difficult to get any response at all. The interviewers have a theory that the respondents had learnt to recognise the telephone number and hence did not answer. Some interviewers thought that it would perhaps have been a good idea to send out a letter informing them about the measurement error study and its importance, so that it was clear that this was something out of the ordinary. This had not only been good for the measurement error study but also in the future. The hope is that respondents will participate in the regular LFS again next year. There is a risk that they won't if they feel they are being "hunted" so soon after the last time they were interviewed.

One problem was that the respondent often saw the reinterview as a normal interview and wanted to end it as soon as the regular block of questions had been asked. It was sometimes a strange situation when going over to the reconciliation. The chosen design meant that it was up to the interviewer to find a way of presenting the reconciliation, and many interviewers felt that it was difficult to do this in a good way to avoid the respondent feeling as if he or she had done something "wrong". More work should therefore been put into how to present the measurement error study, and in particular the reconciliation. It would have been easier for the interviewer if there had been a standardised introduction to the reconciliation part of the interview, in which the reconciliation had been described and in which it had been mentioned that there can be several reasons why discrepancies occur, e.g. that the questions are not good enough to capture the information desired or that it can be difficult to remember things from several weeks ago.

The end of the interview could also have been improved. Since the interviewers will call most of those they interview again, it would have been positive if there had been information on the form informing the interviewee when the next

interview will take place. Some of the interviewers had accessed the LFS production system to check when the next interview would be so that they could finish the interview more naturally, but the information should have been more easily accessible on the actual interview form.

# 6. Establishing true value

In the measurement error study, it was mainly respondents for whom labour force status and degree of attachment differed between the original interview and the reinterview who were interesting to analyse. This is because the aim of the measurement error study was to see how significant the discrepancies (measurement errors) are for the estimations of these central variables. An important task before the material could be analysed was to establish which (if any) of the two interviews had the "true" value. The following approach was used to establish the true value: First, it was noted what type of discrepancy had occurred, i.e. what degree of attachment and labour force status did the respondents have in each interview respectively. The notes made by the interviewer after the reconciliation were then reviewed. Next, the response data were analysed and any recording of the original interview was monitored in order to detect any deficiencies.

Since the monitoring system had not yet been fully implemented at the start of the measurement error study, not all interviews had been recorded. The prerequisites for being able to establish the "true value" were different depending on whether both interviews had been recorded or not. The material could be divided into four categories depending on the prevailing prerequisites: 1) both the interviews had been recorded; 2) only the reinterview had been recorded; 3) neither interview or only the original interview had been recorded; 4) the original interview had been imputed and no reconciliation had been performed. In those cases where only the original interview had been recorded, it was not monitored. This decision was taken primarily for resource reasons. It was felt that there was insufficient justification for only monitoring the original interview since the reinterview and the investigative reconciliation often provided valuable information on the causes of the discrepancies. The recordings of the reinterviews were however monitored, regardless of whether the corresponding original interview had been recorded or not. For category 4, where no reconciliation had been performed, the interviews were not monitored as the original interview could have taken place anything up to one year ago and could not then be used as a reference point.

In 176 cases, or about 30 percent, out of the 580 interviews that were given a divergent value, both the interviews had been recorded and could therefore be monitored. An investigator had listened very carefully to how both interviews had proceeded and identified what had caused the discrepancy.

The number of interviews where the reinterview had been recorded but where it had not been possible to record the original interview amounted to 191. That corresponds to 33 percent of the divergent interviews. In these cases, the reinterview was monitored and the responses from the original interview were analysed. If there were responses from earlier rotations, these were also reviewed.

Finally, there were 213 cases where neither of the interviews or only the original interview had been recorded (137) or where no reconciliation had been performed due to the fact that the original interview had been imputed (76 cases). In these

cases, no monitoring was possible/ had been carried out. This represents 37 percent of the divergent interviews. For these cases, only response data has been analysed

The categories can, in general, be said to be in a descending scale of how certain the true values are. In cases where both the interviews could be monitored, the true value is without exception more certain than for the other categories. It has nevertheless been possible to allocate a true value to almost every respondent. Discrepancies can depend on rather straightforward circumstances, which is why true values where neither of the interviews had been monitored can also be certain. Doubts have arisen in some cases, leading to it not being possible to establish a true value. This happened in a total of 20 cases, where true values could not be established. Of the 2 331 respondents, 2 311 are included in the calculations below.

## 6.1 How the assessment has been made

Where both the interviews could be monitored, the discrepancy could in most cases be assessed without difficulty after listening to them. In a small number of cases, both the interviews were unsatisfactory. This was either because the language difficulties were so great that it was doubtful that the respondent had understood the question, or that the answers in both interviews were so different that it was doubtful whether the respondent had answered truthfully.

In cases where only the reinterview was monitored, considerable emphasis was put on what had emerged during the interview, and especially in the reconciliation. If the interview had not managed to analyse why discrepancies had arisen, the type of discrepancy was studied. Often, the response data could provide information on which of the interviews was more correct, but in certain cases other conditions also had to be taken into account. If it was a question of behaviours or phenomena where memory effects were deemed to be important, for example if the respondent was a job-seeker in the original interview but not in the reinterview, more faith was put in the original interview as that was closer to the reference period in terms of time. This was particularly true of the reinterviews that were performed at a very late stage (see Section 5.1.3). If it emerged that the respondent used a diary/ calendar in order to answer the questions in the reinterview, it was considered to be more trustworthy. If it was, on the other hand, a question of assessing whether the respondent had worked or not during the period in question, it was not just memory effects that had to be considered when carrying out the assessment. In such cases, it was also necessary to look at e.g. how extensive the work had been, if it had been a permanent or a temporary job, and whether the respondent had done the same work for a long time.

As regards the interviews that had not been monitored, they were firstly assessed based on the interviewer's notes, then by type of discrepancy and finally by time lapse to the reference period. Compared to the other categories, there are a larger number of interviews in this category that have not been assigned a true value for labour force status and degree of attachment.

# 7. Results

This chapter presents the results from the measurement error study based on its main aim - to estimate the size of the measurement errors in the LFS's most central variables: labour force status and degree of attachment (see Chapter 3 for a more detailed definition) and to present the reasons why misclassifications occur. The results are presented for the 15-74 year-old population in total and disaggregated by sex. Regarding the results for other population groups, please refer to Appendix 10. Chapter 8 then presents proposals for improvements to the measuring process.

## 7.1 Gross and net error and misclassifications

The starting-point for the presentation is a table that shows estimates of the population according to the combination of the classification in the original interview and the true classification, the value from the original interview on the vertical axis and the true value on the horizontal axis. The table present estimations of the proportions of the population that have been classified correctly (estimations in the diagonal) and incorrectly (estimations outside the diagonal) in the original interview and in which category they have been incorrectly classified. Two types of generic measurements are presented; net error and gross error. Gross error is constituted by the sum of the estimates that are outside the diagonal as a percentage of the total number of persons in the population group to which the results refer. The gross error can be said to be an estimate of the probability of being misclassified.

Important estimates of incorrectly included and incorrectly excluded persons are presented along with the causes of the misclassification. An example of note is persons who in Table 7 below were outside the labour force after the original interview but, after being assigned a true value, have been deemed to be employed. After the original interview, 2 104 000 persons were classified as not in the labour force. According to the true value, 45 000 of these were instead classified as employed. These 45 000 hence make a significant contribution to the gross error.

The net error is calculated as the distribution according to the original interview minus the true distribution, i.e. distribution in the column total minus the distribution in the row total. The measurement is an estimate of the measurement error bias and corresponds to the first aim of the study. The net error can also be expressed as the number of incorrectly included minus the number of incorrectly excluded persons in the original interview.

The net error is presented in separate tables for the sake of simplicity. From the estimates in Table 7 below, for example, the net error for the number of persons not in the labour force can be calculated at 68 000. This is calculated as 2 104 000 persons not in the labour force according to the original interview minus 2 036 000 persons according to the true value. In other words, the number of persons outside the labour force has been overestimated by 68 000 persons in the original interview. Table 8 presents the net error for the estimates of labour force status found in Table 7.

The table presenting the net error for estimates of labour force status to of net error has also been supplemented with a presentation of net error, expressed as a percentage, for the estimates of the measures relative unemployment and employment rate. The definitions of the measures are given in the table header.

Even if the gross errors are of significant size, they don't necessarily lead to major net error; namely if the estimated number of incorrectly included persons is about the same size as the number of incorrectly excluded persons from the category in question. An example from Table 7 is that 13 000 persons were incorrectly excluded from the not in the labour force category and that 81 000 were incorrectly included. This results in a net error of 81 000 – 13 000 = 68 000.

The third type of table presents the gross errors. At the end of the chapter, the gross errors expressed as the general risk of an LFS respondent being misclassified are presented. These probabilities are presented by sex, age and Swedish- and foreign born persons. We can see in Table 20, for example, that the risk of a foreign-born person's labour force status being misclassified is between 0.01 and 0.07, i.e. between one and seven percent while the same risk for a Swedish born person is between zero and two percent.

For each estimate of misclassification and net error, there is an uncertainty figure and these are marked in italics in the tables below. If the absolute value (i.e. regardless of whether it is negative or positive) is larger than the uncertainty figure, the difference is statistically significant. An example of note is persons who were classified as not in the labour force in the original interview but after the reinterview were classified as employed. The discrepancy amounted to 45 000 persons (extrapolated to the whole population) and the uncertainty figure was 31 000, which means that the discrepancy is statistically significant.

Significant misclassifications occur that are not commented on in the text below. These are mainly estimates that are based on so few observations that particular caution must be exercised when interpreting the results.

### 7.1.1 Population aged 15-74

**Net errors and misclassifications for labour force status**

**Table 7.**

**Estimates of the population aged 15-74 by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 4620 | 18 | 7 | 4645 |
| | | *31* | *24* | *10* | *18* |
| Unemployed | (2) | 21 | 356 | 6 | 383 |
| | | *20* | *24* | *4* | *13* |
| Not in the labour force | (3) | 45 | 36 | 2023 | 2104 |
| | | *31* | *25* | *42* | *19* |
| Total | (4) | 4685 | 411 | 2036 | 7131 |
| | | *48* | *42* | *44* | *0* |

Table 7 shows how the population is by the original interview and the measurement error study's true value. The respondents have been adjusted up to the population total and only the adjusted values are presented below unless otherwise stated.

The largest proportion of the population can be found on the diagonal in the table which implies that they have been classified correctly in the original interview.

**Table 8.**

**Net error by labour force status for the population aged 15-74, Q4 2012, thousands. Uncertainty figures in italics**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -40 | -28 | 68 | -0.4 | -0.6 |
| *45* | *40* | *40* | *0.8* | *0.6* |

Table 8 shows the net errors that have been caused by the misclassifications shown in Table 7. There is only one significant net error, concerning labour force status, and it for persons not in the labour force. The number of persons not in the labour force is therefore overestimated in the regular LFS measurements by 68 000 persons during this period. The main explanation for the net error can be ascertained from Table 7. Groups of employed (45 000) and unemployed (36 000)

persons respectively have been incorrectly classified as not in the labour force in the original interview. The misclassifications are statistically significant.

The misclassification of unemployed persons was in most cases caused by the concept "looking for work". The respondents are asked the question whether they have looked for work during the last four weeks, which in certain cases is interpreted as the respondent having applied for a job. Some respondents, often persons who are only looking for work to a small extent, interpret it as having submitted an application or something similar. In LFS terminology, "looking for work" is a wider concept that covers several different activities. If the respondent has not submitted any applications, he/ she therefore answers no to this question and will not be classified as unemployed.

The misclassification of employed persons is mainly due to the LFS definition of "work". In LFS terminology, one hour or more per week is counted as work if it remunerated or done in order to generate income. Since even temporary, very small jobs are to be considered as work, there is a risk that these will not be brought up in the interview if the respondent doesn't consider it as work. In most of these cases, it was the small scope or temporary nature of the work that led to the respondent not considering it as work and hence failed to mention it during the original interview.

The fact that the number of employed persons is also underestimated results in the employment rate, i.e. the percentage of employed persons in the population, being possibly slightly underestimated. The underestimation of the percentage of employed persons is not statistically significant, however.

Another significant misclassification can be noted in Table 7. Of those classified as unemployed persons after the original interview, 21 000 were actually employed. The most common cause of this is again the definition of "work". In most cases, the work was of such a small scope that the respondents did not count it as being employed.

### Net error and misclassifications for degree of attachment

The section below presents the size and causes of the net error for the other main variable in the study - degree of attachment. The presentation follows the same pattern as for the labour force status variable above. As above, estimated values in the population are stated here and how they are by the original interview and the true value.

The more detailed level shown in Table 7 provides us with a list of the different misclassifications. Regarding the 45 000 employed persons who were misclassified as not in the labour force, we can see from Table 9 that most of them were classified in the original interview as not having worked during the last 12 months. Furthermore, we can see that it was mostly temporarily employed persons and entrepreneurs/ assisting household members who were misclassified in this way. If we add together the different sub-categories of degree of attachment for employed persons, unemployed persons and persons not in the labour force, we can see that they show the same thing as the table for labour force status.

**Table 9.**

**Estimates of the population aged 15-74, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 3390 | 108 | 0 | 0 | 0 | 0 | 0 | 0 | 3498 |
| employed | | *98* | *97* | *0* | *1* | *0* | *0* | *0* | *0* | *19* |
| Temporary | (2) | 22 | 612 | 0 | 17 | 1 | 0 | 2 | 0 | 653 |
| employed | | *22* | *34* | *0* | *24* | *1* | *0* | *3* | *0* | *15* |
| Self-employed and | (3) | 43 | 0 | 445 | 0 | 0 | 0 | 5 | 0 | 493 |
| family workers | | *22* | *0* | *27* | *0* | *0* | *0* | *9* | *0* | *15* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 17 | 2 | 159 | 3 | 3 | 0 | 0 | 183 |
| last 12 months | | *0* | *20* | *2* | *21* | *2* | *3* | *0* | *0* | *9* |
| Have not worked | (5) | 0 | 1 | 1 | 9 | 185 | 0 | 3 | 0 | 200 |
| the last 12 months | | *0* | *2* | *1* | *8* | *13* | *0* | *3* | *0* | *11* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 10 | 2 | 2 | 1 | 282 | 23 | 2 | 323 |
| last 12 months | | *1* | *7* | *3* | *2* | *2* | *23* | *16* | *2* | *14* |
| Have not worked | (7) | 0 | 10 | 16 | 0 | 24 | 31 | 1381 | 3 | 1465 |
| the last 12 months | | *0* | *20* | *21* | *0* | *22* | *31* | *50* | *4* | *18* |
| EX | (8) | 1 | 2 | 3 | 0 | 9 | 5 | 63 | 234 | 317 |
| | | *2* | *2* | *5* | *0* | *11* | *5* | *20* | *20* | *11* |
| Total | (9) | 3456 | 759 | 469 | 188 | 222 | 321 | 1477 | 238 | 7131 |
| | | *103* | *106* | *34* | *33* | *28* | *39* | *57* | *21* | *0* |

Even if we look at the more detailed breakdown, degree of attachment, we can see that the vast majority of the population are on the diagonal in the table, which means that they were classified correctly in the original interview.

**Table 10.**

**Net error for the population aged 15-74 by degree of attachment, Q4 2012, thousands. Uncertainty figures in italics**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 42 | -106 | 24 | -5 | -23 | 2 | -12 | 78 |
| *101* | *106* | *32* | *32* | *27* | *37* | *55* | *20* |

The more detailed breakdown shows that it is within a specific group of persons not in the labour force that measurement errors lead to a statistically significant net error. Persons with the degree of attachment EX - long-term ill - are overestimated in the regular LFS by 78 000 which corresponds to 25 percent.

The misclassification which is the main cause of the net error is that 63 000 persons incorrectly classified as EX in the original interview actually belonged to the group persons not in the labour force who had not worked the last 12 months (see Table 9). The misclassification has two main causes: Firstly, the special LFS control interview procedure for this group and secondly insufficient or unclear instructions to the interviewers. In cases where a respondent has been classified with the degree of attachment EX the last time he or she was interviewed, the next control interview starts with a question in order to check whether the respondent thinks that he or she will continue to be long-term ill for the next 12 months (until the next interview in that case). In other words, the first question in the control interview is a leading one. Furthermore, this group lies "dormant" for several interview rounds, which means that the respondent is not contacted for an interview each quarter. It is assumed instead that he or she is still long-term ill. Only after 12 months is new contact made, which starts by ascertaining how the respondent answered in the previous interview and the respondent is then asked whether he or she will be in the same situation in 12 months' time. Not only is it difficult for the respondent to remember how he or she answered 12 months earlier but it is also a question that requires the respondent to make a rapid assumption about his or her health in 12 months' time. The risk is that he or she will answer based on previous responses instead of stating his or her current situation.

The other cause of the misclassification is the instructions given to the interview regarding this question. Persons who answer the self-classifying question that forms the base of their allocation to the degree of attachment EX shall, according to the instructions, be allocated the code pensioner if they are old-age pensioners. The problem is that the information that forms the basis of the classification is a question that also aims to ask the respondent what they mainly see themselves as, which can lead to incorrect coding.

Being an old-age pensioner does not exclude the respondent from still considering themselves to be ill. There are no controls that tell the interview that this codes a person over 65 as something other than a pensioner. The interviewer must therefore keep the information in his or her head and look at the birth date on the screen. If a person has previously participated and answered that they are long-term ill, the initial control question is used as an answer to the self-classifying question. If the respondent has become an old-aged pensioner since their last interview and answers yes to the control question, the question of how they see themselves is never asked. The interviewer must therefore at the start of the interview keep in mind that the respondent has most probably become a pensioner, which can be very difficult to remember.

Table 9 shows some more misclassifications worth mentioning. These concern permanently employed persons who have been misclassified as self-employed and temporarily employed persons misclassified as permanently employed. There are also significant misclassifications between the groups worked the last 12 months and not worked the last 12 months respectively among persons outside the labour force.

According to the study, 43 000 of the 493 000 classified as self-employed or family worker in the original interview were classified as permanently employed according to true value (see Table 9). It is not a question of these respondents having changed jobs or form of employment, but of the interviewer instructions giving a certain amount of scope for different interpretations. According to the instructions, it is up to the respondents themselves to determine whether they are permanently employed or self-employed, if the company is run as a limited company with only a few employees. According to the guidelines published by Eurostat, such a person shall be classified either as an employed or self-employed. Legally speaking, persons who run a limited company in Sweden are employed in that company. Both answers are therefore correct according to the instructions and the Eurostat guidelines, even though they have been reported as misclassifications.

The second misclassification concerns 108 000 temporarily employed persons who have been incorrectly classified as permanently employed. This misclassification was in most cases caused by the fact that the respondents were unaccustomed to the terminology used in the LFS. The concepts of permanent and temporary employment caused most of the discrepancies since the respondents in some cases did not really understand them.

The instructions given to the interviewers may also have caused some of the discrepancies. If a respondent is uncertain about his or her form of employment, the interview normally asks whether there is a final date for the employment as a follow-up question. Several of those who were misclassified thought that there was no final date and their job just "trundled along".

Another cause of the misclassification was that some respondents made projections about their current situation. A person may have had provisional employment, or been promised permanent employment, and then interpreted their situation as having the latter. The most common cause of misclassification was however due to respondents not being familiar with the concepts of permanent and temporary employment.

Within the group not in the labour force, 31 000 were misclassified as not having worked the last 12 months and 23 000 as having worked the last 12 months. Regarding the former, the main cause of the misclassification was the respondent failing to mention shorter jobs on the labour market. They did not remember short-term jobs or regarded them as not being significant enough to mention.

Memory error was not the cause of the misclassification in the original interview of the 23 000 persons outside the labour force as having worked the last 12 months. It was more a question of the instructions given on how to classify previous work. The instructions to interviewers state that shorter jobs on the labour market, e.g. a summer job, are not to be counted as previous work. If, however, a person doing the same job more frequently, e.g. every weekend between the holidays, is to be counted as previous work. Exactly how often the person is to have worked, apart from the example of "every weekend", is not defined, however. In other word, the limit is currently somewhat unclear.

The result of this is that in certain cases it will be an arbitrary decision as to whether a job is to be classified as previous work or not. For students, for example, it is common to work now and again at the same time as they are studying. Since there is no clear limit for when a job is to be classified as previous work or not, there is a risk of this group being misclassified.

Something which can further complicate matters for the interviewers is that shorter jobs on the labour market are to be considered as work during the period the person has worked. A person who has had a summer job is therefore classified as employed during the period that they worked. After the period, however, they are to be classified as not having worked previously.

For the 23 000 persons incorrectly classified, it is almost exclusively the case that summer jobs or similar short interventions on the labour market have been classified as previous work. The majority have worked at the time of a previous interview, which may have caused the misunderstanding when they have been interviewed again later. For a small number of them, the work they talked about as previous work experience was deemed not to be extensive enough to be counted. The work had extended beyond the holidays, which is one of the criteria, but had not been continually recurring, i.e. the respondent had only worked occasionally.

Furthermore, 24 000 unemployed persons who had not worked the last 12 months were incorrectly classified as not in the labour force. The explanation for the misclassification is not entirely clear-cut, but there are two areas that can be identified. Firstly, there is the previously mentioned definition of "looking for work" and secondly there was the fact that persons had a different definition of "work". They thought they were just looking for extra work or wanted to do work rehabilitation training. The respondents did not, in other words, think of the wider definition of work used in the LFS.

Of the temporarily employed, 10 000 had been classified as outside the labour force and having worked the last 12 months. The explanation for the misclassification was exclusively the definition of work used. The extent or nature of the work, i.e. it was not a question of regular jobs, meant that they were not considered as work and were therefore left out.

### 7.1.2 Men aged 15-74

**Net errors and misclassifications for labour force status**

**Table 11.**

**Estimates of men aged 15-74 by labour force status according to original interview and true value, Q4 2012, thousands. Uncertainty figures in italics**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 2438 | 1 | 2 | 2440 |
| | | *15* | *1* | *3* | *15* |
| Unemployed | (2) | 17 | 189 | 2 | 209 |
| | | *21* | *22* | *2* | *9* |
| Not in the labour force | (3) | 20 | 16 | 922 | 958 |
| | | *22* | *14* | *28* | *14* |
| Total | (4) | 2475 | 207 | 926 | 3607 |
| | | *33* | *26* | *28* | *0* |

The misclassifications of men in Table 11 are very reminiscent of those in the table for the entire population. Most of them are on the diagonal, which means that they were classified correctly in the original interview.

If we compare Table 7 for the population with Table 11, men constitute about half of the misclassifications of employed and unemployed persons who were incorrectly classified as not in the labour force. The similarities with the population are not as obvious for the other misclassifications.

**Table 12.**

**Net error by labour force status for men aged 15-74, Q4 2012, thousands. Uncertainty figures in italics**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -35 | 2 | 33 | 0.2 | -1.0 |
| *30* | *25* | *25* | *0.9* | *0.8* |

The results for men show that the net errors for the number of employed persons (35 000) and for the number not in the labour force (33 000) are both statistically significant. During the fourth quarter of 2012, the number of employed men was therefore underestimated by 35 000 and the number outside the labour force was overestimated by 33 000.

Compared to men in the entire population, i.e. men and women together, we can see that there are differences with regard to the net error. Of the statistically insignificant net error in the population of 40 000 employed persons, men made up 35 000. For men, however, the net error is statistically significant. Like the population, the number of persons outside the labour force is overestimated. Men make up about half (33 000) of the total net error, which was 68 000.

There is only one statistically significant misclassification involving a number of unemployed persons (16 000) being incorrectly classified as outside the labour force. This misclassification is a partial explanation for the net error for men outside the labour force and is mainly caused by the respondent misinterpreting the question about looking for work. This is partly caused, as before, by them interpreting the question as them having applied for work but also by them having looked for something they don't themselves define as work. Another reason can be identified and that is the question not being read properly by a small number of respondents. This was partly a question of the interviewer not underlining the fact that even looking for work of very limited scope constituted looking for work and partly due to the time period being misread. In the LFS, the reference period varies somewhat between the questions and errors can occur if the interviewer does not bring attention to the applicable period.

## Net error and misclassifications for degree of attachment

**Table 13.**

**Estimates of men aged 15-74, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 1769 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 1797 |
| employed | | *29* | *25* | *0* | *1* | *0* | *0* | *0* | *0* | *16* |
| Temporary | (2) | 3 | 279 | 0 | 0 | 1 | 0 | 2 | 0 | 284 |
| employed | | *6* | *12* | *0* | *0* | *1* | *0* | *3* | *0* | *10* |
| Self-employed and | (3) | 35 | 0 | 324 | 0 | 0 | 0 | 0 | 0 | 360 |
| family workers | | *20* | *0* | *23* | *0* | *0* | *0* | *0* | *0* | *13* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 15 | 1 | 85 | 2 | 1 | 0 | 0 | 103 |
| last 12 months | | *0* | *21* | *1* | *21* | *1* | *1* | *0* | *0* | *7* |
| Have not worked | (5) | 0 | 1 | 1 | 8 | 95 | 0 | 2 | 0 | 106 |
| the last 12 months | | *0* | *2* | *1* | *7* | *10* | *0* | *2* | *0* | *7* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 2 | 1 | 2 | 0 | 131 | 10 | 1 | 147 |
| last 12 months | | *0* | *3* | *2* | *2* | *0* | *14* | *9* | *2* | *9* |
| Have not worked | (7) | 0 | 0 | 16 | 0 | 11 | 19 | 644 | 0 | 691 |
| the last 12 months | | *0* | *0* | *21* | *0* | *13* | *24* | *35* | *0* | *11* |
| EX | (8) | 0 | 0 | 1 | 0 | 4 | 2 | 26 | 87 | 121 |
| | | *0* | *0* | *3* | *0* | *4* | *4* | *12* | *14* | *7* |
| Total | (9) | 1807 | 324 | 344 | 95 | 112 | 153 | 684 | 88 | 3607 |
| | | *36* | *34* | *31* | *22* | *17* | *27* | *38* | *15* | *0* |

Even for the variable degree of attachment, the misclassifications for men do not differ appreciably from the entire population. Most of them are on the diagonal, which means that they were classified correctly in the original interview.

**Table 14.**

**Net error by degree of attachment for men aged 15-74, Q4 2012, thousands. Uncertainty figures in italics**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| -10 | -40 | 15 | 8 | -6 | -6 | 7 | 32 |
| *32* | *33* | *29* | *22* | *16* | *26* | *37* | *14* |

The net errors also display similarities with those reported for the entire population in Table 10. Among men, the number of temporarily employed is underestimated by 40 000 and the number of persons with the degree of attachment EX is overestimated by 32 000. Other discrepancies are not statistically significant.

The underestimation of temporarily employed persons can be partially explained by them being misclassified as permanently employed in the original interview. Of those classified as permanently employed in the original interview, 27 000 were actually temporarily employed. As for the population as a whole, the main cause of the misclassification was that the respondents were unsure of the terms used in the LFS. They did not know what the concepts of permanent and temporary employment meant. A small number even made a projection of their current situation as they thought that they would continue working there and had hence interpreted their job as a permanent one. Permanent employment in LFS terms is having an open-ended contract, while the respondents in these cases thought that because they were going to continue working in their present job, they believed it was permanent when in fact it was temporary. A small amount of misclassifications were also caused by interviewers quite simply miscoding respondents during the interview.

Other misclassifications have occurred in the employed persons group. In the population, permanently employed persons were incorrectly classified as self-employed in the original interview. Men made up virtually all the misclassifications of permanently employed persons as self-employed. In contrast to the other misclassifications, both classifications were correct and such a change can occur without it being a question of a misclassification based on the current concept apparatus (see the section on the population). Self-employment is more common among men which can explain why that is where most of the misclassifications occur.

Another misclassification that was significant among both men and the population was in the group not in the labour force. This concern the classification of whether a person has or has not worked the last 12 months. Of those who had not worked the last 12 months, 10 000 had been incorrectly classified in the original interview as having done so. As for the population, the main cause of the misclassification was the guidelines and instructions given on how to classify a person's previous

work. Summer jobs or entirely temporary ones are not to be classified as previous work, which is what has happened for those persons who have been misclassified. A similar misclassification can also be noted in the group unemployed persons. Of unemployed persons who had worked the last 12 months, 8 000 had been misclassified as not having done so in the original interview. The main cause of this misclassification is a pure memory effect. The persons have forgotten shorter-term jobs when they were interviewed. The interviewers have, however, had a major influence on the process. If they have helped the respondents to remember by mentioning different time periods, e.g. worked since last summer, it would have been easier for the respondents to remember.

### 7.1.3 Women aged 15-74

Net errors and misclassifications for labour force status

**Table 15.**

**Estimates of women aged 15-74 by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 2182 | 17 | 5 | 2204 |
| | | *29* | *24* | *9* | *14* |
| Unemployed | (2) | 3 | 167 | 4 | 174 |
| | | *3* | *11* | *4* | *10* |
| Not in the labour force | (3) | 24 | 20 | 1101 | 1146 |
| | | *22* | *21* | *34* | *15* |
| Total | (4) | 2210 | 204 | 1110 | 3524 |
| | | *36* | *34* | *35* | *0* |

The results in Table 11 for men and in Table 7 for the whole population show major similarities with the table above where only women are presented.

Like men, the vast majority of women are on the diagonal which means that they were classified correctly in the original interview.

On the less detailed level, i.e. labour force status, there does not seem to be any major differences in misclassifications that depend on sex.

**Table 16.**

**Net error by labour force status for women aged 15-74, Q4 2012, thousands.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -5 | -30 | 35 | -1.1 | -0.1 |
| *34* | *32* | *32* | *1.3* | *1.0* |

The net errors for women were only significant for persons outside the labour force. The results indicated that persons outside the labour force were overestimated by 35 000. The underestimation of the number of employed persons that was previously reported was mainly focused on men.

In contrast to men, however, there was a significant misclassification of women, where a group of employed persons (24 000) were incorrectly classified as not in the labour force in the original interview. The corresponding misclassification for men was not significant but this may have been caused by chance as it was very close to being a significant discrepancy. As in previous presentations, the misclassification was mainly caused by the LFS definition of work not being conveyed clearly enough in the interviews.

## Net error and misclassifications for degree of attachment

**Table 17.**

**Estimates of women aged 15-74, by degree of attachment according to the original interview and the reinterview, Q4 2012, thousands. Uncertainty figures in italics**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 1621 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 1701 |
| employed | | *94* | *94* | *0* | *0* | *0* | *0* | *0* | *0* | *13* |
| Temporary | (2) | 19 | 333 | 0 | 17 | 0 | 0 | 0 | 0 | 369 |
| employed | | *21* | *32* | *0* | *24* | *0* | *0* | *0* | *0* | *12* |
| Self-employed and | (3) | 8 | 0 | 121 | 0 | 0 | 0 | 5 | 0 | 134 |
| family workers | | *9* | *0* | *14* | *0* | *0* | *0* | *9* | *0* | *7* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 2 | 1 | 74 | 1 | 2 | 0 | 0 | 81 |
| last 12 months | | *0* | *2* | *2* | *7* | *2* | *3* | *0* | *0* | *6* |
| Have not worked | (5) | 0 | 0 | 0 | 2 | 90 | 0 | 2 | 0 | 94 |
| the last 12 months | | *0* | *0* | *0* | *2* | *9* | *0* | *2* | *0* | *9* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 8 | 1 | 1 | 1 | 151 | 13 | 0 | 176 |
| last 12 months | | *1* | *6* | *2* | *1* | *2* | *18* | *14* | *0* | *10* |
| Have not worked | (7) | 0 | 10 | 0 | 0 | 13 | 12 | 737 | 3 | 774 |
| the last 12 months | | *0* | *20* | *0* | *0* | *18* | *20* | *37* | *4* | *14* |
| EX | (8) | 1 | 2 | 2 | 0 | 6 | 2 | 36 | 147 | 196 |
| | | *2* | *2* | *3* | *0* | *10* | *3* | *17* | *18* | *9* |
| Total | (9) | 1649 | 435 | 125 | 94 | 111 | 167 | 793 | 150 | 3524 |
| | | *97* | *101* | *15* | *25* | *23* | *27* | *43* | *18* | *0* |

Like men, the vast majority of women are on the diagonal which means that they were classified correctly in the original interview.

**Table 18.**

**Net error by degree of attachment for women aged 15-74 years, Q4 2012, thousands. Uncertainty figures in italics**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 52 | -66 | 9 | -13 | -17 | 9 | -19 | 46 |
| *96* | *101* | *13* | *24* | *21* | *26* | *42* | *17* |

The net errors do not differ too much from those among men, even if this is not a question of significant discrepancies apart from for women with the degree of

attachment EX. For women, the number of persons with this degree of attachment has been overestimated by 46 000 during the fourth quarter (Q4) of 2012.

A partial explanation for the overestimation of the number of women who are long-term ill can be found in the misclassification of the group not in the labour force. Of the women who were outside the labour force and who had not worked the last 12 months, 36 000 had been misclassified as EX. This misclassification was noted in the whole population. Neither does the cause of the misclassification among women differ too much from those among the population as a whole. It is still the control interviews and the instructions for the self-classifying question that have caused the error (see the section on the population). The vast majority of them should instead have been classified as old-age pensioners in this question.

Another significant misclassification in Table 17 is worth mentioning and this concern temporarily employed persons. Of the temporarily employed persons, 8 000 had been incorrectly classified as outside the labour force and as having worked the last 12 months. There were generally only a very small number of temporarily employed persons who were excluded. In some cases, the interviewer had not conveyed clearly enough the fact that work comprising of only a few hours should also be counted. In other cases, respondents themselves did not consider it to be work due to its scope or nature. It is once again a question of the LFS definition not being sufficiently well communicated.

The fact that the uncertainty figures differ between men and women as regards employed persons is due partly to the auxiliary information used in the estimation and partly to how the sample for the reinterview study was drawn. As a result of this, there are major discrepancies in weighting factors between various groups of individuals. The fact that the discrepancy between permanently and temporarily employed persons was statistically significant for men but not for women can be explained by fewer women than men provided the basis for the estimation, even if the enumerated number was higher - that the estimate for women was based on a smaller number of observations is however reflected by the higher uncertainty figure.

Appendix 10 presents estimates according to the original interview and the reinterview in the same way as above for the other populations groups.

## 7.2 Gross error for different population groups and variables

Only statistically significant misclassifications regarding degree of attachment and labour force status have been dealt with in the above chapter based on net errors and misclassifications in the original interview. The total number of discrepancies was naturally higher than what has been presented so far. The gross error is made up of the sum of the estimates that are outside the diagonal as a percentage of the total number of persons in the population group to which the results refer. The gross error can be said to be an estimate of the probability of being misclassified.

To illustrate how probable it is that a person is misclassified in general, a total risk of misclassification is presented below. It is partly a question of the rougher breakdown, labour force status, but also the more detailed breakdown, i.e. degree of attachment.

**Table 19.**

**Probability of misclassification of labour force status by sex, age and Swedish and foreign born persons, Q4, 2012**

| | Probability of misclassification | Uncertainty figures |
|---|---|---|
| Population aged 15-74 | 0.02 | 0.01 |
| Men | 0.02 | 0.01 |
| Women | 0.02 | 0.01 |
| 15-19 years | 0.01 | 0.02 |
| 20-24 | 0.03 | 0.02 |
| 25-64 | 0.02 | 0.01 |
| 65-74 | 0.02 | 0.02 |
| Swedish born | 0.01 | 0.01 |
| Foreign born | 0.04 | 0.03 |

The probability of a respondent being incorrectly classified as regards their labour force status is generally speaking very low. For the population as a whole, the probability is between 1 and 3 percent (0.02 ± 0.01). In other words, the risk of respondents being misclassified can be as low as 1 percent. For some of the sub-groups (15-19 year-olds and foreign born persons), the estimated error probability is even lower.

For foreign born respondents, the probability of being incorrectly classified is slightly higher than for other sub-groups. An explanation might be that some of the terms used in LFS can be difficult to understand for respondents who don't have a good command of the Swedish language.

**Table 20.**

**Probability of misclassification of degree of attachment by sex, age and Swedish- and foreign born persons, Q4, 2012**

| | Probability of misclassification | Uncertainty figures |
|---|---|---|
| Population aged 15-74 | 0.06 | 0.02 |
| Men | 0.05 | 0.02 |
| Women | 0.07 | 0.03 |
| 15-19 years | 0.07 | 0.05 |
| 20-24 | 0.11 | 0.05 |
| 25-64 | 0.05 | 0.02 |
| 65-74 | 0.07 | 0.04 |
| Swedish born | 0.06 | 0.02 |
| Foreign born | 0.07 | 0.03 |

Looking at the more detailed breakdown, we can see that the probability of misclassification is generally speaking a lot higher. This is perhaps not so surprising as the more detailed level demands more from the respondent in terms of understanding the different concepts and this in turn puts greater demands on their memory. To be classified correctly in terms of degree of attachment, the respondent must remember the final month of their latest employment given that it was about 12 months ago, as this distinction is used in LFS. Furthermore, they must also be aware of the type of employment they have, which, as we have seen above, has proven problematic for some.

Especially for persons aged 20-24, the probability of being incorrectly classified is higher than for other groups. Persons in this age group generally have a relatively loose attachment to the labour market and many switch back and forth between job-seeking, studying and employment. Of the reconciliations performed in the measurement error study, 20-24 year-olds made up 19 percent. The group constituted 13 percent of the sample and can therefore be seen as slightly overrepresented as regards the number of discrepancies. It has previously mentioned that shorter jobs are sometimes excluded and the question on whether the respondent has looked for work has occasionally been misinterpreted. There are therefore more discrepancies in groups with a labour market situation for which these questions are more relevant. In addition to the errors mentioned previously, there is one error that is particularly relevant for persons doing their first job making their first entry into the labour market and that concerns when they finished their last job. The instructions given to the interviewers state that summer jobs and shorter jobs on the labour market are not to be counted as previous working life experience, i.e. when they finished their last job. The instructions therefore leave scope for interpretations of what can be considered as shorter jobs. Even if the work was over the summer holidays, for example, it can be difficult to do a correct classification. The respondent may have had work now and again before and the interviewer can then make the assessment that it should be counted as previous working life experience.

# 8. Possible improvements to questionnaires, instructions and interviewer training

One aim of the measurement error study was, apart from estimating the size of measurement errors in the central variables, to acquire information about the causes of errors in the survey. This information is to be used to improve the questionnaire, and the interviewer instructions and training.

## 8.1 Identified problems/measurement errors

As Chapter 7 has indicated, the study has not shown any major systematic measurement errors (net errors) in the central variables of labour force status and degree of attachment. The two statistically significant measurement errors detected both concern the "not in the labour force" group. As regards the rougher breakdown labour force status, it is a question of an overestimation of persons outside the labour force. This means that the number of persons in the labour force (employed and unemployed persons together) is underestimated. Of those classified in the original interview as "not in the labour force", 45 000 were employed and 36 000 were unemployed after true value had been established (see Table 7).

The fact that persons who were actually employed were incorrectly classified as "not in the labour force" was mainly due to the definition of work used in the LFS. It is sufficient for a person to work one hour for remuneration or for the purpose of generating income for it to be considered "work". As regards persons who should have been classified as unemployed, the misclassification mostly depended on the way the questions were formulated. The interviewer asks the respondent whether they have looked for work over the past 4 weeks, which is interpreted by many as meaning whether they had applied for a job.

For the more detailed variable degree of attachment, the measurement error was mostly down to a change in the "Not in the labour force" group. There were two main groups that were misclassified in the original interview. One group was persons who were classified as long-term ill (EX) in the original interview, but who, after true value was established, were shown to be still outside the labour force but belonging to the group "not worked the last 12 months". The other group was persons who according to the original interview had worked the last 12 months, but who actually belonged to the group "not worked the last 12 months". This applied primarily to persons who did not have a permanent attachment to the labour market, but had done just shorter-term jobs on the labour market, e.g. holiday jobs. This type of work is not to be counted as previous work according to the instructions.

For the first group, i.e. persons incorrectly classified as EX, the misclassifications were due partly to the way the persons were classified in the original interview in

the LFS, using a self-assessment question, and partly to the survey design aimed at how to deal with those who had been classified as long-term ill in previous interviews. Most of those classified as long-term ill were not contacted every quarter but instead were only contacted once a year and assumed to be still long-term ill in the quarters in between long-term ill When they are contacted next time, they receive the question whether they believe they are going to be ill for at least the next 12 months, which is a leading question. It is easy to answer in the affirmative, even if the conditions have actually changed, at least according to LFS definitions. An example in which there is a risk of misclassification is persons who have become old-age pensioners since the last time they were interviewed and hence should be classified as such. Other groups also risk being misclassified since no follow-up questions are asked about work, job-seeking or education if the respondent answers yes to the first question.

Regarding the other group, persons incorrectly classified as having worked the last 12 months but who actually belong to the "not worked the last 12 months" group, the misclassifications were mainly due to ambiguities in the instructions. The instructions state that short term jobs on the labour market, such as a summer job, are not to be counted as previous work. If, on the other hand, the person has had the same job on a more regular basis, then this should be counted as previous work. How often the person is supposed to have worked is not stipulated, other than in the example "every weekend". But there is nothing stipulated about how to assess less frequent jobs/ work, e.g. working every other weekend or once a month. It is common for students to work now and again parallel with their studies, and since there is no clear borderline regarding when a job is to be classified as previous work, there is a risk of this group being misclassified.

Something which further complicates the matter, not least for the interviewers, is the way having worked during the reference period is defined in the LFS. Here, all work, including shorter jobs on the labour market, is to be considered as work if it occurs during the reference period. Since the measurement error study was performed during the LFS reference period October-December 2012, a large share of the persons had previously been interviewed in LFS rounds in July-September. A person who had a summer job in July was therefore classified as employed during the period, but in October, the same person was classified as not having had a job previously. Even more confusing was the fact that the interview in October was often performed as a control interview, which meant starting by checking whether the respondent still had the same job as they had had in July. It was easy for both the respondent and the interviewer to think that a temporary summer job was supposed to be counted as previous work, which was also the most common cause of misclassification.

There are two more problem areas regarding degree of attachment which are worth mentioning. Firstly, a transition from permanent to temporary employment, and secondly a shift from self-employed to permanently employed (See Table 9). Although these problems have not caused any statistically significant net error (according to Table 10), they nevertheless deviate quite clearly from the diagonal in Table 9, which indicates that quite a large number of people had indeed changed their degree of attachment.

The main cause of persons being classified as permanently employed when they actually had a temporary job was the inability of the respondent to understand the concept of permanent versus temporary employment. As regards persons who had gone from being self-employed to permanently employed, it was not actually a question of misclassification. It was more a problem of insufficient clarity in the interviewer instructions.

## 8.2 Proposals for improvements

A total of six major problem areas that can cause measurement error have been identified in LFS. It is a question of the definition of work, the questionnaire for job-seekers, the way of classifying "long-term ill persons", the definition of "worked the last 12 months", the concepts of permanent versus temporary employment and the classification of self-employed persons. Proposals for improvements to the questionnaire and to the instructions are given below.

### 8.2.1 Definition of work in LFS

The LFS definition of work during the reference period does not always tally with the respondents' picture of what having a job involves, which has led to the number of employed persons being underestimated in the measurement error study. According to ILO guidelines, all work performed for remuneration or for income-generation purposes is to be counted in LFS. This means, for example, that being on the board of a company or organisation or having a political function for which one receives remuneration is to be included, as is work as a self-employed person for which one doesn't take out salary. Furthermore, it is sufficient if one has only worked for one hour during the reference week for it to be counted as work. In most cases where discrepancies occur, it is the scope and nature of the work that has led the respondent not to consider it as work and hence has not mentioned it during the original interview.

One way of clarifying what is meant by work is to emphasise the LFS definition of work at the beginning of the interview even more than is currently the case. The respondent is currently asked an introductory question whether he or she has worked at all during the reference week. If the respondent answers no to this question, the interviewer is then to read a supplementary text that says "We are interested in all kinds of work, even if it was just for a few hours". The text may need to be improved so that the respondent realises that even just a few hours work is to be counted and that it is not just a question of regular jobs. The respondent does not currently receive the information that one hour of work is sufficient and that it may be a question of different types of jobs.

### 8.2.2 Wording of question about job-seeking

Another problem area that is in need of review is the question on looking for work. The question says "Have you looked for work the last 4 weeks?" This also applies to work of only a few hours, or if you have tried to establish yourself as self-employed". Some people, often those only looking for work on only a small scale, interpret the question as having submitted an application to an employer. The wording needs therefore to be adapted so that it covers the wider concept of job-seeking as it is defined in LFS. A wording needs to be found that corresponds more

exactly to the sample question issued by ILO, which is "Have you looked for work?"

The second part of the question, "This also applies to work of only a few hours, or if you have tried to establish yourself as self-employed", is not particularly well worded either. This is more likely to confuse rather than clarify and also needs to be reviewed.

### 8.2.3 Classification of "long-term ill persons"

The reasons why persons incorrectly classified as long-term ill instead of as old-age pensioners vary depending on which interview round it is. At the first interview, respondents are classified using a self-assessment question, in which they are asked to state what they mostly consider themselves as. Many older people have aches, pains and illnesses which cause them to consider themselves as long-term ill rather than as old-age pensioners. The interviewer instructions for the question do indeed state that old-age pensioners are to be classified as pensioners, but it also says at the beginning that it is the respondent's opinion that counts. The instructions are also somewhat unclear as regards the difference between old-age pensioners and those on early retirement (which is the terminology used). This leads to some people being misclassified as long-term ill even though they are old-age pensioners. The interviewer instructions therefore need to be clearer in this area.

Furthermore, the interview system should include an age control which kicks in if a person who is over 65 answers that he or she is long-term ill. Controls are often used as a aid to the interviewer to check how reasonable an answer is and in this case the interviewer will be alerted to the fact that the person is over 64 years of age. An alternative to controls is to ask a question to respondents who have reached retirement age whether they are paid an old-age pension or not.

If a person is classified as long-term ill, he or she is often not interviewed again three months later, which is the usual procedure in LFS. Instead the interview remains "dormant" for at least two rounds. The following interview is performed as a control interview, and the first questions is: "At the time of your last interview, you were long-term ill. Do you think you will be so for another year?". The question looks both forward and back in time, and is also a leading question, so it is easy for the respondent to just agree. Since up to a year may have passed since the first interview was performed, the person may have retired in the meantime or his or her circumstances may have changed in some other way. The current control question needs therefore to be reviewed and changed. Furthermore, the person's age could be used to ask direct questions about whether the person has become an old-age pensioner.

It is not just pensioners who risk being misclassified, however. Other classifications can also be wrong due to the way "long-term ill persons" are dealt with in the control interview. If the respondent answers yes to the question, no follow-up questions are asked about work, job-seeking or education. A person can of course be long-term ill and also look for work or study, and this shows a serious

shortcoming in the current control questionnaire. Control questions on job-seeking and employment need to be asked in order to reduce the risk of misclassification.

### 8.2.4 Definition of "worked during the last 12 months"

The problem with the definition of "Having worked the last 12 months" is primarily caused by a lack of clarity in the instructions. Temporary work is not to be counted, but there is a lack of clear guidelines for how long-term or frequent a job is to be for it to be counted as "having worked the last 12 months". The instructions therefore need to be clarified considerably so that it is not a matter of judgement whether something is to be counted as work during the last 12 months or not.

The instructions need to be clearer as regards why the definition of "work the last 12 months" is different to the LFS definition concerning work during the reference period. It is confusing for the interviewers that temporary interventions on the labour market are to be counted in one case but not in another and it needs to be made clearer why there is a difference.

It may also be necessary to review how the control interview works for persons who had a holiday job last time they were interviewed. It isn't particularly good to start with the question "The last time you were interviewed, you worked at (company's name). Was it still your main work during the week (reference week)?"

### 8.2.5 Permanently versus temporarily employed

When it comes to permanent and temporary employment, it is mainly the terminology itself that is problematic. Some persons, especially those who are young and foreign born, don't know what permanent and temporary employment are. Some persons with temporary employment say they are permanently employed since their work has no time limit, it just "carries on". To investigate whether it is a matter of a permanent or a temporary job, the interviewer often asks follow-up questions concerning whether there is a contract for a specific time period or whether the job has a final date. But many who have temporary jobs say that they don't have a contract and it is therefore a question of what the legislation specifies in this area.

The legislation therefore needs to be reviewed to make it clear which follow-up questions are appropriate to ask.

It may be a question of the respondent answers based on what he or she knows or believes will happen in the future. A person with trial employment, or who has been promised a permanent position, may very well answer based on their future situation rather than on their current one.

Furthermore, the question should be adapted so that it tallies better with the respondent's use of language. A qualitative study in which respondents are allowed to describe in their own words how they view their employment would be a good starting-point from which to find a better wording for the question.

### 8.2.6 Classification of self-employed persons

When it comes to distinguishing self-employment from employment, it is not the wording of the questions that cause the discrepancy but it is rather a question of the instructions given to interviewers. In a strictly legal sense, a self-employed person is someone who runs their own firm as a limited company and is employed in that company. But if the firm only has a few employees, the interviewer instructions say that it is up to the respondent to determine whether they consider themselves to be self-employed or not. What is meant by "a few employees" is not made clear in the instructions. The reason is that there is no clear definition as to where the boundary for number of employees is to be drawn. The guidelines issued by Eurostat for whether a person is to be classified as employed or self-employed are intended for use by all Member States and can therefore not be too strict. There is certain scope for interpretation as regards whether a person is to be classified as self-employed or employed. A first step to clarifying the interviewer instructions is therefore to study the ILO guidelines more thoroughly to find out what they actually say about this, and see whether LFS in Sweden actually follow the directives in this area to the letter. Any remaining ambiguities after such a review must then be described for Eurostat so that they can issue clarification. The next step is to draft clear rules for when a person is to be classified as employed and self-employed respectively.

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# 10. Appendices

## 10.1 Appendix 1 Labour force status and degree of attachment in LFS

The following categories of labour force status are used in LFS:

1) Not in the labour force

2) Employed – In work

3) Employed – Absent the entire week

4) Unemployed

5) Not in the labour force Not in the labour force (long-term ill)

The following degrees of attachment are used in LFS:

2 Temporarily employed

3 Self-employed or freelancer

4 Family worker

5 Out of work – has worked the last 12 months

6 Out of work – has not worked the last 12 months

7 EX - long-term ill for 12 months or more

11 Permanent employee

12 Temporarily employed with an underlying permanent position

**Table 21.**

**Breakdown of degree of attachment over labour force status**

| | Labour force status | | | | |
|---|---|---|---|---|---|
| Degree of attachment | **1** | **2** | **3** | **4** | **5** |
| 2 | | X | X | | |
| 3 | | X | X | | |
| 4 | | X | X | | |
| 5 | X | | | X | |
| 6 | X | | | X | |
| 7 | | | | | X |
| 11 | | X | X | | |
| 12 | | X | X | | |

## 10.2 Appendix 2 Procedure for determining sample size per substratum

To achieve the criteria presented in Section 4.4 as far as possible, the sample sizes have been determined based on an assumption that the response behaviour of persons in LFS month m 2012 tallies with the actual response behaviour in month m 2011.

The diagram below shows the stepwise procedure used in August to determine sample sizes for the reference months of October, November and December. The results for October are given as an example, but the same process was used for November and December:

1) Sub-sample 1 is assumed to make up 215/290 of the total monthly sample (actual situation October 2011). Expected number of participants in the reinterview (RI) is to amount to

a) about 62 persons (=215*83/290) per rotation group in sub-sample 1

b) about 62 persons (=215*83/290) per outcome of degree of attachment (see Chapter 3.1) (i.e. regular interview) in sub-sample 1

c) about 21 persons (=75*83/290) per rotation group in sub-sample 2

d) about 21 persons (=75*83/2909 per outcome of degree of attachment LFS (i.e. regular interview) in sub-sample 2

2) Probability of a person participating in ÅI, given that the person has participated in LFS, is assumed to be 0.75.

3) In combination with the empirical response information from October 2011, it follows from 1) and 2) that the sample size for substratum 1 is set at 118. Analogically, the sample size for sub-stratum 11 is initially set to 42.

4) For substrata, the sample size is set at 100 per substratum, which, in combination with the empirical response information from October 2011 and 2) that, corresponds to about 15 respondents in RI per substrata.

Based on the established sample sizes for substrata 1, 2, 11 and 12, the expected number of respondents in LFS (and RI) by degree of attachment is estimated based on the empirical data from last year. In combination with 1), 2) and the empirical data from last year, an equation system is created with eight equations and eight unknowns, the solution of which gives the sample sizes from substrata 3-10 and 12-20.

In practice, the solution of the equation system must be adjusted, since the solution of the system can lead to negative random text sample sizes. This adjustment is made by setting the smallest sample size allowed to 30 for substrata 3-10 and 20 for substrata 12-20.

In summary, the stepwise procedure gives the following results for October.

**Table 22.**

**Sample size by substratum and expected participation**

| Substratum | Sample size | Expected number of participants in LFS | Expected number of participants in RI |
|---|---|---|---|
| 1 | 118 | 82 | 62 |
| 2 | 100 | 20 | 15 |
| 3 | 30 | 28 | 21 |
| 4 | 30 | 27 | 21 |
| 5 | 78 | 72 | 54 |
| 6 | 203 | 185 | 139 |
| 7 | 116 | 108 | 81 |
| 8 | 137 | 124 | 93 |
| 9 | 30 | 28 | 21 |
| 10 | 79 | 77 | 58 |
| 11 | 42 | 29 | 22 |
| 12 | 100 | 19 | 14 |
| 13 | 20 | 19 | 14 |
| 14 | 20 | 18 | 14 |
| 15 | 30 | 28 | 21 |
| 16 | 49 | 43 | 33 |
| 17 | 40 | 38 | 28 |
| 18 | 34 | 30 | 23 |
| 19 | 20 | 19 | 14 |
| 20 | 26 | 26 | 19 |
| Total | 1302 | 1020 | 767 |

When drawing the sample for October, it was decided to:

– adjust the sample size in substrata 2 and 12 up to 150

– set the smallest sample size to 30 for all the substrata

– round off to the nearest five-digit number

To ensure that the sub-samples for November and December were drawn according to the same principle at the sub-sample for October, the abovementioned procedure was also used for November and December. This also means that the stepwise procedure was also used for these months, adjusted only afterwards according to the above bullet points.

## 10.3 Appendix 3: Definition of target characteristics

A theoretical framework is required to be able to define the estimated values. In the diagram below:

- $U = \{1,...,k,...,N\}$ denotes the target population which is of interest
- $t$ denotes the reference year and $M$ denotes the reference month
- $\mathbf{z}_{k,t,M} = (z_{1k,t,M},...,z_{dkt,M},...,z_{Dk,t,M})'$ denotes the classification vector for year $t$, month $M$, according to the measurement in the regular LFS, where
- $z_{dk,t,M} = \begin{cases} 1 & \text{if } k \text{ associates with class } d \text{ according to the "regular" LFS} \\ 0 & \text{else} \end{cases}$
- $\mathbf{y}_{k,t,M} = (y_{1k,t,M},...,y_{dk,t,M},...,y_{Dk,t,M})'$ denotes the classification vector for year $t$, month $M$, after reinterview and any subsequent reconciliation and establishment of true value, where
-

$$y_{dk,t,M} = \begin{cases} 1 & \text{if } k \text{ associates with class } d \text{ after reinterview and possible following and following reconciliation and establishing of true value} \\ 0 & \text{else} \end{cases}$$

and

- $s_{1,t,M}$ denotes regular LFS sample year $t$, month $M$

The classification that results from the measurement in the regular LFS is assumed to adhere to a misclassification model $\mu$ according to which $z_{dk,t,M}$ is a stochastic variable such that

$$E_\mu(z_{dk,t,M} \mid s_{1,t,M}) = \Pr(z_{dk,t,M} = 1 \mid s_{1,t,M}) = \theta_{dk,t,M}$$

i.e. the misclassification probability for individual $k$ is assumed to be same regardless of which sample is realized. It therefore also follows thatt

$$C_\mu(z_{dk,t,M}, z_{d'l,t,M} \mid s_{1,t,M} \ni \{k,l\}) = \begin{cases} \theta_{dk,t,M}(1-\theta_{dk,t,M}) & \text{om } k = l \text{ och } d = d' \\ -\theta_{dk,t,M}\theta_{d'k,t,M} & \text{om } k = l \text{ och } d \neq d' \\ 0 & \text{else} \end{cases}$$

It is further assumed that the classification obtained after reinterview and any subsequent reconciliation and establishment of true value is error-free.

Let

$$I_{k\gamma} = \begin{cases} 1 & \text{if } k \text{ belong to study domain } \gamma \\ 0 & \text{else} \end{cases}$$

and let $\mathbf{\Phi}_{k,t,M} = \boldsymbol{\theta}_{k,t,M}\mathbf{y}'_{k,t,M}$, where $\boldsymbol{\theta}_{k,t,M} = (\theta_{1k,t,M},...,\theta_{dkt,M},...,\theta_{Dk,t,M})'$. Element $dd'$ in matrix $\mathbf{\Phi}_{k,t,M}$ can be interpreted as the probability of individual $k$ for year $t$, month $M$, associated with class $d$ in the regular LFS and class $d'$ after reinterview and any subsequent reconciliation and establishment of true value. It follows therefore that element $dd'$ in matrix

$$\mathbf{T}_{\mathbf{\Phi},t,M,\gamma} = \sum_{k\in U} I_{k\gamma}\mathbf{\Phi}_{k,t,M}$$

represents the number of individuals in study domain $\gamma$ is expected to be associated with class $d$ in the regular LFS and class $d'$ after reinterview and any subsequent reconciliation and establishment of true value.

In the measurement error study, the most important target characteristic is constituted by a weighted quarterly mean value of matrix $\mathbf{T}_{\mathbf{\Phi},t,M,\gamma}$ for the final quarter (Q4) of 2012, where each month is given a weight that is proportional to the number of measurement weeks in the month. Mathematically, this can be expressed as

$$\mathbf{T}_{\mathbf{\Phi},t,\gamma} = \sum_{M=10}^{12} w_M \mathbf{T}_{\mathbf{\Phi},t,M,\gamma}$$

where $w_M = 4/13$ for $M = 10$, 11 (October and November) and $w_M = 5/13$ for $M = 12$ (December). Based on matrix $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$ we can study both the expected number of individuals who are misclassified (gross error) and the expected effect that the use of the error-strewn classification method has on important values.

In the measurement error study, the gross error that is of interest is constituted by the non-diagonal element in $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$. Net error will be studied regarding the difference between the expected number associated with a certain class when using the error-strewn classification method and the number of individuals associated with the class when the classification is error-free. Mathematically, this kind of net error can be expressed as

$$\mathbf{d}_\gamma = \mathbf{T}_{\mathbf{\Phi},t,\gamma}\mathbf{1} - \mathbf{T}'_{\mathbf{\Phi},t,\gamma}\mathbf{1} = \sum_{M=10}^{12} w_M \sum_{k\in U} I_{k\gamma}\boldsymbol{\theta}_{k,t,M} - \sum_{M=10}^{12} w_M \sum_{k\in U} I_{k\gamma}\mathbf{y}_{k,t,M}$$

Furthermore

$$\delta_{empl,\gamma} = \frac{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma} \theta_{1k,t,M}}{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma}} - \frac{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma} y_{1k,t,M}}{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma}}$$

and

$$\delta_{unemp,\gamma} = \frac{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma} \theta_{2k,t,M}}{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma} (\theta_{1k,t,M} + \theta_{2k,t,M})} - \frac{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma} y_{2k,t,M}}{\sum_{M=10}^{12} w_M \sum_{k \in U} I_{k\gamma} (y_{1k,t,M} + y_{2k,t,M})}$$

where class 1 corresponds to employed persons and class 2 corresponds to unemployed persons, will be studied. For interpretation purposes, these values are also to be considered as net error – $\delta_{empl,\gamma}$ denotes the difference between expected employment rate when using the error-strewn classification method and the actual employment rate while $\delta_{unemp,\gamma}$ denotes the difference between the expected relative unemployment rate when using the error-strewn classification method and the actual relative unemployment rate. We can also show that $\delta_{empl,\gamma}$ and $\delta_{unemp,\gamma}$ can be expressed as functions of the elements in matrix $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$.

The values $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$, $\mathbf{d}_\gamma$, $\delta_{empl,\gamma}$ and $\delta_{unemp,\gamma}$ will be estimated for all the study domains specified in Section 4.3.

## 10.4 Appendix 4. Point estimation

**Estimation under ideal response conditions**

In LFS it is true that $s_{1,t,M}$, the sample for month $M$, year $t$, t, is made up of the union of two in principle independent sub-samples, each of which was drawn as an independently stratified sample without resetting. Let $s_{1_1,t,M}$ ($s_{1_2,t,M}$) denote the $n_{1_1,t,M}$ ($n_{1_2,t,M}$) individuals in sub-sample 1 (2), and let $s_{1_1,t-j,M}$ ($s_{1_2,t-j,M}$) denote the $n_{1_1,t-j,M}$ ($n_{1_2,t-j,M}$) individuals in sub-sample 1 (2) who come from the annual sample for year $t-j$, $j=0,1$. Different stratification principles have been used for the two sub-samples. Let $s_{1_1,t,M,h}$ ($s_{1_2,t,M,h'}$) denote the subset of $s_{1_1,t,M}$ ($s_{1_2,t,M}$) who come from stratum $h=1,...,H$ ($h'=1,...,H'$). Also let $s_{1_1,t-j,M,h}$ ($s_{1_2,t-j,M,h'}$) denote the subset of $n_{1_1,t-j,M,h}$ ($n_{1_2,t-j,M,h'}$) individuals in $s_{1_1,t,M,h}$ ($s_{1_2,t,M,h'}$) who come from the annual sample for year $t-j$, $j=0,1$.

Let $\mathbf{x}_1$ denote the auxiliary vector used in the regular LFS. For the variables that are included in the auxiliary vector, relevant values on the individual level are retrieved from *the Public Employment Service's job-seeker register, the Employment Register (SREG), the Total Population Register (RTB), the Register of Earnings and Taxes (IoT)* and *the Longitudinal Integration Database for Sickness Benefit and Labour Market Studies (LISA)*, which is why the value $\mathbf{x}_{1k,t,M}$ is known for each month during the reference year for all $i \in U$. Also let $\mathbf{x}_2 = (\mathbf{x}'_{2A}, \mathbf{x}'_{2B}, \mathbf{x}'_{2C})'$, where the vectors $\mathbf{x}_{2A}$, $\mathbf{x}_{2B}$ and $\mathbf{x}_{2C}$ are defined in Appendix 5. Since $\mathbf{x}_2$ is defined based on the LFS variables Grad and Arbstatus, $\mathbf{x}_{2k,t,M}$ are only known for $k \in s_{1,t,M}$.

In order to draw the sample for the measurement error study, $s_{2,t,M}$, the sample is divided $s_{1,t,M}$ into substrata according to the description above. Let $s_{1,t,M,g}$ denote the set of $n_{1,t,M,g}$ individuals included in substratum $g$ and let $s_{2,t,M,g}$ denote the $n_{2,t,M,g}$ individuals who make up the sub-sample drawn from $s_{1,t,M,g}$ for reinterview ($g=1,...,G$).

For $k \in \cup_{g=1}^{G} s_{2,t,M,g}$ it is noted that $y_{d'k,t,M}$, which is why the variable

$$v_{dd'k,t,M} = \begin{cases} 1 & \text{if } z_{dk,t,M}\, y_{d'k,t,M} = 1 \\ 0 & \text{else} \end{cases}$$

is known for $k \in \cup_{g=1}^{G} s_{2,t,M,g}$, for $d=1,...,D$ and $d'=1,...,D$.

For $k \in (s_{1_1,t-j,M} \cup s_{1_2,t-j,M})$, let

$$d_{1k} = \begin{cases} N_{h(k)} / n_{1_1,t-j,M,h(k)} & \text{for } k \in s_{1_1,t-j,M} \\ N_{h'(k)} / n_{1_1,t-j,M,h'(k)} & \text{for } k \in s_{1_2,t-j,M} \end{cases}$$

where $h(k)$ denotes the stratum that individual $k$ belonged to when was drawn $s_{1_1,t-j,M}$ and $h'(k)$ denotes the stratum that individual $k$ belonged to when was drawn $s_{1_2,t-j,M}$, $j = 0,1$. For $k \in s_{2,t,M}$, let

$$d_{2k} = n_{1,t,M,g(k)} / n_{2,t,M,g(k)}$$

where $g(k)$ denotes the stratum that individual $k$ belonged to when was drawn $s_{2,t,M}$. Finally, let $a_k$ denote the non-random individual weight used in LFS for weighing together the various annual samples for sub-samples 1 and 2 and define

$$\mathbf{t}_{\mathbf{x}_1} = \sum_{M=10}^{12} \sum_{k \in U} w_M \mathbf{x}_{1k,t,M},$$

$$\hat{\mathbf{t}}_{\mathbf{x}_1 s_1} = \sum_{M=10}^{12} \sum_{j=0}^{1} \left( \sum_{k \in s_{1_1,t-j,M}} d_{1k} w_M a_k \mathbf{x}_{1k,t,M} + \sum_{l \in s_{1_2,t-j,M}} d_{1l} w_M a_l \mathbf{x}_{1l,t,M} \right),$$

$$\hat{\mathbf{t}}_{\mathbf{x}_2 s_1} = \sum_{M=10}^{12} \sum_{j=0}^{1} \left( \sum_{k \in s_{1_1,t-j,M}} d_{1k} w_M a_k \mathbf{x}_{2k,t,M} + \sum_{l \in s_{1_2,t-j,M}} d_{1l} w_M a_l \mathbf{x}_{2l,t,M} \right),$$

$$\hat{\mathbf{t}}_{\mathbf{x}_2 s_2} = \sum_{M=10}^{12} \sum_{k \in s_{2,t,M}} d_{1k} d_{2k} w_M a_k \mathbf{x}_{2k,t,M},$$

$$\hat{t}_{v_{dd'} s_2, \gamma} = \sum_{M=10}^{12} \sum_{k \in s_{2,t,M}} d_{1k} d_{2k} I_{k\gamma} w_M a_k v_{dd'k,t,M},$$

$$\hat{\mathbf{B}}_{1dd',\gamma} = \hat{\mathbf{T}}^{-1}_{\mathbf{x}_1 \mathbf{x}_1 s_1} \hat{\mathbf{T}}_{\mathbf{x}_1 \mathbf{x}_2 s_1} \hat{\mathbf{B}}_{2dd',\gamma},$$

where

$$\hat{\mathbf{T}}_{\mathbf{x}_1 \mathbf{x}_1 s_1} = \sum_{M=10}^{12} \sum_{j=0}^{1} \left( \sum_{k \in s_{1_1,t-j,M}} d_{1k} w_M a_k \mathbf{x}_{1k,t,M} \mathbf{x}'_{1k,t,M} + \sum_{l \in s_{1_2,t-j,M}} d_{1l} w_M a_l \mathbf{x}_{1l,t,M} \mathbf{x}'_{1l,t,M} \right)$$

$$\hat{\mathbf{T}}_{\mathbf{x}_1\mathbf{x}_2 s_1} = \sum_{M=10}^{12}\sum_{j=0}^{1}\left( \sum_{k\in s_{1_1,t-j,M}} d_{1k} w_M a_k \mathbf{x}_{1k,t,M}\mathbf{x}'_{2k,t,M} + \sum_{l\in s_{1_2,t-j,M}} d_{1l} w_M a_l \mathbf{x}_{1l,t,M}\mathbf{x}'_{2l,t,M} \right)$$

and

$$\hat{\mathbf{B}}_{2dd',\gamma} = \hat{\mathbf{T}}^{-1}_{\mathbf{x}_2\mathbf{x}_2 s_2}\hat{\mathbf{T}}_{\mathbf{x}_1 v_{dd' s_2},\gamma}$$

where

$$\hat{\mathbf{T}}_{\mathbf{x}_2\mathbf{x}_2 s_2} = \sum_{M=10}^{12}\sum_{k\in s_{2,t,M}} d_{1k} d_{2k} w_M a_k \mathbf{x}_{2k,t,M}\mathbf{x}'_{2k,t,M}$$

and

$$\hat{\mathbf{T}}_{\mathbf{x}_1 v_{dd' s_2},\gamma} = \sum_{M=10}^{12}\sum_{k\in s_{2,t,M}} d_{1k} d_{2k} I_{k\gamma} w_M a_k \mathbf{x}_{2k,t,M} v_{dd'k,t,M}$$

An approximate, expected estimator for element $dd'$ in matrix $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$ is then given by

$$\tilde{t}_{v_{dd'},\gamma} = (\mathbf{t}_{\mathbf{x}_1} - \hat{\mathbf{t}}_{\mathbf{x}_1 s_1})\hat{\mathbf{B}}_{1dd',\gamma} + (\hat{\mathbf{t}}_{\mathbf{x}_2 s_1} - \hat{\mathbf{t}}_{\mathbf{x}_2 s_2})\hat{\mathbf{B}}_{2dd',\gamma} + \hat{t}_{v_{dd' s_2},\gamma}$$

By selecting $v_{dd'}$ for all combinations of $d = 1,...,D$ and $d' = 1,...,D$, it follows that this estimator can be used to estimate all elements in matrix $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$. Let $\hat{\mathbf{T}}_{\mathbf{\Phi},t,\gamma}$ denote the estimator obtained via this procedure. Since all target values of interest can be expressed as rational functions of the elements in $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$, $\hat{\mathbf{T}}_{\mathbf{\Phi},t,\gamma}$ can be used to estimate these values.

**Estimation in practice**

In practice there will be non-response in both the first and the second phase of the study.

Let $r_{1_1,t-j,M,h}$ ($r_{1_2,t-j,M,h'}$) denote the $m_{1_1,t-j,M,h}$ ($m_{1_2,t-j,M,h'}$) individuals in $s_{1_1,t-j,M,h}$ ($s_{1_2,t-j,M,h'}$) who belong to the response set in the regular LFS $j = 0,1$, and let

$$\tilde{d}_{1k} = \begin{cases} N_{h(k)} / m_{1_1,t-j,M,h(k)} & \text{for } k \in \cup_{h=1}^{H} r_{1_1,t-j,M,h} \\ N_{h'(k)} / m_{1_2,t-j,M,h'(k)} & \text{for } k \in \cup_{h'=1}^{H} r_{1_2,t-j,M,h'} \end{cases}$$

Also let $r_{1,t,M,g}$ denote the $m_{1,t,M,g}$ individuals in $r_{1,t,M}$ who are put into group $g$, let $r_{2,t,M,g}$ denote the $m_{2,t,M,g}$ individuals who belong to the response set in the reinterview study

$$\tilde{d}_{2k} = m_{1,t,M,g(k)} / m_{2,t,M,g(k)}$$

The estimator that is in practice used to estimate element $dd'$ in matrix $\mathbf{T}_{\mathbf{\Phi},t,\gamma}$ is obtained by $\tilde{t}_{v_{dd'},\gamma}$ replacing

- $d_{1k}$ with $\tilde{d}_{1k}$
- $d_{2k}$ with $\tilde{d}_{2k}$

$a_k$ with $\tilde{a}_k$, where $\tilde{a}_k$ is a version of $a_k$ intended to compensate for non-response in the regular LFS in all places where these weights occur.

This procedure is equivalent to using design strata as response homogeneity groups in the first phase, while substrata are used as response homogeneity groups in the second phase. This procedure involves assuming that the following model is a good description of the actual, unknown, response behaviour:

- $\Pr(k \text{ answers} \mid s_{1,t,M}) = \begin{cases} \pi_{1,h(k)} & \text{for } k \in s_{1_1,t-j,M} \\ \pi_{1,h'(k)} & \text{for } k \in s_{1_2,t-j,M} \end{cases}$

- $\Pr(k \text{ answers} \mid r_{1,t,M}) = \pi_{2,g(k)}$

According to the model, the probability of an individual participating in the regular LFS is only dependent on which design stratum the individual belongs to. For the reinterview study, the probability of a selected individual, who has also participated in the regular LFS, participating is only dependent on which substratum the individual belongs to. If the model is a good description of the actual, unknown response behaviour, both the point and the mean error estimators will continue to be approximately as expected. In practice, however, it is not possible to determine whether the model is reasonable or not.

*Comment:* The definitions of the vectors $\mathbf{x}_1$ and $\mathbf{x}_2$ are such that the matrix $\hat{\mathbf{T}}_{\mathbf{x}_2\mathbf{x}_2 s_2}$ will not be of full rank, which means that the matrix $\hat{\mathbf{T}}^{-1}_{\mathbf{x}_2\mathbf{x}_2 s_2}$ does not exist. This is dealt with in ETOS by reducing the vector $\mathbf{x}_2$ to one dimension that guarantees that estimates can be calculated. The ETOS user however works

exclusively with the vector $\mathbf{x}$; the reduced vector is created automatically by the software in connection with execution.

## 10.5 Appendix 5. Definition of auxiliary vectors

Each of the vectors $\mathbf{x}_{2A}$, $\mathbf{x}_{2B}$ and $\mathbf{x}_{2C}$ is an indicator vector, i.e. an vector with zeros (0) on all rows apart from one, which will contain a one (1). The following table shows in which row the one (1) will occur.

**Table 1. Classification for auxiliary vectors.**

| One (1) on row | $\mathbf{x}_{2A}$ | $\mathbf{x}_{2B}$ | $\mathbf{x}_{2C}$ |
|---|---|---|---|
| 1 | Employed, 15–19 years | Permanently employed, man | Permanently employed, Swedish born |
| 2 | Unemployed, 15–19 years | Temporarily employed, man | Temporarily employed, Swedish born |
| 3 | Not in the labour force, 15–19 years | Self-employed or family worker, man | Self-employed or family worker, Swedish born |
| 4 | Employed, 20–24 years | Unemployed, has worked the last 12 months, man | Unemployed, has worked the last 12 months, Swedish born |
| 5 | Unemployed, 20–24 years | Unemployed, has not worked the last 12 months, man | Unemployed, has not worked the last 12 months, Swedish born |
| 6 | Not in the labour force, 20–24 years | Not in the labour force, has worked during the last 12 months, not long-term ill, man | Not in the labour force, has worked during the last 12 months, not long-term ill, Swedish born |
| 7 | Permanently employed, 25-64 years | Not in the labour force, has not worked during the last 12 months, not long-term ill, man | Not in the labour force, has not worked during the last 12 months, not long-term ill, Swedish born |
| 8 | Temporarily employed, 25-64 years | Not in the labour force, long-term ill, man | Not in the labour force, long-term ill, Swedish born |
| 9 | Self-employed or family worker, 25-64 years | Permanently employed, woman | Permanently employed, foreign born |
| 10 | Unemployed, has worked the last 12 months, 25–64 years | Temporarily employed, woman | Temporarily employed, foreign born |
| 11 | Unemployed, has not worked the last 12 months, 25–64 years | Self-employed or family worker, woman | Self-employed or family worker, foreign born |
| 12 | Not in the labour force, has worked the last 12 months, not long-term ill, 25-64 years | Unemployed, has worked the last 12 months, woman | Unemployed, has worked the last 12 months, foreign born |
| 13 | Not in the labour force, | Unemployed, has not | Unemployed, has not |

| | | | |
|---|---|---|---|
| | has not worked during the last 25 months, not long-term ill, 25-64 years | worked the last 12 months, woman | worked the last 12 months, foreign born |
| 14 | Not in the labour force long-term ill, 25-64 years | Not in the labour force, has worked the last 12 months, not long-term ill, woman | Not in the labour force, has worked the last 12 months, not long-term ill, foreign born |
| 15 | Employed, 65–74 years | Not in the labour force, has not worked the last 12 months, not long-term ill, woman | Not in the labour force, has not worked the last 12 months, not long-term ill, foreign born |
| 16 | Not employed, 65–74 years | Not in the labour force, long-term ill, woman | Not in the labour force, long-term ill, foreign born |

## 10.6 Appendix 6. Variance estimation

The variance of $\tilde{t}_{v_{dd'},\gamma}$ can be written as

$$V(\tilde{t}_{v_{dd'},\gamma}) = V_{p_1}E_{\mu}E_{p_2}(\tilde{t}_{v_{dd'},\gamma} \mid s_1) + E_{p_1}V_{\mu}E_{p_2}(\tilde{t}_{v_{dd'},\gamma} \mid s_1) + E_{p_1}E_{\mu}V_{p_2}(\tilde{t}_{v_{dd'},\gamma} \mid s_1)$$

where $p_1$ and $p_2$ denotes the sample design in the first and second phase respectively. If we introduce the approximation

$$\tilde{t}_{v_{dd'},\gamma} \approx \tilde{t}_{v_{dd'},\gamma,lin} = (\mathbf{t}_{\mathbf{x}_1} - \hat{\mathbf{t}}_{\mathbf{x}_1 s_1})'\mathbf{B}_{1dd',\gamma} + (\hat{\mathbf{t}}_{\mathbf{x}_2 s_1} - \hat{\mathbf{t}}_{\mathbf{x}_2 s_2})'\mathbf{B}_{2dd',\gamma} + \hat{t}_{v_{dd'}s_2,\gamma}$$

where $\mathbf{B}_{1dd',\gamma} = E_{p_1}E_{\mu}E_{p_2}(\hat{\mathbf{B}}_{1dd',\gamma} \mid s_1)$ and $\mathbf{B}_{2dd',\gamma} = E_{p_1}E_{\mu}E_{p_2}(\hat{\mathbf{B}}_{2dd',\gamma} \mid s_1)$

follows that $V(\tilde{t}_{v_{dd'},\gamma}) \approx V(\tilde{t}_{v_{dd'},\gamma,lin})$, where

$$\begin{aligned} V(\tilde{t}_{v_{dd'},\gamma,lin}) = {} & V_{p_1}E_{\mu}E_{p_2}(\tilde{t}_{v_{dd'},\gamma,lin} \mid s_1) + E_{p_1}V_{\mu}E_{p_2}(\tilde{t}_{v_{dd'},\gamma,lin} \mid s_1) \\ & + E_{p_1}E_{\mu}V_{p_2}(\tilde{t}_{v_{dd'},\gamma,lin} \mid s_1) \end{aligned}$$

Let $\pi_{1_1 k,t-j,M}$ ($\pi_{1_2 k,t-j,M}$) denote the inclusion probability of the first order for element $k$ and let $\pi_{1_1 kl,t-j,M}$ ($\pi_{1_2 kl,t-j,M}$) denote the inclusion probability of the second order for the element pair $k$ and $l$ under the sample design used to draw the sample $s_{1_1,t-j,M}$ ($s_{1_2,t-j,M}$), $j = 0,1$ and $M = 10,...,12$. Also let $\pi_{2k,t,M|s_{1,t,M}}$ and $\pi_{2kl,t,M|s_{1,t,M}}$ denote the inclusion probabilities of the first and second order under the sample design used in the second phase and define

$E_{1k,\gamma} = w_M a_k (I_{k\gamma}\phi_{dd'k,t,M} - \mathbf{x}'_{1k,t,M}\mathbf{B}_{1dd',\gamma})$ and

$E_{2k,\gamma} = w_M a_k (I_{k\gamma}v_{dd'k,t,M} - \mathbf{x}'_{2k,t,M}\mathbf{B}_{2dd',\gamma})$, $M = 10,...,12$, where $\phi_{dd'k,t,M}$ denotes element $dd'$ in matrix $\mathbf{\Phi}_{k,t,M}$. It is then true that

$$V_{p_1}E_{\mu}E_{p_2}(\tilde{t}_{v_{dd'},\gamma,lin} \mid s_1) = \sum_{M=10}^{12}\left(\sum_{i=1}^{2} V_{1_i,lin,M}\right)$$

where

$$V_{1_i,lin,M} = \sum_{j=0}^{1}\sum_{k\in U}\sum_{l\in U}(\pi_{1_i kl,t-j,M} - \pi_{1_i k,t-j,M}\pi_{1_i l,t-j,M})\frac{E_{1k,\gamma}}{\pi_{1_i k,t-j,M}}\frac{E_{1l,\gamma}}{\pi_{1_i l,t-j,M}}$$

$$E_{p_1}V_{\mu}E_{p_2}(\tilde{t}_{v_{dd'},\gamma,lin} \mid s_1) = E_{p_1}\left[\sum_{j=0}^{1}\sum_{k\in s_{1,t-j,M}} \frac{w_M^2 a_k^2 I_{k\gamma} C_{\mu}(z_{dk,t,M}, z_{d'k,t,M} \mid s_{1,t,M})}{\pi_{1k,t-j,M}^2}\right]$$

and

$$E_{p_1}E_{\mu}V_{p_2}(\tilde{t}_{v_{dd'},\gamma,lin} \mid s_1) = E_{p_1}E_{\mu}\left(\sum_{M=10}^{12}\sum_{i=1}^{2}\sum_{i'=1}^{2} V_{2_{ii'},lin,M}\right)$$

where

$$V_{2_{ii'},lin,M} = \sum_{j=0}^{1}\sum_{j'=0}^{1}\sum_{k\in s_{1_i,t-j,M}}\sum_{l\in s_{1_{i'},t-j',M}} (\pi_{2kl,t,M|s_{1,t,M}} - \pi_{2k,t,M|s_{1,t,M}}\pi_{2l,t,M|s_{1,t,M}}) \times \frac{E_{2k,\gamma}}{\pi_{1_i k,t-j,M}\pi_{2k,t,M|s_{1,t,M}}} \frac{E_{2l,\gamma}}{\pi_{1_{i'} l,t-j,M}\pi_{2l,t,M|s_{1,t,M}}}$$

Let $s_{2_1,t-j,M} = s_{2,t,M} \cap s_{1_1,t-j,M}$ and $s_{2_2,t-j,M} = s_{2,t,M} \cap s_{1_2,t-j,M}$. A hypothetical variance estimator is given by

$$\hat{V}_{hyp}(\tilde{t}_{v_{dd'},\gamma}) = \sum_{M=10}^{12}\left(\sum_{i=1}^{2}\hat{V}_{1_i,hyp,M} + \sum_{i=1}^{2}\sum_{i'=1}^{2}\hat{V}_{2_{ii'},hyp,M}\right)$$

where

$$\hat{V}_{1_i,hyp,M} = \sum_{j=0}^{1}\sum_{k\in s_{2_i,t-j,M}}\sum_{l\in s_{2_i,t-j,M}} \frac{\pi_{1_i kl,t-j,M} - \pi_{1_i k,t-j,M}\pi_{1_i l,t-j,M}}{\pi_{1_i kl,t-j,M}\pi_{2kl,t,M|s_{1,t,M}}} \frac{\tilde{E}_{1k,\gamma}}{\pi_{1_i k,t-j,M}} \frac{\tilde{E}_{1l,\gamma}}{\pi_{1_i l,t-j,M}}$$

with $\tilde{E}_{1k,\gamma} = w_M a_k (I_{k\gamma} z_{dd'k,t,M} - \mathbf{x}'_{1k,t,M}\mathbf{B}_{1dd',\gamma})$ and

$$\hat{V}_{2_{ii'},hyp,M} = \sum_{j=0}^{1}\sum_{j'=0}^{1}\sum_{k\in s_{2_i,t-j,M}}\sum_{l\in s_{2_{i'},t-j',M}} \frac{\pi_{2kl,t,M|s_{1,t,M}} - \pi_{2k,t,M|s_{1,t,M}}\pi_{2l,t,M|s_{1,t,M}}}{\pi_{2kl,t,M|s_{1,t,M}}} \times \frac{E_{2k,\gamma}}{\pi_{1_i k,t-j,M}\pi_{2k,t,M|s_{1,t,M}}} \frac{E_{2l,\gamma}}{\pi_{1_{i'} l,t-j,M}\pi_{2l,t,M|s_{1,t,M}}}$$

We can show that under $p_1$, $\mu$ and $p_2$ it is true that

$$E_{p_1}E_{\mu}E_{p_2}[\hat{V}_{hyp}(\tilde{t}_{v_{dd'},\gamma})] = V(\tilde{t}_{v_{dd'},lin}) - E_{p_1}\left[\sum_{j=0}^{1}\sum_{k\in s_{1,t-j,M}}\frac{w_M^2 a_k^2 I_{k\gamma} C_{\mu}(z_{dk,t,M}, z_{d'l,t,M} \mid s_{1,t,M})}{\pi_{1k,t-j,M}}\right]$$

Since $p_1$, the sample design used in LFS, is such that

$$\frac{-E_{p_1}\left[\sum_{j=0}^{1}\sum_{k\in s_{1,t-j,M}} w_M^2 a_k^2 I_{k\gamma} C_{\mu}(z_{dk,t,M}, z_{d'l,t,M} \mid s_{1,t,M})/\pi_{1k,t-j,M}\right]}{V(\tilde{t}_{v_{dd'},lin})}$$

is expected to be negligible, it is true that $E[\hat{V}_{hyp}(\tilde{t}_{v_{dd'},\gamma})] \approx V(\tilde{t}_{v_{dd'},\gamma,lin}) \approx V(\tilde{t}_{v_{dd'},\gamma})$.

Under the sample designs $p_1$ and $p_2$ used in the measurement error study, it is possible to derive closed expressions for the terms in

$$\hat{V}_{hyp}(\tilde{t}_{v_{dd'},\gamma}) = \sum_{M=10}^{12}\left(\sum_{i=1}^{2}\hat{V}_{1_i,hyp,M} + \sum_{i=1}^{2}\sum_{i'=1}^{2}\hat{V}_{2_{ii'},hyp,M}\right)$$

If we consistently replace all sample sizes in these expressions with corresponding response values, and replace $\mathbf{B}_{1dd',\gamma}$ with $\hat{\mathbf{B}}_{1dd',\gamma}$ and $\mathbf{B}_{2dd',\gamma}$ with $\hat{\mathbf{B}}_{2dd',\gamma}$ we obtain a working variance estimator in practice. It is this estimator, $\hat{V}(\tilde{t}_{v_{dd'},\gamma})$, that is implemented in ETOS. For more information, see Andersson (2012, Sections 3.4.4 and 4.5). Given that the model with response homogeneity groups that is assigned to deal with the non-response problem, it is a good description of the actual response behaviour, $\hat{V}(\tilde{t}_{v_{dd'},\gamma})$ is forecast to be approximately as expected for $E[\hat{V}_{hyp}(\tilde{t}_{v_{dd'},\gamma})]$.

## 10.7 Appendix 7. Response percentages

**Table 2. Weighted and unweighted response percentages by Swedish and foreign born persons, Q4 2012.**

| Degree of attachment | Weighted | | | Unweighted | | |
|---|---|---|---|---|---|---|
| | Swedish born | Foreign born | Total | Swedish born | Foreign born | Total |
| Permanently employed | 75.3 | 70.5 | 74.5 | 75.2 | 65.3 | 73.4 |
| Temporarily employed | 75.9 | 54.0 | 72.0 | 76.3 | 60.3 | 73.6 |
| Self-employed or family worker | 80.0 | 56.8 | 76.8 | 79.9 | 67.6 | 78.6 |
| Unemployed, has worked the last 12 months | 69.9 | 77.1 | 71.5 | 77.9 | 70.0 | 76.1 |
| Not in the labour force, has worked the last 12 months | 83.4 | 49.9 | 78.4 | 82.5 | 71.1 | 81.3 |
| Unemployed, has not worked the last 12 months | 79.8 | 51.7 | 68.5 | 78.5 | 62.3 | 72.0 |
| Not in the labour force, has not worked the last 12 months | 86.0 | 62.2 | 81.9 | 83.0 | 64.6 | 79.5 |
| Not in the labour force, long-term ill | 71.6 | 48.7 | 65.4 | 71.6 | 48.0 | 66.3 |
| Total | 78.1 | 63.6 | 75.4 | 78.1 | 62.9 | 75.1 |

**Table 3. Weighted and unweighted response percentages by age, Q4 2012.**

| Degree of attachment | Weighted | | | | | Unweighted | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 15-19 | 20-24 | 25-64 | 65-74 | Total | 15-19 | 20-24 | 25-64 | 65-74 | Total |
| Permanently employed | 88.6 | 82.0 | 73.9 | 74.7 | 74.5 | 88.9 | 72.5 | 72.8 | 80.0 | 73.4 |
| Temporarily employed | 59.2 | 76.1 | 74.1 | 56.5 | 72.0 | 71.9 | 72.3 | 74.1 | 83.3 | 73.6 |
| Self-employed or family worker | 74.4 | 100.0 | 74.8 | 87.0 | 76.8 | 75.0 | 100.0 | 77.0 | 91.7 | 78.6 |
| Unemployed, has worked the last 12 months | 84.9 | 56.0 | 75.3 | 0.0 | 71.5 | 92.9 | 75.8 | 74.6 | 0.0 | 76.1 |
| Not in the labour force, has worked the last 12 months | 50.0 | 79.9 | 70.0 | 96.4 | 78.4 | 80.0 | 75.0 | 79.0 | 92.2 | 81.3 |
| Unemployed, has not worked the last 12 months | 88.7 | 80.6 | 56.8 | 37.5 | 68.5 | 85.7 | 75.0 | 69.0 | 50.0 | 72.0 |
| Not in the labour force, has not worked the last 12 months | 85.6 | 70.6 | 69.5 | 85.0 | 81.9 | 80.2 | 69.5 | 76.9 | 87.6 | 79.5 |
| Not in the labour force, long-term ill | 100.0 | 66.9 | 64.5 | 77.4 | 65.4 | 100.0 | 57.1 | 66.0 | 73.3 | 66.3 |
| Total | 80.2 | 76.8 | 72.7 | 84.9 | 75.4 | 81.0 | 73.6 | 73.1 | 87.6 | 75.1 |

## 10.8 Appendix 8. Probability of misclassification

**Table 4. Misclassification probability by labour force status and interview type, persons aged 15-74, Q4 2012. Uncertainty figures in italics. Percent.**

| | True value | | |
|---|---|---|---|
| | Employed | Unemployed | Not in the labour force |
| | (1) | (2) | (3) |
| Question about recording asked in original interview | 0.9% | 10.5% | 0.9% |
| | *0.8%* | *8.0%* | *0.7%* |
| Question about recording not asked in original interview | 1.2% | 17.8% | 2.0% |
| | *1.3%* | *18.9%* | *3.3%* |

**Table 5. Test statistics for test of $H_0$ after labour force status, persons aged 15-74, Q4 2012.**

| | True value | | |
|---|---|---|---|
| | Employed | Unemployed | Not in the labour force |
| | (1) | (2) | (3) |
| Test statistic | -0.38 | -0.70 | -0,65 |

**Table 6. Misclassification probability by degree of attachment and interview type, persons aged 15-74, Q4 2012. Uncertainty figures in italics. Percent.**

| | True value | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Employed | | | Unemployed | | Not in the labour force | | |
| | Of which | | | Of which | | Of which | | |
| | Permanently employed | Temporarily employed | Self-employed or family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| Question about recording asked in original interview | 2.1% | 23.8% | 3.5% | 13.1% | 15.9% | 2.9% | 4.0% | 3.8% |
| | *1.1%* | *15.2%* | *5.0%* | *9.6%* | *12.5%* | *2.3%* | *3.2%* | *5.0%* |
| Question about recording not asked in original interview | 1.5% | 4.3% | 8.6% | 22.8% | 13.6% | 9.7% | 7.8% | 9.2% |
| | *1.8%* | *3.6%* | *13.3%* | *29.8%* | *19.2%* | *11.4%* | *6.6%* | *14.2%* |

**Table 7. Test statistics for test of $H_0$ after degree of attachment, persons aged 15-74, Q4 2012.**

| | True value | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Employed | | | Unemployed | | Not in the labour force | | |
| | Of which | | | Of which | | Of which | | |
| | Permanently employed | Temporarily employed | Self-employed or family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| Test statistic | 0.55 | 2.44 | -0.68 | -0.61 | 0.19 | -1.15 | -1.00 | -0.71 |

## 10.9 Appendix 9. SAS script to produce values after reinterview

```
data matfelue;
          set matfel.återintervjuresultat;
          where '11'<=resultatkod<='19';
          if omgnr in ('1241', '1242', '1243', '1244') then
mman='201210';
          if omgnr in ('1245', '1246', '1247', '1248') then
mman='201211';
          if omgnr in ('1249', '1250', '1251', '1252',
'1301') then mman='201212';
          uenr=(substr(uenr, 4, 6));
          man1=(substr(mman, 5, 2));
          man= input (man1, 2.);
          ar1=(substr(mman, 1, 4));
          ar= input (ar1, 4.);
                    Arbl19a = ' '||Arbl19a||' ';
          if index(Arbl19a,' 1 ') or index(Arbl19a,' 2 ') or
             index(Arbl19a,' 3 ') or index(Arbl19a,' 4 ') or
             index(Arbl19a,' 5 ') or index(Arbl19a,' 6 ') or
             index(Arbl19a,' 7 ') or index(Arbl19a,' 8 ') or
             index(Arbl19a,' 9 ') or index(Arbl19a,' 10 ')
or
             index(Arbl19a,' 11 ') or index(Arbl19a,' 12 ')
then Sokt=1;
                    run;


          /* Skapar Arbetskraftsstatus*/


          data matfelue;
set matfelue;
if ak1=1 or (ak3=1 and ak5=1) then arbstatus_m=2;
if Ak2=1 or (Ak4=1 and Ak5=1) then arbstatus_m=3;
if (((Arbl1=2 or Arbl3=2 or (Arbl1=1 and Arbl2=2)) or Arbl15
in (2, .)) and ((ak1=2 and ak2=2 and ak3=2 and ak4=2) or
(ak3=1 and ak5=2))) and verks1 not in (9, 11)then
arbstatus_m=1;
if ((Arbl3=1 and Arbl15=1 and (Sokt=1)) or (Arbl2=1 and
Arbl15=1)) then arbstatus_m=4;
if arbstatus_m not in (1, 2, 3, 4) and Verks1 in (9, 11) then
arbstatus_m=5;
```

```
nalder = input(alder,3.0);
drop alder;
rename nalder=alder;
nmman = input(mman,5.0);
drop mman;
rename nmman=mman;
run;

/* Skapar anknytningsgradgrad*/

          data work.matfelue;
          set work.matfelue;
          if arbstatus_m in (2, 3) and hu7=2 then grad_m=11;
          if arbstatus_m in (2, 3) and hu9=1 then grad_m=12;
          if arbstatus_m in (2, 3) and hu7=1 and hu9 in (2,
.) then grad_m=2;
          if arbstatus_m in (2, 3) and hu4a=2 then grad_m=3;
          if arbstatus_m in (2, 3) and (ak5=1 or hu4b=1)
then grad_m=4;
          if arbstatus_m in (1, 4) and (Verks1 not in (9,
11) and  ((Tarb2a=ar) or ((Tarb2a=2011) and (Tarb2b>=man))))
then grad_m=5;
          if arbstatus_m in (1, 4) and (verks1 not in (9,
11) and (Tarb1=2 or ((1900<=Tarb2a<=2010) or (Tarb2a=2011 and
Tarb2b<man)) or (Tarb2a in (6666, 7777)))) then grad_m=6;
          if Arbstatus_m=5 and verks1 in (9, 11) then
grad_m=7;
          run;
```

## 10.10 Appendix 10. Net error and misclassifications

**Table 8. Estimate of the population aged 15-19, by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 97 | 0 | 0 | 97 |
| | | *6* | *0* | *0* | *6* |
| Unemployed | (2) | 1 | 48 | 0 | 48 |
| | | *1* | *8* | *0* | *8* |
| Not in the labour force | (3) | 1 | 5 | 415 | 420 |
| | | *1* | *8* | *12* | *9* |
| Total | (4) | 98 | 52 | 415 | 566 |
| | | *6* | *11* | *12* | *0* |

**Table 9. Net error by labour force status for the population aged 15-19, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -1 | -4 | 5 | -1.4 | -0.2 |
| *2* | *8* | *8* | *3.7* | *0.3* |

**Table 10. Estimate of the population aged 15-19, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 10 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| employed | | *12* | *14* | *0* | *0* | *0* | *0* | *0* | *0* | *17* |
| Temporary | (2) | 2 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 72 |
| employed | | *4* | *21* | *0* | *0* | *0* | *0* | *0* | *0* | *20* |
| Self-employed and | (3) | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| family workers | | *0* | *0* | *11* | *0* | *0* | *0* | *0* | *0* | *11* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 1 | 0 | 21 | 1 | 0 | 0 | 0 | 22 |
| last 12 months | | *0* | *1* | *0* | *10* | *1* | *0* | *0* | *0* | *10* |
| Have not worked | (5) | 0 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 26 |
| the last 12 months | | *0* | *0* | *0* | *1* | *12* | *0* | *0* | *0* | *12* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 1 | 0 | 0 | 0 | 12 | 10 | 0 | 24 |
| last 12 months | | *0* | *1* | *0* | *1* | *0* | *13* | *13* | *0* | *18* |
| Have not worked | (7) | 0 | 0 | 0 | 0 | 4 | 11 | 380 | 0 | 395 |
| the last 12 months | | *0* | *0* | *0* | *0* | *8* | *20* | *29* | *0* | *20* |
| EX | (8) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *2* | *0* | *2* |
| Total | (9) | 12 | 81 | 6 | 21 | 31 | 23 | 392 | 0 | 566 |
| | | *13* | *17* | *11* | *10* | *15* | *23* | *26* | *0* | *0* |

**Table 11. Net error by degree of attachment for the population aged 15-19, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 7 | -9 | 0 | 1 | -5 | 1 | 3 | 1 |
| *14* | *15* | *0* | *2* | *8* | *24* | *25* | *2* |

**Table 12. Estimate of the population aged 20-24, by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 364 | 6 | 0 | 370 |
| | | *14* | *11* | *0* | *10* |
| Unemployed | (2) | 1 | 82 | 2 | 84 |
| | | *1* | *7* | *2* | *6* |
| Not in the labour force | (3) | 1 | 9 | 202 | 212 |
| | | *2* | *10* | *14* | *9* |
| Total | (4) | 365 | 96 | 204 | 666 |
| | | *14* | *16* | *14* | *0* |

**Table 13. Net error by labour force status for the population aged 20-24, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| 4 | -12 | 8 | -2.2 | 0.6 |
| *11* | *15* | *11* | *2.9* | *1.6* |

**Table 14. Estimate of the population aged 20-24, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 198 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 219 |
| employed | | *39* | *23* | *0* | *1* | *0* | *0* | *0* | *0* | *30* |
| Temporary | (2) | 13 | 124 | 0 | 5 | 0 | 0 | 0 | 0 | 143 |
| employed | | *17* | *36* | *0* | *10* | *0* | *0* | *0* | *0* | *34* |
| Self-employed and | (3) | 1 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 8 |
| family workers | | *4* | *0* | *12* | *0* | *0* | *0* | *0* | *0* | *14* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 0 | 0 | 35 | 0 | 1 | 0 | 0 | 37 |
| last 12 months | | *0* | *0* | *1* | *11* | *0* | *2* | *0* | *0* | *11* |
| Have not worked | (5) | 0 | 0 | 0 | 4 | 42 | 0 | 0 | 0 | 47 |
| the last 12 months | | *0* | *1* | *0* | *6* | *12* | *0* | *1* | *0* | *11* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 1 | 0 | 0 | 1 | 73 | 8 | 1 | 83 |
| last 12 months | | *0* | *2* | *0* | *1* | *2* | *31* | *8* | *2* | *31* |
| Have not worked | (7) | 0 | 0 | 0 | 0 | 1 | 5 | 113 | 0 | 119 |
| the last 12 months | | *0* | *0* | *0* | *0* | *2* | *7* | *33* | *0* | *32* |
| EX | (8) | 0 | 0 | 0 | 0 | 6 | 0 | 3 | 0 | 9 |
| | | *0* | *0* | *0* | *0* | *10* | *0* | *5* | *0* | *10* |
| Total | (9) | 213 | 145 | 7 | 45 | 51 | 79 | 125 | 1 | 666 |
| | | *41* | *43* | *12* | *16* | *16* | *31* | *32* | *2* | *0* |

**Table 15. Net error by degree of attachment for the population aged 20-24, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 5 | -2 | 1 | -8 | -4 | 4 | -5 | 8 |
| *28* | *30* | *4* | *12* | *12* | *11* | *11* | *10* |

**Table 16. Estimate of the population aged 25-64, by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 4011 | 13 | 2 | 4025 |
| | | *25* | *21* | *3* | *14* |
| Unemployed | (2) | 19 | 223 | 5 | 247 |
| | | *20* | *22* | *4* | *9* |
| Not in the labour force | (3) | 24 | 23 | 564 | 611 |
| | | *22* | *21* | *30* | *13* |
| Total | (4) | 4054 | 259 | 570 | 4882 |
| | | *39* | *37* | *31* | *0* |

**Table 17. Net error by labour force status for the population aged 25-64, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -28 | -12 | 40 | -0.2 | -0.6 |
| *37* | *36* | *28* | *0.8* | *0.7* |

**Table 18. Estimate of the population aged 25-64, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 3158 | 79 | 0 | 0 | 0 | 0 | 0 | 0 | 3237 |
| employed | | *95* | *93* | *0* | *0* | *0* | *0* | *0* | *0* | *18* |
| Temporary | (2) | 7 | 354 | 0 | 12 | 1 | 0 | 2 | 0 | 375 |
| employed | | *13* | *27* | *0* | *21* | *1* | *0* | *3* | *0* | *11* |
| Self-employed and | (3) | 30 | 0 | 384 | 0 | 0 | 0 | 0 | 0 | 413 |
| family workers | | *17* | *0* | *21* | *0* | *0* | *0* | *0* | *0* | *12* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 16 | 1 | 103 | 2 | 2 | 0 | 0 | 124 |
| last 12 months | | *0* | *20* | *2* | *21* | *2* | *3* | *0* | *0* | *7* |
| Have not worked | (5) | 0 | 1 | 1 | 5 | 113 | 0 | 3 | 0 | 123 |
| the last 12 months | | *0* | *1* | *1* | *5* | *9* | *0* | *3* | *0* | *7* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 1 | 0 | 1 | 0 | 121 | 0 | 1 | 125 |
| last 12 months | | *1* | *1* | *0* | *1* | *0* | *8* | *1* | *2* | *8* |
| Have not worked | (7) | 0 | 0 | 16 | 0 | 18 | 3 | 159 | 3 | 199 |
| the last 12 months | | *0* | *0* | *21* | *0* | *21* | *4* | *28* | *4* | *9* |
| EX | (8) | 1 | 2 | 3 | 0 | 4 | 5 | 38 | 234 | 286 |
| | | *2* | *2* | *5* | *0* | *4* | *5* | *17* | *20* | *10* |
| Total | (9) | 3196 | 453 | 405 | 122 | 137 | 131 | 202 | 238 | 4882 |
| | | *97* | *99* | *30* | *30* | *23* | *11* | *33* | *21* | *0* |

**Table 19. Net error by degree of attachment for the population aged 25-64, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 41 | -77 | 8 | 2 | -14 | -6 | -3 | 49 |
| *95* | *98* | *28* | *29* | *22* | *8* | *32* | *19* |

**Table 20. Estimate of the population aged 65-74, by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 148 | 0 | 5 | 152 |
| | | *12* | *0* | *9* | *9* |
| Unemployed | (2) | 0 | 4 | 0 | 4 |
| | | *0* | *1* | *0* | *1* |
| Not in the labour force | (3) | 20 | 0 | 842 | 862 |
| | | *22* | *1* | *23* | *9* |
| Total | (4) | 167 | 4 | 846 | 1017 |
| | | *25* | *2* | *25* | *0* |

**Table 21. Net error by labour force status for the population aged 65-74, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -15 | 0 | 15 | 0.0 | -1.5 |
| *23* | *1* | *23* | *0.6* | *2.3* |

**Table 22. Estimate of the population aged 65-74, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| employed | | *26* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *26* |
| Temporary | (2) | 0 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 63 |
| employed | | *0* | *37* | *0* | *0* | *0* | *0* | *0* | *0* | *37* |
| Self-employed and | (3) | 12 | 0 | 50 | 0 | 0 | 0 | 5 | 0 | 66 |
| family workers | | *14* | *0* | *23* | *0* | *0* | *0* | *9* | *0* | *24* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| last 12 months | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| Have not worked | (5) | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 |
| the last 12 months | | *0* | *0* | *0* | *0* | *1* | *0* | *0* | *0* | *1* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 7 | 2 | 0 | 0 | 76 | 5 | 0 | 90 |
| last 12 months | | *0* | *7* | *3* | *1* | *0* | *34* | *6* | *0* | *34* |
| Have not worked | (7) | 0 | 10 | 0 | 0 | 0 | 12 | 729 | 0 | 751 |
| the last 12 months | | *0* | *20* | *0* | *0* | *0* | *22* | *46* | *0* | *35* |
| EX | (8) | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 20 |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *11* | *0* | *11* |
| Total | (9) | 35 | 81 | 52 | 0 | 4 | 88 | 758 | 0 | 1017 |
| | | *30* | *43* | *23* | *1* | *1* | *41* | *46* | *0* | *0* |

**Table 23. Net error by degree of attachment for the population aged 65-74, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| -12 | -18 | 15 | 0 | 0 | 2 | -7 | 20 |
| *14* | *21* | *17* | *1* | *0* | *25* | *34* | *11* |

**Table 24. Estimate of Swedish born persons aged 15-74, by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 3901 | 6 | 7 | 3913 |
| | | *23* | *11* | *10* | *18* |
| Unemployed | (2) | 4 | 237 | 4 | 245 |
| | | *3* | *12* | *3* | *11* |
| Not in the labour force | (3) | 44 | 19 | 1637 | 1700 |
| | | *31* | *14* | *39* | *19* |
| Total | (4) | 3949 | 262 | 1647 | 5858 |
| | | *39* | *21* | *40* | *0* |

**Table 25. Net error by labour force status for Swedish born persons aged 15-74, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -36 | -17 | 53 | -0.3 | -0.6 |
| *34* | *18* | *36* | *0.4* | *0.6* |

**Table 26. Estimate of Swedish born persons aged 15-74, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 2885 | 102 | 0 | 0 | 0 | 0 | 0 | 0 | 2988 |
| employed | | *98* | *96* | *0* | *1* | *0* | *0* | *0* | *0* | *18* |
| Temporary | (2) | 14 | 487 | 0 | 5 | 0 | 0 | 2 | 0 | 509 |
| employed | | *15* | *23* | *0* | *10* | *0* | *0* | *3* | *0* | *14* |
| Self-employed and | (3) | 35 | 0 | 377 | 0 | 0 | 0 | 5 | 0 | 417 |
| family workers | | *20* | *0* | *24* | *0* | *0* | *0* | *9* | *0* | *14* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 1 | 2 | 126 | 2 | 2 | 0 | 0 | 133 |
| last 12 months | | *0* | *1* | *2* | *8* | *2* | *3* | *0* | *0* | *7* |
| Have not worked | (5) | 0 | 1 | 1 | 7 | 102 | 0 | 1 | 0 | 111 |
| the last 12 months | | *0* | *1* | *1* | *7* | *12* | *0* | *2* | *0* | *9* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 10 | 2 | 2 | 0 | 238 | 23 | 0 | 276 |
| last 12 months | | *1* | *7* | *3* | *2* | *0* | *22* | *16* | *0* | *13* |
| Have not worked | (7) | 0 | 10 | 16 | 0 | 8 | 31 | 1135 | 3 | 1203 |
| the last 12 months | | *0* | *20* | *21* | *0* | *9* | *31* | *47* | *4* | *18* |
| EX | (8) | 1 | 2 | 3 | 0 | 8 | 3 | 51 | 154 | 222 |
| | | *2* | *2* | *5* | *0* | *11* | *3* | *15* | *15* | *10* |
| Total | (9) | 2936 | 613 | 400 | 142 | 120 | 274 | 1217 | 157 | 5858 |
| | | *101* | *101* | *33* | *15* | *18* | *38* | *52* | *15* | *0* |

**Table 27. Net error by degree of attachment for Swedish born persons aged 15-74, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 52 | -104 | 16 | -8 | -9 | 2 | -14 | 65 |
| *99* | *100* | *30* | *14* | *16* | *37* | *50* | *15* |

**Table 28. Estimate of foreign born persons aged 15-74, by labour force status according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | Total |
|---|---|---|---|---|---|
| | | Employed | Unemployed | Not in the labour force | |
| | | (1) | (2) | (3) | (4) |
| Employed | (1) | 719 | 13 | 0 | 731 |
| | | *24* | *21* | *0* | *12* |
| Unemployed | (2) | 16 | 119 | 3 | 138 |
| | | *20* | *21* | *3* | *8* |
| Not in the labour force | (3) | 0 | 17 | 386 | 404 |
| | | *0* | *21* | *23* | *11* |
| Total | (4) | 735 | 149 | 388 | 1273 |
| | | *31* | *36* | *23* | *0* |

**Table 29. Net error by labour force status for foreign born persons aged 15-74, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | Unemployed | Not in the labour force | Unemployment rate% | Employment rate % |
|---|---|---|---|---|
| (1) | (2) | (3) | (2)/(1)+(2) | (1)/(1)+(2)+(3) |
| -4 | -11 | 15 | -1.0 | -0.3 |
| *29* | *35* | *21* | *3.8* | *2.3* |

**Table 30. Estimate of foreign born persons aged 15-74, by degree of attachment according to the original interview and true value, Q4 2012, thousands. Uncertainty figures in italics.**

| Original interview | | True value | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Employed | | | Unemployed | | Not in the labour force | | | Total |
| | | -of which | | | -of which | | -of which | | | |
| | | Perma-nently emp-loyed | Temp-orary emp-loyed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX | |
| Employed -of which | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Permanently | (1) | 505 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 510 |
| employed | | *15* | *10* | *0* | *0* | *0* | *0* | *0* | *0* | *11* |
| Temporary | (2) | 8 | 124 | 0 | 12 | 1 | 0 | 0 | 0 | 145 |
| employed | | *15* | *26* | *0* | *21* | *1* | *0* | *0* | *0* | *6* |
| Self-employed and | (3) | 8 | 0 | 69 | 0 | 0 | 0 | 0 | 0 | 77 |
| family workers | | *10* | *0* | *11* | *0* | *0* | *0* | *0* | *0* | *5* |
| Unemployed -of which | | | | | | | | | | |
| Have worked the | (4) | 0 | 16 | 0 | 33 | 1 | 1 | 0 | 0 | 50 |
| last 12 months | | *0* | *20* | *0* | *20* | *1* | *1* | *0* | *0* | *5* |
| Have not worked | (5) | 0 | 1 | 0 | 2 | 84 | 0 | 2 | 0 | 89 |
| the last 12 months | | *0* | *1* | *0* | *3* | *7* | *0* | *2* | *0* | *6* |
| Not in the labour force -of which | | | | | | | | | | |
| Have worked the | (6) | 0 | 0 | 0 | 0 | 1 | 44 | 0 | 1 | 47 |
| last 12 months | | *0* | *0* | *0* | *0* | *2* | *6* | *1* | *2* | *5* |
| Have not worked | (7) | 0 | 0 | 0 | 0 | 15 | 0 | 246 | 0 | 262 |
| the last 12 months | | *0* | *0* | *0* | *0* | *20* | *0* | *23* | *0* | *10* |
| EX | (8) | 0 | 0 | 0 | 0 | 1 | 2 | 12 | 80 | 95 |
| | | *0* | *0* | *0* | *0* | | *4* | *13* | *14* | *6* |
| Total | (9) | 520 | 146 | 69 | 47 | 102 | 46 | 260 | 82 | 1273 |
| | | *24* | *34* | *11* | *29* | *22* | *7* | *26* | *14* | *0* |

**Table 31. Net error by degree of attachment for foreign born persons aged 15-74, Q4 2012, thousands. Uncertainty figures in italics.**

| Employed | | | Unemployed | | Not in the labour force | | |
|---|---|---|---|---|---|---|---|
| -of which | | | -of which | | -of which | | |
| Permanently employed | Temporary employed | Self-employed and family workers | Have worked the last 12 months | Have not worked the last 12 months | Have worked the last 12 months | Have not worked the last 12 months | EX |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| -10 | -1 | 8 | 3 | -14 | 0 | 2 | 13 |
| *21* | *34* | *10* | *29* | *21* | *5* | *24* | *13* |

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