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The Household Finance and Consumption Survey: Methodological report for the 2017 wave

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This report was drafted by the Household Finance and Consumption Network (HFCN). The HFCN is chaired by Ioannis Ganoulis (ECB) and Oreste Tristani (ECB), with Juha Honkkila (ECB) and Jiri Slacalek (ECB) as Secretaries. The HFCN is composed of members from the European Central Bank, the Nationale Bank van België/Banque Nationale de Belgique, Česká národní banka, Danmarks Nationalbank, the Deutsche Bundesbank, Eesti Pank, the Central Bank of Ireland, the Bank of Greece, the Banco de España, the Banque de France, Hrvatska narodna banka, the Banca d'Italia, the Central Bank of Cyprus, Latvijas Banka, Lietuvos bankas, the Banque centrale du Luxembourg, the Magyar Nemzeti Bank, the Central Bank of Malta, De Nederlandsche Bank, the Oesterreichische Nationalbank, Narodowy Bank Polski, the Banco de Portugal, Banca Naţională a României, Banka Slovenije, Národná banka Slovenska, Suomen Pankki – Finlands Bank, and Sveriges Riksbank, as well as Statistics Estonia, the Irish Central Statistics Office , the French National Institute of Statistics and Economic Studies (INSEE) , the Hungarian Central Statistical Office, Statistics Portugal, Statistics Finland, Eurostat, and consultants from Goethe University Frankfurt and the University of Naples Federico II. The HFCN collects household-level data on households' finances and consumption in the euro area through a harmonised survey. It aims to study in depth the micro-level structural information on euro area households' assets and liabilities.

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1 Introduction

The Household Finance and Consumption Survey (HFCS) is a joint project of all of the national central banks of the Eurosystem, the central banks of three EU countries that have not yet adopted the euro, and several national statistical institutes.[1] The HFCS provides detailed household-level data on various aspects of household balance sheets and related economic and demographic variables, including income, private pensions, employment and measures of consumption.

The HFCS is conducted in a decentralised manner. Each institution participating in the Household Finance and Consumption Network (HFCN) (the national central bank (NCB) and/or national statistical institute (NSI)) is responsible for conducting the survey. The European Central Bank (ECB) in conjunction with the HFCN coordinates the whole project, ensuring the application of a common methodology, pooling the country datasets and performing quality-control on them, as well as disseminating the survey results and microdata through a single access gateway.

The third wave of the HFCS was conducted mainly in 2017. Table 1 provides a summary snapshot of the fieldwork periods. Different reference periods have an effect on comparability, and consequently the charts between the survey waves in individual countries have been adjusted for inflation using the Harmonised Index of Consumer Prices.[2] The adjustment factors between the two latest survey waves are shown the right-hand column of Table 1. An adjustment factor of, for example, 1.047 indicates that inflation between the two survey waves was 4.7%.[3] For countries that have not yet adopted the euro, results in local currency are converted into euro using the exchange rate for 2016-18.

1 The first, 2010 wave of the HFCS was conducted in 15 euro area countries, the second, 2014 wave in 18 euro area countries, as well as in Hungary and Poland, and the third wave in all 19 euro area countries, as well as in Croatia, Hungary and Poland; the fourth wave of the survey in 2023 will also include the Czech Republic.

2 The values of assets, debt, income and consumption have been adjusted for by multiplying the first- and second-wave charts with the ratio between the yearly averages of the price level in the reference years for the survey waves.

3 Comparability over time can also be affected by the changing euro area coverage. However, restricting statistics for the 2017 wave to the 18 euro area countries covered in 2014 has negligible effects on the results. For simplicity, this change is therefore ignored in any comparisons of euro area characteristics between the two waves.

Table 1

Fieldwork and reference periods of the 2017 wave and inflation adjustment factor

Country	Fieldwork period	Assets and liabilities	Income	Inflation adjustment factor between the 2014 and 2017 waves
Belgium	January 2017 – September 2017	2017	2016	1.047
Germany	March 2017 – October 2017	Time of interview	2016	1.022
Estonia	March 2017 – June 2017	Time of interview*	2016	1.050
Ireland	April 2018 – January 2019	Time of interview	Last 12 months	1.011
Greece	February 2018 – September 2018	2018	Last 12 months	1.008
Spain	October 2017 – May 2018	Time of interview	2016	1.011
France	September 2017 – January 2018	Time of interview	2016	1.056
Croatia	March 2017 – June 2017	Time of interview	2016	-
Italy	January 2017 – September 2017	31 December 2016**	2016	1.000
Cyprus	February 2017 – September 2017	Time of interview	Last 12 months	0.979
Latvia	September 2017 – November 2017	Time of interview	2016	1.032
Lithuania	December 2017 – May 2018	31 December 2016	2016	-
Luxembourg	March 2018 – November 2018	Time of interview	2017	1.043
Hungary	October 2017 – December 2017	Time of interview	Last 12 months	1.029
Malta	January 2017 – April 2017	31 December 2016	2016	1.029
Netherlands	May 2017 – July 2017	Time of interview	2016	1.019
Austria	November 2016 – July 2017	Time of interview	2016	1.040
Poland	September 2016 – November 2016	Time of interview	Last 12 months	0.991
Portugal	May 2017 – September 2017	Time of interview	2016	1.030
Slovenia	April 2017 – October 2017	Time of interview	2016	1.006
Slovakia	February 2017 – April 2017	Time of interview	2016	1.005
Finland	January 2017 – June 2017	31 December 2016	2016	1.014

Source: HFCS metadata.
*Time of interview for variables collected at the interview, 30 April 2017 for variables derived from register data.
** Time of interview for values of dwellings.

The HFCS is designed around a common set of methodological principles, which ensures the comparability of results. When compared with other international data on household wealth surveys (such as the Luxembourg Wealth Study), one of the most distinctive features of the HFCS is that the constituent country wealth surveys follow an **ex ante harmonised methodology**. In particular, all country-level HFCS datasets

provide a set of core output variables according to a set of common definitions and descriptive features according to an output-oriented approach.

Household samples have been designed in each country to ensure representative results at both the euro area and national level. More than 91,000 households were surveyed in the third wave, with sample sizes varying across countries. All country surveys have a **probabilistic sample design**. This means that each household in the target population has an ex ante defined non-zero probability of being part of the sample. Given the unequal distribution of household wealth and the fact that certain financial instruments are almost exclusively held (and in large quantities) by the wealthiest households, most countries apply some type of **oversampling of wealthy households**.

One feature of survey data is the existence of item non-response, i.e. respondents' inability to provide a reliable answer to all questions asked. However, economic analyses with survey data should always be run with complete datasets. **Imputing** missing values – i.e. the process of assigning values to variables that have been collected incorrectly or not at all – is a prerequisite for being able to use the data. For the HFCS, a multiple stochastic imputation strategy has been chosen. The dataset provides five imputed values (replicates) for every missing value corresponding to a variable entering the composition of household wealth, consumption or income.

In the 2017 wave 12 countries had a **panel component**, comprising the same households as in the previous wave.

Finally, it should be emphasized that cross-country differences in survey results should be interpreted with caution. Despite the improvement in the HFCS data comparability made possible by a considerable effort in ex-ante harmonisation, remaining methodological differences described in this report may account for part of observed differences across countries. For example, the coverage of the top of the wealth distribution may be affected by differences in sample design and particularly in the oversampling of most affluent households. Moreover, differences between countries in statistics of interest must be assessed against relevant institutional and socio-demographic differences. The shape of the distribution of income or wealth among households crucially depends, for example, on the household structure, hence on the age composition of the population and on factors affecting household formation. Institutional and methodological issues affecting cross-country comparability of results are further discussed in Chapter 9.2 of this report.

This document describes the methodologies applied in the production of the Household Finance and Consumption Survey across countries. Detailed methodologies are described for the HFCS blueprint questionnaire and output variables, data collection, sample design, unit non-response and weighting, editing, item non-response, imputation, and variance estimation. In addition there are sections on statistical disclosure control and data comparability across survey waves, across countries and vis-à-vis selected benchmark statistics.

2 The HFCS blueprint questionnaire and list of output variables

The list of core output variables is the reference document for data production and includes the harmonised definitions of the survey variables. To facilitate the collection of the core variables, a blueprint questionnaire has been designed as a benchmark for national surveys. Countries are free to adapt the wording or sequencing of questions. The HFCS blueprint questionnaire consists of an introduction, sections on the nine topics with household-level and person-level questions for collecting the core output variables, and interview closure.

2.1 Pre-interview part of the HFCS questionnaire

2.1.1 Interview introduction and selection of main respondent

The HFCS blueprint questionnaire provides a script for establishing contact with the sampled household as well as some introductory information (on the importance of participating in the survey, measures to ensure data confidentiality, how the survey data will be used, etc.) that all interviewers are instructed to read out to the interviewees before the start of the interview.

An important part of the interview introduction is the selection of the main household respondent, who is called the Financially knowledgeable person (FKP). The FKP is considered to be the main respondent, and provides financial information for the whole household. This is to minimise response burden and to avoid duplications. For a survey like the HFCS whose main focus is on household finances, assets and liabilities, it is of vital importance to target the right person, so that the best available information on household finances can be collected during the interview. The interview introduction contains a checklist of attributes providing detailed criteria on how to identify the FKP.

2.1.2 Household listing, HFCS household definition and reference person

The purpose of this part of the questionnaire is to establish a list of household members, i.e. defining the perimeter of the household. The replies of the main respondent regarding the household's financial information (assets, debts, consumption, etc.) should thus (only) refer to the household members identified in this initial step.

For the definition of household, the HFCS uses a variation of the so-called "housekeeping concept".[4] A household is defined as a person living alone or a group of people who live together in the same private dwelling and share expenditures, including the joint provision of the essentials of living.[5]

The outcome of the screening part is the list of household members verified against the household membership definition. Individual members are then listed according to their relationships with an interview reference person chosen from among the household members. The interview reference person may be, but need not always be, identical to the FKP. Additionally, the interview reference person defined at the beginning of the interview (i.e. the person around whom the household is drawn) may not be the same as the reference person used in the presentation of survey results. To release survey results for some characteristics such as age, education or labour status that can be assigned only at individual person level, one person must represent the household as a whole. Such a person must be chosen with pre-defined objective criteria, as the household will be classified according to this reference person's characteristics. The information necessary to apply a set of criteria is not yet available when the interviewer is asked to list the members of the household. The reference person for statistical outputs is therefore constructed ex post, based on the information collected about the household during the interview.

In HFCS publications showing euro area results, the criteria are based on international standards for household income statistics presented by the so-called Canberra Group (UNECE, 2011). It uses the following sequential steps to determine a unique reference person in the household:

- one of the partners in a registered or de facto marriage, with dependent children,
- one of the partners in a registered or de facto marriage, without dependent children,
- a lone parent with dependent children,
- the person with the highest income,
- the eldest person.

2.2 The HFCS list of core output variables

The HFCS list of core output variables is split into nine sections. The sections on demographics, employment, and pensions and insurance policies cover information collected at the personal level, i.e. individually for all persons aged 16 or over (some demographic information are collected for children also). The sections on real assets and their financing, other liabilities and credit constraints, private businesses and

4 As opposed to the dwelling concept, where all persons living in one dwelling are automatically considered as one household. See, for example, UN (2008), p. 100 for a more in-depth discussion of these two concepts.

5 The complete household definition applied for the HFCS is provided in the Appendix.

financial assets, intergenerational transfers and gifts and consumption cover information collected at the household level. In the section on income, some income components are collected at the personal level (e.g. employment-related income, pension income, etc.) and some at the household level (e.g. income from financial investments).

The full list of HFCS core output variables is available on the HFCN web page. Changes to the questionnaire between the second and third waves are listed in Box 1 at the end of Chapter 2.3.

2.2.1 Demographics

The demographics section contains a basic set of information collected for all household members, namely age, gender, country of birth, and length of stay in the country (for the foreign born). Information on marital status and the highest level of education attained are only collected for household members aged 16 or over. The section also contains a variable on life satisfaction, collected only from the interview reference person.

2.2.2 Real assets and their financing

This section collects information on ownership and current values of real estate assets (household main residence for homeowners, other real estate properties owned by the household), vehicles (cars, other types of vehicles such as motorbikes, boats, etc.) and valuables (such as jewellery, works of art, antiques). In this section information is also collected on the purchase of vehicles within the past 12 months, and on house price expectations.

Variables on selected characteristics are collected for the household main residence (way and year of acquisition, value at the time of acquisition, etc.). Both owners and tenants are asked about the size of the household main residence and the length of stay in the current household main residence. Tenants also provide information about the monthly amount paid as rent. For other real estate properties, the type of owned property, its main use, the percentage of the property owned by the household and its current value are collected in a loop for up to three main properties.

The HFCS applies a collection approach that classifies mortgages by collateral. Selected characteristics of mortgages are collected, including the purpose of the loan, year when the loan was taken out, initial and current maturity, interest rate and the current monthly payment made on the loan. This set of variables is collected for the three mortgages with largest outstanding value collateralised by the household main residence. For other real estate properties, the variables are collected separately for the three biggest mortgages collateralised by each of the three main properties.[6] In the blueprint questionnaire, questions on each mortgage collateralised by each

[6] This approach of collecting separate loops for each of the three other real estate properties has been applied starting from the 2017 wave.

property are asked immediately after information is collected about the property in question. This reduces the risk of respondents forgetting to report on specific debts.

2.2.3 Other liabilities, credit constraints

The section on other liabilities contains variables on non-mortgage debt instruments – leasing contracts, credit lines/overdrafts, credit cards, private loans from family or friends and other loans not collateralised by real estate. On other loans not collateralised by real estate, a loop for up to three main loans collects individual details such as the purpose of the loan, initial amount borrowed, interest rate and current monthly payments. The remaining part of the section targets questions on loan application (applied for credit in the last three years) and credit constraints (credit refusal experience, not applying for credit due to perceived credit constraint).

2.2.4 Private businesses, financial assets

The first part of this section covers self-employment private businesses (with the loop for details on up to the three most important, including sector of activity [NACE[7]], legal form, number of employees and the current value of the household's share in the business). These are distinguished from other "passive" investments in non-publicly traded equity, for which only variables on ownership and on total current value of the equity holdings are collected.

The second part then covers financial assets: sight accounts, saving accounts, mutual funds, bonds, publicly traded shares, additional assets in managed accounts, money owed to the household, and a residual variable on other financial assets. Selected additional characteristics are collected for bonds, mutual funds and listed shares. The section also includes a self-assessment question on risk attitudes.

2.2.5 Employment

This section includes variables collected for all household members aged 16 or more, starting with a variable on self-reported current labour status. For employed persons details of their current job are collected, including their job description (based on the International Standard Classification of Occupations – ISCO), the sector of activity (NACE), contract type and hours their work in a week. In addition employed persons are asked to estimate the probability of losing their job during the next 12 months. Those currently unemployed or retired are asked questions on their previous work history, and unemployed persons are asked to estimate the probability of finding a job during the next 12 months. All persons who are not yet retired and are currently or have in the past been employed are asked a question on the age they plan to stop working.

7 See details of the NACE classification.

2.2.6 Pensions and life insurance policies

The HFCS classifies pension wealth as voluntary pension schemes and life insurance contracts, occupational pension plans and public pension plans. The section aims to collect basic information on participation of household members aged 16 or over in these types of pension plans, on the current value of plans with an account balance, on monthly contributions, on the age at which the respondent expects to start receiving benefits and the expected percentage of final labour income to receive upon retirement from all public and occupational plans. Voluntary pension schemes and life insurance contracts are included in households' financial wealth in the report of HFCS results.

This particular part of the questionnaire is labelled as indicative, open to particular national implementations. The structure of the pensions section variables was revised after the second wave. However, the contents of the pension variables remained virtually unchanged (see Box 1).

2.2.7 Income

The HFCS is a survey focused on the collection of information on household wealth. Therefore, the main target of the income section is the collection of the main components for the construction of total gross household income, not including lower level details of each of these components (such as, for example, the further breakdown of income from financial assets or regular transfers).

This section combines personal-level questions (employee income, self-employment income, income from public pensions, income from private and occupational pensions, unemployment benefits) and household-level questions (social benefits other than pensions and unemployment benefits, private transfers received, rental income, financial investments income, private business or partnership income, other residual sources of income).

The concepts and definitions of the income section were designed along the lines of those of the UNECE Canberra group handbook on household income statistics.[8] Imputed rents and income in kind components are not covered by the HFCS core income section. The target income aggregate is gross, including taxes and social insurance contributions paid by employees.[9]

In addition to the income-component questions, two qualitative supplementary questions are asked on the level of annual income as compared with normal and on income expectations over the following year.

8 UNECE (2011).

9 There are some cross-country differences in the strategies to collect information on income (see Chapter 3.3 for details).

2.2.8 Intergenerational transfers, gifts

This section collects information on received inheritances and substantial gifts, and is aimed at tracing household wealth accumulation patterns. The loop for up to the three most important transfers and gifts contains questions on when they were received, what asset types were received, their value and from whom they were received.

2.2.9 Consumption and saving

This section focuses on selected aspects of household consumption and saving. It collects information on several consumption indicators that, according to the literature,[10] may be used to infer total consumption. These items are spending on food at home, spending on food outside the home, spending on utilities and expenses on trips and holidays. Additionally, one item on overall spending on non-durable consumer goods and services is collected. All consumption items refer to spending in a typical month.

In addition, collected items include regular private transfers made outside the household (alimony, assistance, etc.), saving motives, comparison of last 12 months' expenditure with the usual level (higher/normal/lower), balance of expenditures and income (expenses higher than/equal to/lower than income) and ability to get emergency (financial) assistance from friends or relatives. For the third wave a question on how much the respondent would spend from an unexpected windfall gain was added.

2.3 Interview closure and post-interview debriefing/paradata

The last part of the questionnaire covers one question intended to close the interview on topics and items that the respondent may have forgotten to report before.

After the interview, an additional set of questions is aimed at collecting feedback from interviewers (so-called paradata). The interview paradata section encompasses 16 questions covering aspects surrounding the interview, e.g. the accuracy of the respondent's calculations, who was present during the interview, perceived trust of the respondent before and after the interview, etc. This information is deemed very valuable for the treatment of the data ex post, i.e. for data editing and imputation.

Box 1

Changes compared with the list of core variables for the second wave

In the section on demographics, a question on life satisfaction was added to the list of core variables.

A question on house price expectations was added to the section on real assets and their financing. In the subsection on loans, variables on the remaining maturity of mortgages were added. The section

[10] See for example Browning, Crossley and Weber (2003).

on mortgages collateralised by real estate properties other than the household main residence was expanded, with detailed information on such mortgages collected separately for each of the three largest properties, instead of three biggest mortgages on any other real estate properties.

A new variable on financial help from relatives and friends was added to the income section.

In the employment section, new variables were added for the unemployed on previous work status, job description and economic sector of the employer. The same information was collected from all inactive persons, referring to the main job in their career based on hours worked. In addition, unemployed persons were asked to assess the probability of their finding a job within the next 12 months, and employed persons were asked to assess the probability of losing their job within the next 12 months.

The pensions section was reorganised, and the variables now include loops for up to seven most important pension plans, for which the same information is collected. Variables were added on the age at which the respondent expects to receive payments and on the percentage of final labour income they expect to receive upon retirement from all public and occupational plans taken together.

In the consumption section, a new item was added on annual expenditure on trips and holidays. A new question was inserted on how much the respondent would spend in the next 12 months out of an unexpected gain equal to the amount of household monthly income.

In addition, on the basis of the experience from previous survey waves, some question wordings and interviewer instructions were clarified to improve the quality of the data collected. These additions had no significant impact on the definitions of output variables. A few changes were introduced to the filtering of individual questions to avoid unnecessary data collection.

2.4 Data collection approaches

2.4.1 Loops

Loops are sequences of questions referring to individual items, which are repeated for each individual item. There are seven loops in the HFCS core questionnaire, collecting details on household main residence mortgages, other real estate properties, mortgages on other real estate properties, private loans, non-collateralised loans, self-employment businesses and gifts/inheritances received. Each loop sequence starts with a question on the number of instances (e.g. number of loans, number of other properties) followed by a set of questions on details which are repeated for up to three main items. The loop ends with a mop-up question collecting aggregate information on remaining items four and above, for which details are no longer collected (e.g. the total outstanding amount for loans number four and higher, properties).[11]

[11] In some countries, simplified loops of up to two items with a mop-up question for items three and above are used.

2.4.2 Collection of monetary value questions

A standardised CAPI data collection script is used to collect monetary values (called the “Euroloop”, as it targets the collection of values in euro, or in national currencies in non-euro area countries). The Euroloop encompasses a set of questions which should be asked in a strict sequence.

First, the interviewer should ask the exact amount, which respondents may provide either in euro or in national legacy currencies. Only if respondents are unable (or unwilling) to provide the exact amount should the interviewer then proceed to ask the respondent to provide the information in flexible brackets, i.e. to provide self-reported upper and lower bounds. If the respondent is still unable to answer, there is a third step involving a card with 20 prefilled fixed intervals in euro and corresponding amounts in national legacy currencies. In this last step, the coded amount or interval (lower-upper bound) are displayed to the respondent as numbers and spelled out to check and confirm.

After collecting each reply, interviewers are instructed to repeat aloud the amount reported by respondents in order to try to correct possible mistakes on the spot.

2.5 The HFCS non-core questions

The blueprint questionnaire covers the core HFCS variables. In addition to the core survey content, the HFCN prepared a supplementary harmonised set of non-core variables, which usually supplement the topic covered by the existing core questionnaire parts with more detailed information. The recommended question wording and the recommended position in the questionnaire vis-à-vis the related core survey items are provided in the HFCS non-core variables catalogue. This provides a guideline as to how the non-core questions can be inserted into the core national questionnaires.

By their nature, non-core variables are collected only in a subset of the HFCS countries. An overview of non-core variables covered in one or more of the HFCS country files in the 2017 wave is provided in the Appendix.

3 Collection of data and other fieldwork aspects

The HFCS data collection is ex ante output harmonised with a list of core output variables that every country should collect in accordance with a set of common definitions. However, the HFCS output harmonisation enables a few temporary deviations from the recommended data collection mode and the use of other reliable data sources complementing/completing the survey data. In addition to data collection, various other fieldwork issues are also examined in this chapter.

3.1 Survey mode

The type of interaction between the respondent and the survey questionnaire is an important determinant of possible measurement error. The first and most important decision for a household survey is therefore the selection of the mode of data collection (Jäckle, Roberts and Lynn, 2006; Dillman and Christian, 2005). Using different modes to interview different sample units entails a high risk of comparability between survey results (de Leeuw, 2005). In a multi-national setting, this risk also becomes evident in comparisons between different countries using different survey modes.

For the HFCS, the same survey mode should be applied throughout all sample units in a country and across countries. The survey mode chosen for the HFCS is Computer Assisted Personal Interviews (CAPI), i.e. face-to-face interviews administered by an interviewer using a computer to record the replies provided by respondents. Survey data can be complemented by administrative data for variables with available consistent register sources. The use of a computer allows a smooth and error-free administration of the routing of the questions (which is particularly complex in the HFCS questionnaire), the application of consistency checks during the interview and the automatic storage of the data. Eliminating errors at the interview stage improves the quality of the survey data, and may save considerable resources in the subsequent data editing and cleaning phase.

In addition, interviewers play an important role in collecting high-quality income and wealth information, namely in: (1) persuading respondents to participate in the survey, increasing response rates, and reducing the risk of response bias; (2) building up trust vis-à-vis respondents, thus lowering the likelihood that a respondent will drop out in the middle of an interview; (3) minimising levels of item non-response by personally assisting (i.e. offering pre-designed prompts) – if required – during the interview; (4) avoiding incomplete responses; (5) providing additional information (interviewers' observations and paradata); etc. (HFCN, 2008a).

To a large extent, HFCS uses one dominant survey mode in each participating country (see Table 2). For mainly practical reasons, a small share of interviews was conducted

via a mode other than the dominant one in various countries, but this share is in most cases negligible. While 19 countries applied CAPI interviews in the third wave, in three countries, CAPI was not the main data collection method. In Poland, Paper-and-Pencil Interview (PAPI), in Finland, Computer Assisted Telephone Interview (CATI) and in the Netherlands, Computer Assisted Web Interview (CAWI) were the dominant survey modes[12]. The dominant survey modes have been the same in all waves in all countries, except for Cyprus, where PAPI was the main mode in the first wave. In addition, Malta used both CAPI and PAPI in the first two waves, and Hungary used both CAPI and CAWI in the second wave.

The median duration of the interview was more than one hour in seven countries, while it was less than 40 minutes in five countries. The interview lengths are not directly comparable, since there is variation in the number of core and non-core variables collected in the countries (see appendices). Moreover, there may be national variables collected especially in countries in which the HFCS is a continuation of an existing wealth survey. In addition, the countries that are able to use register data benefit from a reduced questionnaire length. In most countries that conducted the second HFCS wave, the median interview duration was somewhat longer in the third wave. This is likely to be caused by the increase in the number of variables in the HFCS core variables list.

[12] In Finland, most items on wealth, liabilities and income were not collected by interviews, but drawn directly or estimated with information from administrative registers.

Table 2

Share of interviews by survey mode in HFCS countries and length of interviews

Country	CAPI	CATI	CAWI	PAPI	Other or unknown	Median length of interview (minutes)
Belgium	100	0	0	0	0	72
Germany	100	0	0	0	0	71
Estonia	100	0	0	0	0	47
Ireland	100	0	0	0	0	42
Greece	100	0	0	0	0	62
Spain	100	0	0	0	0	N/A
France	100	0	0	0	0	75
Croatia	100	0	0	0	0	N/A
Italy	94.7	0	0	5.3	0	47
Cyprus	100	0	0	0	0	67
Latvia	95.4	4.4	0	0.2	0	40
Lithuania	97.3	0	0	0.9	1.8	39
Luxembourg	100	0	0	0	0	45
Hungary	100	0	0	0	0	35
Malta	99.9	0	0	0.1	0	44*
Netherlands	0	0	100	0	0	-
Austria	100	0	0	0	0	55
Poland	0	0	0	100	0	70
Portugal	100	0	0	0	0	59
Slovenia	100	0	0	0	0	37
Slovakia	100	0	0	0	0	65
Finland	1.8	98.2	0	0	0	32†

Notes: CAPI: Computer Assisted Personal Interviews; CATI: Computer Assisted Telephone Interviews; CAWI: Computer Assisted Web Interview; PAPI: Paper-and-Pencil Interview.
* Excludes the screener, household listing and interview closure, as well as interviews conducted by PAPI.
† Refers to the Income and living conditions survey (SILC) that included a module on household wealth and liabilities.

3.2 Fieldwork

In ten countries, the national statistical institute (NSI) was in charge of data collection, and interviews were conducted by staff in the survey units of the corresponding NSIs (see Table 3). In all other countries, the organisation responsible for conducting interviews was an external survey agency selected by the NCB in charge of the survey. In the Netherlands, a research institute was responsible for collecting the HFCS data through a web survey.

Interviewers were either employees of the survey agency or the NSI in charge of the data collection, or freelancers directly recruited by the survey agency. Before the start of the fieldwork, nearly all countries organised face-to-face training sessions for interviewers.

Fieldwork periods in the third wave of the HFCS varied from two months in Poland to 9 months in Austria and Ireland. Shorter fieldwork periods are beneficial for data comparability, either because the reference periods for income or balance sheet items

are closer or, in the case of a fixed reference period, to minimise recall bias. Conversely, longer fieldwork periods allow more opportunities to increase the number of contact attempts and thus obtain a higher number of interviews. The number of interviewers varied across countries, to a large extent depending on the sample size. The number of language versions of the questionnaire varied from one to four.

Table 3

Fieldwork indicators

Country	Organisation responsible for fieldwork	Number of interviewers conducting the survey	Language versions of the questionnaire	Length of fieldwork period (months)	Adaptation of existing survey (other than HFCS, second wave)
Belgium	SA	91	French, Dutch, English, German	5	N
Germany	SA	273	German	7.5	N
Estonia	NSI	63	Estonian, Russian	4	N
Ireland	NSI	100	English	9	N
Greece	SA	70	Greek	7	N
Spain	SA	N/A	Spanish	8	Y
France	NSI	580	French	4	Y
Croatia	SA	112	Croatian	3	N
Italy	SA	236	Italian, English	7	Y
Cyprus	SA	24	Greek, English	8	N
Latvia	NSI	42	Latvian, English, Russian	2.5	N
Lithuania	SA	56	Lithuanian	6	N
Luxembourg	SA	52	French, German, English	8	N
Hungary	NSI	274	Hungarian, English	3	N
Malta	NSI	27	English, Maltese	3	N
Netherlands	SA	Not applicable	Dutch	3	N
Austria	SA	70	German	9	N
Poland	NSI	867	Polish, English	2	N
Portugal	NSI	175	Portuguese	4	N
Slovenia	SA	73	Slovenian	6	N
Slovakia	NSI	137	Slovak	3	N
Finland*	NSI	120	Finnish, Swedish, English	6	Y

SA = Survey Agency, NSI = national statistical institute. N/A = information not available.
* Parts of the data were collected from the EU-SILC survey, selection of target variables based on the HFCS and previous wealth surveys by Statistics Finland.

Of the 22 countries participating in the third wave of the HFCS, 20 had already conducted the second wave of the survey and 15 also the first wave of the survey. Croatia and Lithuania joined the HFCS in the 3rd wave while Estonia, Ireland, Latvia, Poland and Hungary started in the 2nd wave.

In four countries, the HFCS has been adapted from an existing national survey. Two central banks added harmonised HFCS output variables to an existing wealth survey. These countries and their surveys were Italy (Indagine sui Bilanci delle Famiglie Italiane – Survey on Household Income and Wealth, SHIW), and Spain (Encuesta Financiera de las Familias, EFF).

In France, the HFCS was a joint effort between the NCB and the NSI (Insee), and an adaptation of the Enquête Patrimoine previously conducted by Insee. In Finland, the HFCS was integrated with EU-SILC by adding selected HFCS variables to the questionnaire and using administrative data on assets and liabilities, replacing the former separate Statistics Finland's household wealth survey (Kotitalouksien Varallisuustutkimus).

In the Netherlands, the third wave sample is based on LISS panel and the questionnaire follows the wording of the HFCN questionnaire. In the first two waves, information about assets and liabilities was derived from existing Dutch surveys (see Chapter 9.1 on data comparability between survey waves).

In Portugal, the HFCS has replaced the Household Wealth Survey (Inquérito ao Património e Endividamento das Famílias, IPEF), which was already a joint project of Banco de Portugal and Statistics Portugal (INE).

3.3 Collection of income variables

The core output variables on income are defined as gross of taxes and social contributions. However, different approaches were taken to the collection of data on income. In eight countries, income data were collected in gross terms only. In Italy and Poland, net income was collected and gross income constructed by estimating the amount of taxes and social contributions with the help of legislative and institutional parameters. In several countries, respondents had the option to provide net income for all or for some income components, in which case gross income was estimated (see Table 4).

Estonia, Ireland, France, Latvia and Finland derived income data from administrative registers, to a varying extent. In France, income data were based on registers only, while in Latvia, register data was used in combination with interview-based data. In addition to gross income variables, Italy and Finland provided income taxes and social contributions, and Italy, Poland and Portugal provided net income variables. For these countries, the variables enable net disposable income[13] to be harmonised.

[13] The concept of "net income" varies country by country and has not been harmonised.

Table 4

Exceptions in the collection of income variables

Country	Information
Estonia	Regular social transfers, unemployment benefits and occupational and private pension plans were derived from registers. Net income figures – where provided – were converted from interview data to gross income using information about the tax system.
Ireland	Register data on income, including employee income, profits and social transfers such as unemployment benefits and pensions, were used in the derivation of income.
France	Income data derived from registers. Income defined as gross of taxes but net of social contributions. Gross income from private business other than self-employment and gross income from other sources not collected.
Italy	Net income collected, gross income estimated with model. Income from financial investments not directly collected but calculated using average interest rates and information collected on households' financial assets. Gross income from private business other than self-employment not collected.
Latvia	Income data derived from registers (State Revenue Service) was used to edit survey values if respondent declined to report, did not know or under-reported the amount of income.
Poland	Net income collected, gross income estimated with model.
Finland	Income data derived from registers, except for private inter-household transfers and interest received, which were based on interview data.
Belgium, Germany, Estonia, Greece, Croatia, Latvia, Luxembourg, Hungary, Austria, Portugal	Gross income collected, but respondents had the option to provide net income figures for all or some income variables. Where provided, net income figures were converted to gross income with tax-based model.

Source: ECB – HFCS metadata.

3.4 Other deviations from the data collection framework: other data sources

The ex ante output harmonisation of HFCS data enables data collection methods other than a survey to be used whenever they are considered to provide better quality. In particular, register data can be used to replace survey data if the sources are reliable and the definitions used by the register sources are identical to the definitions of the corresponding target variables.

In most countries, though, most variables were collected directly from the respondents in the survey. A summary of cases in which data other than interview data were used for assets and liabilities is shown in Table 5 (see Table 4. for income variables). In the third wave of the HFCS, Estonia, Ireland, Latvia, Lithuania and Finland used register data to derive wealth components. The use of registers was very extensive in Estonia and Finland, while in Ireland and Latvia, register data were used mainly for editing interview-based data and filling in missing values.

Table 5

Other data sources used for assets, liabilities and other non-income variables

Country	Information
Estonia	Only register data: non-collateralised loans, leasing, and pension plans. Mix of register and interview data: deposits, mutual funds, bonds, managed accounts, credit lines and credit card debt Register data used for editing collateralised loans.
Ireland	Register on residential properties is used for edit checks, to fill missing values, and to find households who did not report owning another property in the interview.
Latvia	Register data used to identify missing answers and to edit values of corresponding variables on real estate properties, mortgage/loans/leasing contracts, and participation in pension schemes (private voluntary pension schemes, funded and unfunded state pension schemes).
Lithuania	Information on households' liabilities is based on registers
Finland	Register data: mortgages, non-mortgage loans (mostly), ownership of other real estate properties and vehicles, ownership and values of business wealth, forest assets, listed shares, mutual funds and bonds. Register-estimated data: value of household main residence and other real estate properties, value of vehicles, ownership and values of voluntary pension schemes Combination of registers and interview data: non-mortgage loans, loan payments. Except for food outside home, consumption variables are to a large extent statistically matched from the Household Budget Survey (HBS). Demographic variables (age, gender etc.) and level of education based on register data.

In Estonia, person-level data were collected from credit institutions, leasing and life insurance companies, the Estonian Central Securities Depository, the Land Register, the Construction Works Register, the Vehicle Register, the Tax and Customs Board, the Health Insurance Fund, the Social Insurance Board and the Unemployment Insurance Fund. Data for non-collateralised loans, leasing and pension plans were taken solely from registers. For deposits, mutual funds, bonds, managed accounts, credit lines and credit card debt, register data were used for Estonian assets while assets held abroad were based on interview data. Register data were used to edit collateralised loans (household main residence and other property mortgages).

In Ireland, administrative data on residential rental properties were used for edit checks and to fill in missing values for the size of the main residence, tenure status and rents paid, as well as values for other properties. In Latvia, administrative data were used to edit interview-based data. Data from the Land Cadastre were used for real estate properties, credit register data for mortgages, loans and leasing contracts, and State Revenue Service data for participation in voluntary pension funds. Data on participation in state pension funds were not collected directly from the respondents but taken from the State Social Insurance Agency. In Lithuania, information on households' liabilities was based on register data.

In Finland numerous types of register data and register-estimation methods as well as statistical matching were used. For the household main residence, ownership was based on survey data but the values were estimated using transaction price data. For other properties and vehicles, values were estimated and ownership was based on registers. Stocks, mutual funds, bonds and business wealth were record-linked from registers, while voluntary pensions were estimated using longitudinal tax data. Loans were taken from registers, but supplemented with interview data in the case of consumption loans and credit card debt. Demographic variables and level of education were also taken from registers.

In some countries, legislative and institutional information may have been used in the construction of the pension variables. Such information includes, for instance, the percentage of current gross earnings contributed to the main public pension plan.

4 Sample design

This chapter analyses the main features of the sample designs and sampling frames chosen by the countries participating in the HFCS. Since wealth is distributed very unequally, all participating countries are encouraged to explore methods for oversampling the wealthiest households. The chapter also provides a description of the oversampling approaches applied in different countries.

4.1 General features

A good sampling design should provide the most efficient and unbiased representation of the relevant population (Kennickell, 2005). Sampling design and implementation is a central component in the potential errors in estimation related to survey data (Verma and Betti, 2008), including errors on coverage, sample selection and also sampling errors and estimation bias.

The first and probably most important feature of the HFCS sample design is the use of probability sampling. This means that each household in the target population has a non-zero probability of being selected in the sample, and this probability should be known beforehand (HFCN, 2008a). Given the sizeable fixed costs of conducting a survey like the HFCS compared with the marginal costs corresponding to each additional sampling unit, the sample size should be representative both at the country and at the euro area level.

Another relevant feature of the sample design for any survey is whether it is intended to introduce a panel component, i.e. whether (at least a portion of) the same households will be interviewed again over subsequent waves. In such a case, survey compilers need to take care to ensure the representativeness of both the cross-sections and the longitudinal component, and to ensure proper refreshment covering for sample attrition. All this may substantially add to the complexity of the sample design.

4.2 Main country features

While probability sampling is applied in all HFCSs in the third wave,[14] countries have adopted a variety of approaches in their sampling designs. The methodologies are largely dependent on the external data (population registers, postal addresses, dwelling registers, etc.) available for building up the sample.

[14] Also in the second wave all countries used probability sampling. In the first wave, probability sampling was used in 14 out of 15 countries; only Slovakia used quota sampling.

4.2.1 Sampling designs applied

In household surveys, stratification of the population prior to sample selection is a commonly-used technique. In a stratified sample, various strata are constructed on the basis of auxiliary information that is known about the population, and sample units are selected independently from each stratum in a manner consistent with the survey's measurement objectives (UN, 2005). Units to be interviewed can be selected in one or multiple stages. In a multiple stage design, the first stage (or stages) involves a selection of geographical areas, from which individual households are chosen in the final stage.

Table 6 describes the sampling designs used in various countries. Five countries used one-stage stratified sampling, while 15 countries had a multi-stage stratified sampling design. In Malta and the Netherlands, no stratification was applied. In all countries, the sample size was chosen to be representative also at the country level.

Table 6

Sampling designs in the HFCS

Type of sampling design	Countries adopting
1-stage stratified sampling	BE, EE, CY, LU, FI
2-stage stratified sampling	IE, GR, ES*, FR, HR, IT*, LV, LT, HU*, AT, PL, PT, SI, SK
3-stage stratified sampling	DE#
1- stage sampling, not stratified	MT, NL

* In Spain and Italy, one stage for households living in larger municipalities with over 100,000 and 40,000 inhabitants respectively, two stages for others. In Hungary, one or two stages depending on the locality.
# In Germany, three stages for households living in municipalities with over 100,000 inhabitants, two stages for others.

Table 7 describes the stratification criteria in various countries. The sampling frames involved data on regions in the first stage (in multi-stage designs) and information on persons, households or dwellings in the second stage (or in the first stage in one-stage designs).

Region and population size of regional units were the most frequently used stratification variables, regions being in several cases additionally divided by the degree of urbanisation. Other stratification criteria included personal or regional average income, labour status and personal taxable wealth.

Table 7

Sampling frames and stratification criteria

Country	Sampling frame(s)	Stratification criteria
Belgium	National population register	Region, average taxable income by statistical sector and average dwelling price by municipality
Germany	List of municipalities and number of inhabitants; list of street sections for large cities; register of local residents from municipalities	Municipality size, anticipated wealth
Estonia	Statistical population register	Five NUTS3 regions and two income groups, the highest decile and the rest
Ireland	Population and housing census 2016	Eight NUTS3 regions and five quintiles of deprivation/affluence.
Greece	List of municipalities, cities, villages and building blocks within cities from census 2011; dwellings	NUTS II region, degree of urbanisation
Spain	Population register supplemented with tax record information	Taxable wealth, municipality size
France	Tax register on main residences (master sample); fiscal sources within master sample	Geographical area and common property
Croatia	Census 2011	Floor space of dwellings, NUTS-3, type of municipality
Italy	List of municipalities, population register	Municipalities by region and demographic size
Cyprus	Customer register of the electricity authority	Counties divided into urban and rural areas
Latvia	Population register, tax register; list of addresses	Degree of urbanisation (three groups), and income (three groups)
Lithuania	List of municipalities; population register	Estimated wealth
Luxembourg	Social security register	Nationality, employment status, monthly income
Hungary	Register of localities; register of addresses	Regions, income tax base per capita, municipality size, estimated value of dwelling
Malta	Population and dwellings register	No stratification
Netherlands	Population register (LISS panel)	No stratification
Austria	List of enumeration districts; register of post box addresses	Region (NUTS 3) and community size classes
Poland	Local data bank (CSO); Population and housing census	Regions (NUTS2), size of places, wealth (tax income and size of properties)
Portugal	National dwellings register	Nine regions (subdivisions or divisions of NUTS 2) and classes of useful area of dwellings
Slovenia	Register of spatial units; Central population register	Municipality size
Slovakia	Household units database based on 2011 Census; database of occupied housing units	Regions (NUTS 3) and municipality size
Finland	Population information system of Statistics Finland	Income level, type of income (personal taxable income of the main income earner of the household-dwelling unit).

Table 8 shows the numbers of strata used in the sampling designs of various countries. It also indicates the number of units, such as geographical areas or clusters, selected in the first stage in multi-stage designs (primary sampling units, PSU).

Table 8

Numbers of strata and primary sampling units selected

Country	Number of strata	Primary sampling units selected, for multi-stage designs
Belgium	24	-
Germany	4	159*
Estonia	10	-
Ireland	157	900
Greece	13	670
Spain	All except Basque Country and Navarre: 5 strata by municipality size and 7 strata by taxable wealth. Basque Country and Navarre: 6 strata by municipality size.	N/A
France	9	567+22
Croatia	16	800
Italy	58	387
Cyprus	8	-
Latvia	9	620
Lithuania	34	17
Luxembourg	20	-
Hungary	626	345
Malta	-	-
Netherlands	-	-
Austria	180	614
Poland	195	2680
Portugal	18	677
Slovenia	6	367
Slovakia	48	1387
Finland	49	-

*Refers to the refresher component of the sample only. N/A = information not available.
Note: number of strata refers to the first sampling stage only. Primary sampling units selected are shown for countries with multi-stage sampling designs.

4.2.2 Panel component

Altogether twelve HFCS countries had a panel component in the third wave of the HFCS (Table 9), compared to six countries in the second wave. Estonia, France, Latvia, Poland, Slovakia and Finland are the new panel component countries in the third wave.

Table 9
Countries with a panel component

Country	Number of households re-contacted at wave 3, % of all contacted households	Panel design
Belgium	28.8	Pure panel with refresher sample
Germany	31.2	Pure panel with refresher sample
Estonia	58.7	Pure panel with refresher sample
France	31.3	Rotating design
Spain	N/A	Rotating design
Italy	38.2	Pure panel with refresher sample
Cyprus	62.4	Pure panel with refresher sample
Latvia	34.3	Rotating design
Malta	45.1	Pure panel with refresher sample
Poland	29.1	Pure panel
Slovakia	21.8	Pure panel
Finland	18.9	Rotating design

Source: ECB – HFCS metadata. N/A = information not available.

4.2.3 Non-coverage of specific sub-populations in the sampling frame

The sampling frames of the HFCS included only households living in the countries where the survey was conducted. In addition, in most national surveys, the whole of the institutionalised population was left out of the sampling frame, because the target population of the HFCS is private households. In addition to homeless, some groups of the population are excluded from the sampling frames of individual countries. The gross sample of Cyprus did not include the population in Northern Cyprus.

Individuals belonging to some of the excluded groups, however, can be included in the sample, if they are considered as part of a household that is part of the sampling frame.

Table 10
Excluded groups

Country	Excluded groups
Germany, Ireland, Greece, Spain, Croatia, Latvia, Lithuania, Netherlands, Austria, Poland, Portugal, Slovakia, Finland	Population in institutions, homeless
Belgium	Population in institutions (residents in homes for the elderly were included in the sampling frame), homeless
Estonia	Population in institutions
France	Population in institutions, homeless, people who do not live in a main residence
Italy	Population in institutions, homeless, individuals not in the population register
Cyprus	Population in institutions, homeless, population of the areas of the Republic of Cyprus not under the effective control of the Government of the Republic of Cyprus
Luxembourg	Population in institutions, homeless, international civil servants and individuals not registered in the social security register in general
Hungary	Population in institutions, homeless, population of municipalities with less than 30 inhabitants
Malta	Population in institutions, homeless, private households already selected to participate in other household surveys
Slovenia	Population in institutions, homeless , people who do not report their current main residence to authorities

Source: HFCS metadata.
Note: Population in institutions refers to persons living in e.g. homes for elderly people, military compounds, prisons and boarding schools.

4.2.4 Use of replacements

A replacement of a sample unit occurs when a non-responding unit is replaced by another reserve unit during the fieldwork. Using replacements may help draw information in particular from groups of households that are most difficult to reach. On the other hand, replacements may have different characteristics from those of non-respondents and using replacements may result in a reduction of interviewers' efforts to get an interview from the originally selected unit. In the HFCS, the use of replacements should be subject to strict control. Replacements should be selected to closely match the replaced units in terms of important characteristics, and replacements are allowed only after special efforts have been made to convert refusals.

Replacements were used in three countries in the third wave: Spain, Italy, and Cyprus. Although the rules for using replacements varied, all countries followed the criteria mentioned above to a large extent.

In Spain, tightly controlled replacements were chosen. In large cities and provincial capitals, up to four replacements were provided for each original household in the sample that would serve as replacements for that household only. These replacements were the two households immediately before and the two immediately after the household in a list ranked by income quartile (for non-filers of wealth tax), wealth stratum, and per capita household income. Replacements had to belong to the same income quartile (for non-filers of wealth tax returns) or the same wealth stratum as the sample household. This was done within municipalities to keep replacements geographically not too distant from the original sample household. In the case of

smaller municipalities, Navarre, and the Basque country, four replacement households were drawn for each refreshment sample household from the same PSU. No replacements were provided for panel households.

In Italy, replacements are allowed within the same municipality after four unsuccessful contacts, on different days and at different times, determining not-at-home, refusals or ineligibility.

In Cyprus, replacements were selected from the same stratum as the original sample unit.

4.3 Oversampling of the wealthy

In wealth surveys, there are several additional challenges for the sample design in comparison to other household surveys. Wealth surveys usually aim to conduct several kinds of analyses on all parts of the distribution. However, it is known that the distribution of wealth is skewed, and some types of assets are possessed only by a small fraction of households. Consequently, for the sample to adequately represent the full distribution of wealth in the population, it is essential to have a relatively high proportion of wealthy households in the sample (Kennickell, 2007). Data on the wealthiest households should be collected as efficiently as possible to get unbiased estimates of total wealth.

Furthermore, the general picture of wealth inequality will be negatively affected by the inability to collect data from the top fractions of the distribution. This will have an impact on indicators such as the Gini index, the share of wealth owned by the top 1%, and quantile ratios (for example, the ratio of net wealth between the households in the top 20% and bottom 20% of the wealth distribution), which are sensitive to the values of the richest households. Recently there have been attempts to measure the bias caused by the inability of survey data to sample the wealthiest households in the population with the help of external sources, such as data from Forbes' The World's Billionaires list (Vermeulen, 2014).

Capturing the values of assets from the wealthiest households is even more relevant in the case of certain individual items, particularly financial assets that are owned only by a small share of households.

In addition, there is evidence from previous wealth surveys that unit non-response rates are higher for wealthier households. This is first caused by the special difficulty of establishing contact with wealthy respondents, since they are more likely to be absent from their principal residence during prolonged periods of time, to possess more than one residence and to be surrounded by additional security measures. In addition, both available time and self-perceived value/time ratios usually predispose wealthy households to refuse to take part in surveys.[15] If it is not compensated by post-survey adjustments, the different non-response rate would cause measurement bias.

[15] For further information, see references in Sanchez-Muñoz (2011).

Furthermore, if the sample is selected using information correlated with wealth,[16] this same supporting information may also be useful in guiding post-survey adjustments, compensating for non-response and reducing sampling error.

In conclusion, a given level of precision would either require a rather large (and costly) sample or, if efficiently designed, a sample which should include a disproportionally high number of wealthy households. Indeed, using data from a purely random selection of units would thus yield a statistically very inefficient estimate of the distribution of wealth. These challenges should be anticipated during the sampling-design phase.

Seventeen out of twenty-two countries were able to use different strategies to oversample wealthy households (Table 11). The two new HFCS countries in the third wave (Croatia and Lithuania) used oversampling. In the second wave, fifteen out of twenty countries had oversampled the wealthy.

The strategies varied significantly between countries, and were heavily dependent on the available data, as shown in Table 11. Spain and France were able to use personal wealth data and Lithuania individual data on real assets. Estonia, Finland, Latvia and Luxembourg used personal income data in oversampling. Proxies for wealth were also household-level electricity consumption (Cyprus), the size of the dwelling (Portugal), and the estimated value of the dwelling (Hungary). Other countries did not have access to personal-level income or wealth data or other proxies, and consequently oversampling had to be based on regional-level information, mainly on income and/or property prices. For instance, Germany and Slovakia oversampled wealthy street sections.

[16] For instance, register-based (such as on wealth or income taxes; property taxes; socio-economic information at municipality or small area level; census of dwellings; etc.) or survey-based information (either from previous waves of the survey or from other surveys).

Table 11

Oversampling strategies

Country	Criteria for oversampling	Details
Belgium	Regional indicators	Neyman allocation based on income dispersion. Regional units with higher number of households and bigger dispersion of income were oversampled.
Germany	Regional indicators	In cities with 100,000 or more adult inhabitants, wealthy street sections were oversampled. Among the smaller municipalities, those with a high share of taxpayers with a total taxable income above a threshold were oversampled.
Estonia	Personal income	The division into two income groups was based on the total net income for 2016 taken from the records of the Estonian Tax and Customs Board for the total population (includes income from employment, benefits, gain or loss from transfer of securities and some other types of income).
Ireland	Regional indicators	The primary sampling units were chosen from geographical areas that scored highly on a wealth index based on homeownership rates and "local property tax" bands. The oversample consisted of an additional 100 geographical areas chosen using probability proportional to size based on a wealth index.
Greece	Regional indicators	Oversampling based on average and median real estate prices by municipality and tax code obtained from the Bank of Greece Real Estate Prices database.
Spain	Personal taxable wealth	Seven wealth strata based on taxable wealth, sample progressively larger in strata with higher taxable wealth, based on wealth and income tax returns.
France	Personal wealth data	Within each selected primary unit, two samples were selected. The first targeted wealthy households and the second the other households. For the wealthy sample, three strata were oversampled: city dwellers with more than €3 million in net assets declared, rural dwellers with more than €3 million in net assets declared, and other households declaring between €1.3 and 3 million in net assets.
Croatia	Dwelling characteristics	Occupied dwellings with floor space of over 120 square metres.
Italy	No oversampling	
Cyprus	Electricity consumption	A fixed oversampling rate was applied, by taking the top 10% of the distribution of annual domestic electricity consumption.
Latvia	Personal income	Different sampling fraction for the highest income decile according to tax registers.
Lithuania	Wealth, real assets	20% of the gross sample was drawn from the top decile according to wealth based on administrative data on real assets. Source: a combination of the Population Register and the Real Property Register.
Luxembourg	Personal income	20% of the gross sample was drawn from the top income decile according to the social security register.
Hungary	Dwelling, estimated value	Allocation scheme with 50% Neyman allocation and 50% proportional allocation based on dwelling values. Strata of households with higher dwelling values have higher dispersion, and the Neyman-allocation results in oversampling of the wealthy.
Malta	No oversampling	
Netherlands	No oversampling	
Austria	No oversampling	
Poland	Regional income and property size	Four groups of wealthy households, based on tax income and size of properties. All these groups were oversampled to varying degrees.
Portugal	Dwelling size	Dwellings with a useful floor space (sqm) above a predefined threshold.
Slovenia	No oversampling	
Slovakia	Regional indicators	The tax office provided a list of streets with a high incidence of high income individuals (top 5% in the region) as residents. Primary sampling units for the high-income groups are streets with at least two people with income above the 95% quantile in the region.
Finland	Personal income	Level of income and type of income. High-income earners and self-employed oversampled, based on personal taxable income of the main income earner of the household-dwelling unit. Data from tax registers and register of household-dwelling units.

Source: ECB – HFCS metadata.

The oversampling strategies have enriched the sample with a higher proportion of households with high asset values, or less common financial assets, leading to more

precise estimates of wealth. However, the final representation of the wealthy in the sample is influenced by other factors, such as non-response. An indicator of the representation of the wealthy in the final sample is the "effective oversampling rate of the wealthy" (see Table 12). It indicates the extent to which the share of wealthy households in the sample exceeds their share in the population. These rates are given separately for households belonging to the richest 5% and 10% of the population.

To compute this indicator, the net wealth values of the 90th and 95th percentiles were first calculated from the weighted data. Subsequently, the (unweighted) shares of interviewed households exceeding these values were computed. When the net sample includes a relatively large number of wealthy households with small final estimation weights on average, it is an indication of high effective oversampling of the wealthy households.

Table 12

Effective oversampling rates of the wealthy

Country	Effective oversampling rate of the top 10%	Effective oversampling rate of the top 5%
Belgium	46	56
Germany	140	174
Estonia	35	42
Ireland	72	72
Greece	-8	-14
Spain	223	413
France	158	278
Croatia	16	20
Italy	5	3
Cyprus	58	66
Latvia	69	76
Lithuania	33	10
Luxembourg	45	58
Hungary	69	93
Malta	-6	-12
Netherlands	26	30
Austria	-15	-15
Poland	-5	0
Portugal	81	90
Slovenia	-2	-4
Slovakia	-17	-20
Finland	83	97

Notes: "Effective oversampling rate" of the top 10%: (S90 – 0.1)/0.1, where S90 is the share of sample households in the wealthiest 10%. Effective oversampling rate of the top 5%": (S95 – 0.05)/0.05, where S95 is the share of sample households in the wealthiest 5%. Wealthiest households are defined as having higher net wealth than 90% (95%) of all households, calculated from weighted data.

The interpretation of the figures in Table 12 is as follows: if the share of rich households in the net sample is exactly 10%, the effective oversampling rate of the top 10% is 0. If the share of households in the wealthiest decile is 20%, the effective oversampling rate is 100, meaning that there are 100% more wealthy households in the sample than there would be if all households had equal weights. A negative

oversampling rate indicates that there are fewer wealthy households in the net sample than there would be if all households had equal weights.

A high effective oversampling rate means that the analyses of wealthy households – and accordingly of aggregate wealth and wealth inequality indicators – are more efficient. The range of oversampling rates is considerable in the HFCS. In the data for some countries, the share of wealthy households in the sample is smaller than their share in the population. In other cases, effective oversampling rates of the top 10% are up to over 200%, and the corresponding rates for the top 5% even higher. Judging by the previous table, oversampling strategies and data availability play a major role in the ability to get interviews from wealthy households. The availability of household-level information seems to be an especially big advantage.

5 Unit non-response and weighting

High unit non-response rates increase the variability of estimates drawn from the sample, and, to the extent that non-response is non-randomly distributed, it may lead to biased estimates of the variables of interest. Weight adjustments may to some extent be used to alleviate non-response bias.

This chapter compares indicators on response behaviour observed in the third wave of the HFCS and describes the common weighting procedure applied in the survey, along with the most significant country features on weighting and calibration.

5.1 Unit non-responsive in wealth surveys

Unit non-response is the failure to obtain information from an eligible sample unit. It is a result of either the inability to contact a selected sample unit, of the unwillingness of the sample unit to respond to the survey, or of several other reasons such as language barriers or inability to participate in the interview. Owing to the sensitivity of wealth data, observed unit non-response rates have been generally higher in wealth surveys than in income surveys.[17]

To improve the quality of the analysis to be conducted with survey data, it is generally considered essential that the basic survey weights determined by the sample design are adjusted to address non-response and other imperfections in the final sample, such as coverage problems. Furthermore, to maximise comparability in such a multi-national survey, it is usually seen as important that such procedures are common in each country, and are compatible with the structure of the sample and the data available for making adjustments.

Although a survey with a 20% response rate has a greater possibility for bias than a comparable survey with a 100% response rate, there is evidence that response rates and non-response bias are not always inversely related (Groves and Peytcheva, 2008). It is common practice to evaluate the degree to which there is identifiable response bias in a survey and the degree to which non-response adjustments may ameliorate such problems. In the case of the HFCS, it will also be important to investigate variations in national surveys that may lead to systematic differences in non-response bias.

5.2 Unit non-response in the HFCS

The HFCS takes special care to minimise non-response rates to reduce non-response bias by emphasising the use of best practices. For example, emphasis has been put on interviewer selection and training, as well as on the incentives and workload the

[17] For further information, see references in Pérez-Duarte et al. (2010).

survey organisation offers to interviewers. To minimise variability in potential bias across the countries participating in the HFCS, emphasis is placed on the use of common practices, to the extent that this is feasible. Despite these efforts and the good flow of information and exchange of best practices across countries, there remained potentially important differences in procedures, such as the protocols used in directing attempted contacts with the survey respondents.

Table 13 presents indicators on response behaviour in the second wave of the HFCS. These indicators are based on standard definitions (see AAPOR, 2011). The following indicators are included:

- Response rate = Achieved interviews / Eligible sample units[18]
- Refusal rate = Sample units refusing to participate / Eligible sample units
- Cooperation rate = Achieved interviews / Contacted sample units
- Contact rate = Contacted sample units / Eligible sample units
- Eligibility rate = Eligible units / Gross sample size

The response rate is probably the most commonly used survey quality indicator. Because non-response reduces the number of observations available for analysis, it has direct implications on the sampling variability of survey estimates. Refusal, cooperation and contact rates provide useful information on the structural characteristics of non-response and may help to better administer survey resources towards respondents with a higher tendency to refuse participation in the survey, with a view to minimising the risk of non-response bias. Eligibility rates indicate the quality of the sampling frame.

There is a significant variation in the achieved response rates in the HFCS, as shown in Table 13. For the countries with a panel component, both response rates of households interviewed for the first time and for the entire sample are given if information is available. In the comparison of response rates, it is worth noting that the Finnish figures refer to an income survey (EU-SILC), and in France and Portugal, the survey is compulsory for households, though participation is never enforced. Moreover, in some countries, the HFCS was an adaptation of existing household surveys.

In a majority of the countries, the main reason reported for unit non-response is refusal to participate. Eligibility rates indicate quality of the sampling frames, and are in most countries above 90% and in half of the countries above 95%. Contact rates also have significant variation across countries, but are in many countries also around 90% or more.

[18] For sample units for which eligibility could not be defined during fieldwork, the share of eligible units is estimated from the corresponding share of those sample units for which eligibility was identified.

Table 13
Response behaviour indicators in the HFCS

Country	Gross sample size	Net sample size	Response rate*	Response rate** (including panel)	Refusal rate	Cooperation rate	Contact rate	Eligibility rate
Belgium	7,613	2,329	28.9	37.6	46.6	38.9	96.5	81.4
Germany	16,375	4,942	16.1	31.5	48.0	31.5	85.5	95.8
Estonia	3,816	2,679	60.7	72.8	17.8	76.3	95.4	96.5
Ireland	13,200	4,793	38.5		26.2	56.8	67.9	94.2
Greece	7,980	3,007	39.4		50.5	41.8	94.3	95.6
Spain	N/A	6,413	N/A	N/A	N/A	N/A	N/A	N/A
France#	21,484	13,685	64.2	68.1	11.3	76.9	76.9	93.6
Croatia	4,055	1,357	35.8		49.2	41.7	41.7	93.5
Italy	15,379	7,420	36.6	50.3	28.6	62.1	81.0	93.9
Cyprus	2,218	1,303	N/A	60.8	28.9	62.6	97.4	96.6
Latvia	2,894	1,249	N/A	45.3	24.7	64.1	70.7	95.3
Lithuania	3,774	1,664	45.3		26.3	56.5	80.2	98.1
Luxembourg	7,100	1,616	24.6		53.7	28.6	86.0	92.0
Hungary	15,006	5,968	44.2		25.0	59.8	73.9	89.9
Malta	1,590	1,004	53.5	64.8	25.3	71.2	91.3	97.4
Netherlands	3,760	2,556	N/A	68.0	28.9	68.0	N/A	N/A
Austria	6,280	3,072	49.8		45.3	50.6	98.5	98.2
Poland	12,038	5,858	45.7	52.5	31.8	53.6	98.0	92.6
Portugal#	8,000	5,924	85.5		3.5	93.5	91.4	86.7
Slovenia	5,505	2,014	37.7		45.5	42.7	88.3	97.1
Slovakia	4,017	2,179	N/A	56.1	26.4	67.2	83.5	96.7
Finland	13,396	10,210	60.1	77.4	15.3	81.6	94.9	98.4

Source: ECB – HFCS metadata. M stands for missing value – comparable information not available from the metadata.
Gross sample includes panel households that have responded to previous waves of the same survey. N/A = information not available.
In France and Portugal, survey participation is compulsory for households.
* For comparability, response rates are shown for households interviewed for the first time.
** Response rates for the whole sample in countries that have a panel component. In Finland, the panel component consists of households interviewed in the three previous waves of the income and living conditions survey.

Finally, it is worth mentioning that oversampling of wealthy households may decrease response rate. In spite of this possible drawback, oversampling of specific population groups is beneficial for survey quality, and should be noted when comparing the response rates of individual surveys.

5.3 Weighting

Weighting procedures are an essential tool for adjusting, to the degree that this is possible, both for the bias caused by unit non-response and for other irregularities in the sample. In the HFCS, all participating surveys follow common high-level weighting procedures to ensure the comparability of survey data. There are minor differences in some of the details of implementation across countries participating in the HFCS. In addition, there are differences in more granular elements, such as the structure of the samples and the frame-based and external sources used to adjust the weights.

5.3.1 Weighting procedures in the HFCS

The standard HFCS procedure for computing and adjusting survey weights takes into account: (i) the unit's probability of selection; (ii) coverage issues; (iii) unit non-response; and (iv) an adjustment of weights to external data (calibration). The methodology is coherent with existing international standards (Eurostat, 2011a and United Nations, 2005). These steps are implemented sequentially as follows:

Design weights are computed as the inverse of the selection probability of each unit in the gross sample, that is, both responding and non-responding units.

The first-stage weights are adjusted for coverage, including adjustments both for non-eligible units in the gross sample (frame over-coverage) and for multiple selection probabilities. This stage of adjustment is relevant especially for sampling frames designed from registers of dwellings rather than of households or individuals.

The coverage-adjusted weights are further adjusted in an attempt to minimise bias potentially induced by discrepancies between characteristics of survey respondents and non-respondents. This adjustment involves estimating response probabilities as functions of characteristics available for both responding and non-responding households, and dividing the coverage-adjusted weights of each responding unit in the achieved sample by the response probability. In the HFCS, such adjustments are conducted either by regression-based modelling or by response homogeneity groups.

To obtain final weights, the non-response-adjusted weights are modified using auxiliary information to align the estimates of a set of variables with corresponding population estimate totals and category frequencies (Särndal, 2007). This adjustment of weights is motivated by a desire to reduce bias induced by discrepancies between the initial sample and the total population that are not captured in the coverage adjustments or that are induced through the other stages of weight adjustment. The HFCS uses a methodology that adjusts weights so that their totals by groups match their representation in the full population of households. To be effective, the calibration variables must be strictly comparable in both the survey and the source of the population data, correlated with the study variables, but not too closely correlated with each other. While the selection of calibration variables varies by country, partly dependent on available data sources, calibrating for at least age, gender and household size is common across all countries in the HFCS (see Table 14).

In surveys that have a panel component, the weighting procedure includes additional features. First of all, personal – and ultimately household – weights need to be adjusted for persons leaving and entering the households between waves. Secondly, household weights need to be adjusted for attrition and for households leaving and entering the target population. Different survey waves are treated as independent samples in the first stage of the weighting procedure, and subsequently the samples are merged and their weights adjusted to the target population of the current wave before the final calibration step[19].

[19] The Finnish sample consists of four rotational groups of the EU-SILC, which are weighted separately, and finally panel-specific cross-sectional weights rescaled in proportion to the sample share of each group.

In sample surveys where different units have unequal probabilities of being sampled, using the inverse selection probabilities in weight construction will produce unbiased estimates of means and totals (Horvitz and Thompson, 1952). However, the variability of weights often increases the sampling variances of important survey estimates relative to those of a sample of the same size without weight variation, and there is a trade-off between unbiasedness and the efficiency (low variance) of estimates (Little, 1991). In the case of highly variable weights, the efficiency of estimates can be increased by setting limits for weight adjustment factors in calibration or by trimming extreme weights.

5.3.2 Variables used for calibration

Table 14 indicates the external variables and sources used in calibration. Note that in some cases, combinations of individual variables (for example, age by region or by municipality size) were used.

Table 14

Calibration variables and sources

Country	Age	Gender	Household size	Region	Other	Source
Belgium	X	X	X	X	-	Population statistics (NSI)
Germany	X	X	X	X	Municipality size, home ownership, size of main residence (for homeowners); education, labour status and nationality	Micro census
Estonia	X	X		X	-	Statistical Population Register
Ireland	X	X	X	X	Home ownership, deprivation, employment status	LFS
Greece			X	X	Home ownership	EU-SILC, LFS
Spain	X	X	X		Age by municipality size, gender by municipality size	Population registers
France	X	X	X	X	Degree of urbanisation, education and socio-economic status of reference person, household type, labour and wealth income	Census. LFS
Croatia	X	X		X		Population Statistics
Italy	X	X		X	Municipality size, income and labour status for panel households	Census
Cyprus	X	X	X	X	-	Census
Latvia	X	X		X	Income	Population statistics, tax register
Lithuania	X	X	X	X	Values of real assets, loans for HMR purchase, income.	The population register, the real property register, loan risk database in the NCB, and social security database.
Luxembourg	X	X	X		Nationality	Social security register
Hungary	X	X		X	Labour status, type of locality	Census. LFS
Malta	X	X	X	X	-	NSI
Netherlands	X	X	X		Home ownership, education	NSI
Austria*			X	X	Home ownership	Micro census
Poland	X	X	X	X	-	Census
Portugal	X	X	X	X	Loans for house purchase	Population statistics, LFS, Credit register
Slovenia	X	X	X	X	-	Population statistics
Slovakia	X	X	X	X	Labour status	Census
Finland	X	X	X	X	1. EU-SILC calibration variables: level of education and 16 income related variables 2. HFCS-specific calibration variables: 4 wealth related variables on listed shares and mutual funds	NSI Population information system, tax and other income registers, register files on the values of listed shares and mutual funds

LFS: Labour force survey. NSI: national statistical institute. EU-SILC: EU Statistics on Income and Living Conditions. CBS: Central Bureau of Statistics, Netherlands.
* Cell-based post-stratification.

5.3.3 Weights

The outcomes of the weighting procedures are shown in Table 15, including the sums, means and coefficients of variation of final estimation weights by country. The sum of final estimation weights corresponds to the size of the target population, i.e. the

number of households. Mean weights indicate the average number of households that one net sample unit represents.

Table 15

Final estimation weights by country

Country	Sum	Mean	Coefficient of variation, %
Belgium	4,884,911	2,097	105
Germany	40,351,000	8,165	125
Estonia	590,739	221	80
Ireland*	1,808,254	377	110
Greece	4,162,442	1,384	88
Spain	18,536,404	2,890	121
France	29,327,561	2,143	103
Croatia	1,495,082	1,102	66
Italy	25,522,082	3,440	104
Cyprus	303,242	233	108
Latvia	836,810	670	99
Lithuania	1,286,924	773	103
Luxembourg	226,378	140	71
Hungary	4,004,215	671	79
Malta	168,467	168	71
Netherlands	7,794,075	3,049	44
Austria	3,933,967	1,281	38
Poland	13,374,992	2,283	69
Portugal	4,117,770	695	115
Slovenia	824,618	409	51
Slovakia	1,852,059	850	77
Finland	2,677,100	262	88

Notes: Sum is the sum of the estimation weights over the households, and corresponds to the size of the target population, i.e. the number of households. Mean weights indicate the average number of households that one net sample unit represents. The coefficient of variation is the relative standard deviation of final estimation weights (as a percentage of the mean of weights). This indicates the variability of the final weights in the net sample.
* The Irish data are based on preliminary weights used for the HFCS 2017 wave reports.

6 Editing, item non-response and multiple imputation

Data editing is an essential part of processing survey data in order to minimise the errors and inconsistencies from collected observations. Kennickell (2006) shows the effect of editing the data in the Survey of Consumer Finances by comparing the distributions of net worth of imputed but unedited data with the imputed and edited data. The unedited data show, for example, underestimation at the bottom of the distribution, but strong overestimation at the top.

In any household survey, a certain degree of item non-response is always expected. In a wealth survey like the HFCS, which contains difficult and sensitive questions on personal finances, one can expect a higher level of missing answers, and in particular for some of the most important variables used in the production of statistical indicators and as components of research models. Imputation is the most frequently used process of correcting for item non-response by assigning plausible values to a variable when it was not collected at all or not correctly collected based on the information collected from other households.

The need to provide users with information about the quality of the data is recognised. For this purpose, a set of shadow, or "flag", variables is produced and provided to users to indicate the origin of the information given for all variables and observations. Flag variables indicate, for example, whether an individual observation was recorded as collected, edited, estimated, imputed from a range value provided by the respondent, or imputed because the respondent could not or did not want provide a valid response.

6.1 Data editing

The procedure for detecting errors in and between data records, during and after data collection and capture, and for adjusting individual items is known as editing (UN, 2001). The use of carefully programmed computer assisted interviews can significantly reduce the number of consistency checks needed after the fieldwork phase. Furthermore, comments made by interviewers during data collection can help in identifying possibly unreliable values (Bledsoe and Fries, 2002).

In all countries conducting the HFCS, consistency and range checks were included in the questionnaires. In most cases, interviewer comments were used systematically in the review of data values. Nearly all countries applied several different editing rules, including logical, range and consistency checks as well as checks for outliers. Seven countries used register data in editing to complement interview information with administrative data. In addition to correcting unreliable observations, editing has been used to convert net amounts of income variables to gross amounts.

6.2 Imputation of the HFCS data

In the HFCS, observations for which no valid response was received from the households should be imputed. In addition to a common methodology on imputations, software tools have been developed for imputation in order to maximise the degree of methodological commonality.

6.2.1 Imputation requirements

A complete-case analysis that discards non-observed units and analyses only units with complete data would disregard too much information and is thus not considered appropriate for the HFCS. Inferences should be made from the survey data on the entire population rather than on only those units that have provided answers to certain questions (Little and Rubin, 2002). While a requirement to impute all missing values for all variables has not been considered realistic, a minimum set of variables that need to be imputed has been determined for the HFCS. The set of 260 variables that were fully imputed in the 2017 wave included all components of household income, consumption and wealth, so that the indicators on households' balance sheets could be based on the observations of all households that participated in the survey. In addition, selected variables that are most frequently used in the reporting of HFCS results, in monetary policy and financial stability analysis, and as good predictors of balance sheet variables in the imputation models were fully imputed.

Each NCB/NSI that produces the data has the responsibility to impute missing observations. Rubin (1996) makes the case explicitly, claiming that modelling the missing data must be, in general, the data constructor's responsibility, since "in general, ultimate users have neither the knowledge nor the tools to address missing data problems satisfactorily." Database constructors using individual HFCS country data have better information on the reasons for non-response and on the relationship between different variables. Besides, country-specific questions or different interviewing strategies are better evaluated at the country level. Finally, part of the information used in the construction of the imputation models is only available at the country level due to confidentiality reasons (wealth strata, regional data, interviewer comments and so on). Against this background, although the HFCS imputation process strictly follows a common methodology (see next sections), its implementation is fully decentralised at the country level[20].

6.2.2 Multiple imputation

The goal of imputation is to preserve the characteristics of the distribution of and the relationships between different variables (Rubin, 1987). In addition to a complete-case analysis, several other simple procedures could be performed to deal with missing values.

[20] See Biancotti et al. (2008) for further references.

Probably the simplest approach is to fill in missing values with the means of observed values. This would naturally lead to a large decrease in variance and would not reproduce the distributions obtained from the survey data. In stochastic regression imputation, missing values are replaced with a value predicted by a regression plus a residual, to reflect the uncertainty in the predicted value. For normal linear regression models, the residual is normal, with zero mean and variance equal to the residual variance in the regression. For binary or multinomial regressions, the predicted value is a probability distribution and the imputed value is drawn from that distribution. While this method preserves the distribution of the imputed values, the uncertainty of the imputation process is not fully reflected in a single imputation.[21]

With multiple imputation (MI), M imputed values based on different random draws are provided to the user for each missing value, resulting in M copies of the complete dataset. MI shares the advantages of single imputation in that it allows complete-data methods of analysis and use all the information available to the data collector. However, with MI, uncertainty can be taken into account (i.e. in order to avoid underestimating the resulting variance), which is particularly important in cases of significant item non-response.

The construction of multiple imputation models in the HFCS is based on the methodologies used in similar surveys by the Federal Reserve Board and Banco de España (see Kennickell, 1991 and 1998, and Barceló, 2006). HFCS datasets include five implicates (imputed sets of values) for each missing observation. The distance between the five implicates accounts for the underlying level of uncertainty. The imputation technique has an iterative and sequential structure. The models follow a path in which all variables are filled in with a predefined sequence. The models are run iteratively several times, and imputed values from each of the previous rounds are treated as observed values in the subsequent iterations.

Furthermore, a broad-conditioning approach is used, meaning that a high number of covariates, based on several criteria, are included in the models for all variables to be imputed. The model should include, first of all, variables that have predictive power, empirically shown by regressions, for the variable to be imputed. Covariates should also include variables that have explanatory power suggested by economic theory, although not empirically exhibited for the dataset in question. Because of the sequential structure of the model, predictors of the most frequently used covariates for other variables are also important. Finally, any variables that could potentially explain the non-response pattern of households should appear as covariates in the imputation model. MI in the HCFS is based on the assumption of “missing at random”, meaning that the distribution of the complete data only depends on the observed data, conditional on the determinants of item non-response and other covariates. Consequently, this complete set of variables has to be incorporated to the imputation models (Barceló, 2006).

[21] For further information, see references in Household Finance and Consumption Network (2008b).

6.3 Imputation methodologies in the HFCS

Descriptions of selected methodological choices for the imputation models are presented in Table 16. The first column shows whether multiple imputation is applied. The second item shows whether survey weights are used in the imputation models – either by performing weighted regressions or by using survey weights as covariates. There is evidence that ignoring information on sampling design in the imputation models will lead to biased results (Reiter et al., 2006; Zhang et al., 2009). However, weighted regression potentially leads to less efficient estimates (Faiella, 2010). The last item describes the selection process of covariates for the imputation model.

Table 16

Imputation methodology

Country		Use of weights			Selection of predictors in the imputation model		
	Use of MI	Weighted regression	Weight as covariate	No weights used	Automatic with limited editing	Automatic pre-selection with case-by-case evaluation	Case-by-case evaluation
Belgium	X	X				X	
Germany	X	X	X			X	
Estonia	X			X	X		
Ireland	X		X				X
Greece	X		X				X
Spain	X			X			X
France		X		X*			X
Croatia	X	X					X
Italy				X			X
Cyprus	X			X	X		
Latvia	X	X	X			X	
Lithuania	X		X		X		
Luxembourg	X		X			X	
Hungary	X	X					X
Malta			X		X		
Netherlands	X					X	
Austria	X		X				X
Poland	X	X					X
Portugal	X		X				X
Slovenia	X			X	X		
Slovakia	X		X		X		
Finland		X				X	

Source: ECB – HFCS metadata.
*depending on the variable.

6.4 Comparative information on item non-response and imputation

Tables 17-19 show information on the imputed observations for three of the most significant balance sheet variables: the current value of the household main residence, the outstanding balance of the biggest loan collateralised by the household main residence and the value of savings accounts. The first two columns indicate the share of households or persons at least 16 years old that have either reported having the item or for which the item was imputed as existing. The next three columns show the share of non-missing observations that were collected, imputed from a range value provided by the respondent or imputed from a missing value, respectively. The last two columns show the difference between the conditional means of all and collected observations.[22] These indicators reflect the degree and quality of imputations in different countries.

With very few exceptions, the variables indicating the existence of the above mentioned items were collected in the interviews. In individual cases the difference between the mean of imputed values and all observations is a couple of percentages. This difference does not necessarily imply a biased imputation, it may just be a reflection of the differences between households that are able to provide asset values in the interview and ones that are not.

In frequent cases a high share of balance sheet values has been imputed from a range value provided by the respondent. This procedure should be distinguished from an imputation for a missing value, since the range value provides a fair estimation of the point value directly received from the respondent.

In the comparison of item non-response rates, a few issues should be noted. In some countries, particularly in those adapting the HFCS to an existing survey and to some extent also in Germany, the HFCS blueprint questionnaire was not implemented as such. A part of the HFCS variables were converted from variables collected in more detail for national-level purposes. Interviewing in more detail, as well as differences in the routing of the questionnaire, might overstate item non-response in the HFCS data compared with national data. When one HFCS variable is constructed from several national variables, non-response to any of the involved national questions is reflected in the HFCS variable.

[22] As has already been mentioned, in Finland these items are collected directly from registers or via register-based estimation, while in Italy the features of the contract with the survey company has produced extremely low item non-response rates.

Table 17

Item non-response rates: current value of household main residence

	% having item		Of those having item*			Conditional mean (EUR)	
Country	Reported having item	Imputed as having item	Collected	Imputed from ranges	Imputed from missing	All	Collected#
Belgium	70.5	0.1	89.5	7.9	2.2	297,308	298,715
Germany	58.8	0.8	95.4	2.7	1.8	264,705	264,287
Estonia	80.4	0.0	79.1	16.4	4.5	74,354	74,538
Ireland	75.4	0.0	86.2	0.0	13.4	305,915	317,212
Greece	65.3	0.0	68.5	18.7	12.8	72,341	72,391
Spain	82,1	0,0	82,7	0,0	17,3	170,140	171,733
France	70.1	0.1	21.2	61.5	17.3	233,136	244,167
Croatia	88.4	0.0	91.1	2.0	5.8	99,065	97,800
Italy	71.9	0.0	97.2	0.0	0.0	204,385	204,378
Cyprus	76.0	0.0	70.4	0.0	29.5	281,468	297,138
Latvia	80.1	0.0	80.4	19.3	0.2	36,624	36,691
Lithuania	92.0	0.5	58.4	0.0	40.8	62,996	59,485
Luxembourg	74.6	0.0	80.2	15.4	4.3	747,151	745,598
Hungary	87.5	0.0	100.0	0.0	0.0	50,776	50,776
Malta	80.1	0.0	99.0	0.0	1.0	250,089	252,816
Netherlands	65.8	0.0	83.4	11.5	5.1	279,390	277,615
Austria	36.9	0.5	81.8	15.0	3.1	293,293	294,565
Poland	79.2	0.0	69.7	16.7	13.6	85,197	81,826
Portugal	82.1	0.0	73.4	19.1	7.5	121,357	123,226
Slovenia	79.4	0.2	75.5	0.0	24.3	125,757	130,061
Slovakia	87.7	0.0	91.6	0.0	8.4	84,818	82,860
Finland	77.7	0.0	All values estimated			195,867	195,867

* Collected observations include those collected from administrative sources. In addition to collected and imputed values, observations can be edited or estimated, which is why the columns do not always add up to 100%.
# Includes observations collected from registers, edited, estimated or collected as range values and then imputed.

Table 18

Item non-response rates: largest mortgage on household main residence: value still owed

Country	% having item		Of those having item*			Conditional mean (EUR)	
	Reported having item	Imputed as having item	Collected	Imputed from ranges	Imputed from missing	All	Collected#
Belgium	27.5	0.3	76.7	13.9	7.5	99,875	98,978
Germany	21.5	0.4	95.0	2.4	2.5	81,854	82,653
Estonia	21.4	0.0	97.7	1.0	1.0	41,977	42,151
Ireland	25.7	0.0	76.0	0.0	18.1	156,576	167,410
Greece	8.0	0.0	64.6	7.9	10.8	49,620	44,076
Spain	21.2	0.0	92.1	0.0	7.9	75,224	75,743
France	25.8	0.0	69.9	0.0	30.1	94,582	106,165
Croatia	8.6	0.4	81.1	8.2	8.2	29,054	29,455
Italy	5.9	0.0	99.3	0.0	0.0	78,583	78,583
Cyprus	36.1	0.1	86.6	0.0	13.0	120,655	122,849
Latvia	13.2	0.2	95.2	0.0	0.0	30,662	30,662
Lithuania	10.2	0.0	100.0	0.0	0.0	39,906	39,906
Luxembourg	33.0	0.3	81.0	10.0	8.1	249,386	246,748
Hungary	15.3	0.0	100.0	0.0	0.0	15,990	15,990
Malta	12.5	0.0	100.0	0.0	0.0	87,367	87,367
Netherlands	49.2	2.8	78.2	10.8	11.0	160,048	155,791
Austria	12.4	0.2	78.2	8.7	12.8	91,061	85,490
Poland	11.0	0.0	79.8	0.0	19.6	31,520	32,194
Portugal	33.7	0.1	76.3	17.3	6.2	58,967	59,056
Slovenia	8.2	0.2	77.2	0.0	21.0	43,410	46,482
Slovakia	14.0	0.1	69.2	0.0	30.8	37,594	37,271
Finland	38.9	0.0	100.0	0.0	0.0	82,658	82,658

* Collected observations include those collected from administrative sources. In addition to collected and imputed values, observations can be edited or estimated, which is why the columns do not always add up to 100%.
# Includes observations collected from registers, edited, estimated or collected as range values and then imputed.

Table 19

Item non-response rates: value of savings accounts

	% having item		Of those having item*			Conditional mean (EUR)	
Country	Reported having item	Imputed as having item	Collected	Imputed from ranges	Imputed from missing	All	Collected#
Belgium	76.2	0.3	82.1	10.4	6.9	42,096	43,956
Germany	77.0	0.1	93.5	3.4	3.1	27,585	27,535
Estonia	41.1	0.0	99.8	0.0	0.2	7,409	7,411
Ireland	49.3	4.6	72.9	0.0	25.4	26,520	27,988
Greece	82.4	0.6	74.5	0.0	25.5	6,386	4,269
Spain	19.5	0.1	85.3	0.1	14.7	33,881	33,812
France	88.3	0.1	71.4	20.6	8.0	19,588	19,750
Croatia	14.7	0.1	84.1	0.0	15.9	13,467	12,305
Italy	24.4	0.0	55.8	44.2	0.0	15,677	15,677
Cyprus	27.6	0.0	87.9	0.0	12.1	37,506	36,497
Latvia	11.5	0.1	79.9	0.7	19.4	5,724	5,885
Lithuania	10.6	1.2	26.6	0.0	71.3	6,513	6,599
Luxembourg	73.2	0.3	58.3	18.2	23.5	61,050	62,697
Hungary	23.0	0.0	82.7	0.0	17.3	10,927	7,997
Malta	86.8	0.0	73.2	0.0	26.8	29,506	26,415
Netherlands	76.5	3.1	68.6	13.6	17.7	35,585	35,031
Austria	84.5	1.6	75.8	11.5	12.7	28,572	27,513
Poland	64.9	0.0	49.2	24.5	26.3	5,788	5,236
Portugal	50.9	0.2	63.1	25.7	11.0	28,712	29,240
Slovenia	21.2	0.4	71.5	0.0	28.5	12,936	12,944
Slovakia	30.4	0.2	60.6	0.0	39.4	8,280	7,760
Finland	45.6	0.6	36.3	5.0	4.9	27,242	27,361

* Collected observations include those collected from administrative sources. In addition to collected and imputed values, observations can be edited or estimated, which is why the columns do not always add up to 100%.

7 Variance estimation

Variance estimation allows researchers to distinguish between a statistically significant phenomenon and a spurious result caused by the random nature of the sample. Variance needs to be estimated, since the true value of the variance of an estimator can only be known if the values of the variables of interest in the whole population are observed. Underestimating the variance of an estimate may lead to incorrect conclusions (too many false positives), while overestimating the variance seemingly decreases the usefulness of the data, as fewer outcomes are estimated as being statistically significant.

Variance can have several components, though not all components can be estimated. One central component is the sampling error, which is caused by the random selection of the units participating in the survey. A second component is item non-response, which is addressed in the chapter on imputation, and which will be connected to total variance estimation in this chapter.[23]

Users of the HFCS need to be able to estimate the variance of several kinds of indicators. This chapter motivates the use of replication-based methods and describes the one chosen for the HFCS. The combination of replicate weights and multiple imputation is given in Section 7.3, and software routines for estimating total variance are sketched out in Section 7.5.

7.1 Motivation for replication-based methods

Since sampling error is linked to the sample design, its estimation relies on the provision of sample design information. In most surveys, the information on the number of stages of sampling, the strata at each stage, the identification of sampling units (primary, secondary, etc.) and the selection method (e.g. with or without replacement, equal or unequal probabilities) is sufficient to allow end-users to estimate sampling variance, using linearisation techniques for estimators other than means or totals. However, even in that case, with complex sample designs, these variance estimates are not simple to compute.

Moreover, sample design information is often withheld for confidentiality reasons: in many countries, the first level of stratification is often geographic (regions), and primary sample units are often linked to geographical units (municipalities, blocks, etc.). This increases the re-identification risk, and survey producers are understandably concerned about providing sample design information in that case.

Replication techniques are a robust and flexible way to estimate variance, even in the case of complex survey designs. Although in theory it applies only to linear statistics,

[23] Other potentially relevant sources of variability, which the survey is not currently able to estimate, include variations in the understanding of questions by respondents, in interviewers' adherence to survey protocol, in formal sample coverage, and in decisions made in data editing or other aspects of processing.

and asymptotically in the case of the bootstrap, in practice these techniques have been found to be very useful because their flexibility allows them to cope with both different kinds of sampling designs and various kinds of statistics, without requiring an explicit formula for the variance of each statistic (as with linearisation techniques).

Replication techniques are similar in that in all cases, the full sample is used to draw (in different ways) sub-samples or replicate samples, which are used to estimate the statistic of interest and its variation across replicate samples, and which can be provided to users as a (large) set of replicate weights. Nevertheless, the relative merits of different replication techniques are still under discussion (among them, Jackknife, Balanced Repeated Replication, and bootstrap, each with many variants).

This chapter will not cover the different methods. Lehtonen and Pahkinen (2004) provide a good exposition and comparison of the different replication methods (called sample reuse methods in their book). We will focus hereafter on the bootstrap, as it was decided by the HFCN that the bootstrap offers the flexibility needed to cover the different national sample designs, and is powerful enough to cover many types of estimators.

In the bootstrap procedure, a with-replacement[24] sample of primary sampling units (PSUs) from each stratum is selected.[25] The number of PSUs per unit does not need to be constant. The number of replicates (bootstrap samples), as well as the number of PSUs sampled in each replicate, can be chosen by the analyst, although there are practical recommendations for both these quantities (for example, in the rescaling bootstrap proposed by Rao and Wu, 1988, and generalised by Rao et al., 1992). The precision of the bootstrap is higher if the number of replicates is increased.

Although the bootstrap has been slower to gain acceptance in the context of sample surveys, as it was originally developed for independent and identically distributed observations, improvements over the past 20 years have shown it to be a good alternative to other replication techniques (see Mach et al., 2007 for a description of its use in Statistics Canada, and Girard, 2009 for a general description).

7.2 The Rao-Wu rescaled bootstrap and its extensions

The variant of bootstrap for the HFCS is the rescaling bootstrap of Rao and Wu (1988), as further specified by Rao, Wu, and Yue (1992). It is applicable for one-stage samples, and can also be used in the case of a multi-stage sample drawn with low sampling fraction in the first stage. This is the case in several popular setups of stratified sampling. In addition, other sampling designs can be approximated by this setup. While – like all bootstrap methods – the rescaling bootstrap is computationally intensive and the resulting variance estimates may be less stable than with other methods (such as Jackknife and linearisation), it provides consistent variance estimates in the case of non-smooth statistics such as distribution quantiles.

[24] Meaning each selection is independent, such that an element may be selected more than once and thus may appear multiple times in the same sample.

[25] In case of multi-stage sample designs, the methods below only consider the first sampling stage, as in practice this stage represents the largest part of the variance.

The Rao-Wu bootstrap can be described as follows. We consider the case of strata indexed by $h = 1, \dots H$, with N_h units in each of them, out of which n_h are sampled without replacement. The sampling fraction is thus $f_h = n_h/N_h$. To each unit (h, i) there is a variable of interest y_{hi} and a weight $w_{hi} = N_h/n_h$. The total of this variable is $Y = \sum_{h=1}^{H} \sum_{i=1}^{N_h} y_{hi}$ which is estimated without bias by $\hat{Y} = \sum_{h=1}^{H} \sum_{i=1}^{n_h} w_{hi} y_{hi}$. The parameter of interest is a function of this total, say $\hat{\theta} = f(\hat{Y})$. For the Rao-Wu bootstrap applied in the HFCS, the following is done B times:

A sample of size m_h is taken with replacement from each stratum.

Writing r_{hi}^* the number of times unit (h, i) is resampled, the weights are adjusted as follows: $w_{hi}^* = \left(1 - \lambda_h + \lambda_h \frac{n_h}{m_h} r_{hi}^*\right) w_{hi}$ with $\lambda_h = \sqrt{\frac{m_h(1-f_h)}{n_h - 1}}$.

The bootstrap total is computed $\hat{Y}_b^* = \sum_{h=1}^{H} \sum_{i=1}^{n_h} w_{hi}^* y_{hi}$ and $\hat{\theta}_{*b} = f(\hat{Y}_b^*)$.

The bootstrap variance is then calculated as $V_{*(\theta)} = \frac{1}{B-1} \sum_{b=1}^{B} \left(\hat{\theta}_{*b} - \bar{\hat{\theta}}_*\right)^2$, where $\bar{\hat{\theta}}_*$ is the mean of the bootstrap total over all B iterations.

7.2.1 Replicate sample size

In the HFCS, the replicate samples are drawn independently and with replacement in each stratum. The number of units m_h drawn in each stratum of size n_h are set to $m_h = n_h - 1$. The final estimation weight for each observation is then rescaled by a specific factor $\frac{n_h}{n_h - 1}$, and multiplied by the frequency of the observation in the replicate sample (number of hits).

7.2.2 Number of replicates

The number of replicates is at least 1,000, as a commonly used compromise between computational efficiency and stability of the variance estimates. Given the way bootstrap works, in practice it is not necessary to use all the weights. It is possible to only use e.g. the first 200 or 500 replicates for faster (but somewhat more unstable) variance estimation. This may depend on the type of estimator and size of the domain (e.g. mean of total population vs. medians for specific population subgroups).

7.2.3 Variance estimation model

Given that the standard Rao-Wu rescaled bootstrap is applicable to one-stage stratified simple random samples, and given the two- and three-stage designs used in some countries, a variance estimation model has been used in several countries. In particular, the second sampling stage is dropped (as in practice most of the variance originates from the first stage), except when the PSU is sampled with certainty, in which case the second sampling stage is used in the bootstrap. Strata may be

merged, in particular if the number of units is small. In countries with dual-list samples, some adaptation of the methods was required.

7.2.4 Calibration of replicate weights

Since the final weights are adjusted for non-response (see Chapter 5.3 of this report), post-stratified or calibrated (the specific technique not being important), the replicate weights have been adjusted according to the same procedure, for example by running the calibration procedure with the same margins on each of the replicate weights. This can be considered an additional rescaling factor. For instance, after drawing the sample and rescaling the weights as in point 3, the weights are further rescaled to satisfy post-stratification or calibration constraints for each replicate. This is to ensure that the replicate estimates are close to unbiased in each replicate sample.

Table 20 shows information on the calibration of replicate weights. In most countries, each set of replicate weights sums up to the same number of households, consistent with the sum of final estimation weights (see Table 15), and to the same number of persons. When they do not, the variation of the number of households/persons is limited. Depending on the exact calibration used, there are some variations between each set of replicate weights in also in the population estimates by gender or age, indicated by the coefficients of variation in Table 20.

Table 20

Calibration of replicate weights and impact on population estimates

Country	At household level	At person level	By gender	By age group*
Belgium	Yes	Yes	Yes	(0.4%)
Germany	Yes	No (0.3%)	No (0.8%)	(1.4%)
Estonia	No (1.0%)	Yes	Yes	(0.6%)
Ireland	Yes	Yes (0.1%)	Yes (0.1%)	(1.1%)
Greece	Yes	No (0.6%)	No (1.2%)	(2.9%)
Spain	Yes	Yes	-	(0.4%)
France**	No (1.6%)	No (1.6%)	No (1.7%)	(2.4%)
Croatia	No	No	No (0.4%)	(0.8%)
Italy	No (0.7%)	Yes	No (0.2%)	(0.9%)
Cyprus	Yes	Yes	Yes	(1.3%)
Latvia	Yes	Yes	Yes	(1.4%)
Lithuania	Yes	No (2.0%)	No (2.6%)	(3.0%)
Luxembourg	Yes	No (0.2%)	No (0.4%)	(0.8%)
Hungary	No (0.7%)	Yes	Yes	(1.1%)
Malta	Yes	Yes	Yes	(0.4%)
Netherlands	Yes	Yes	No (0.9%)	(1.4%)
Austria	Yes	No (0.6%)	No (1.0%)	(2.6%)
Poland	Yes	Yes	Yes	(0.2%)
Portugal	Yes	Yes	Yes	(0.3%)
Slovenia	Yes	Yes	Yes	(1.3%)
Slovakia	Yes	Yes	Yes	(0.5%)
Finland	Yes	Yes	Yes	(0.2%)

Notes: In parentheses, the coefficient of variation of the weighted total. For gender and age, the average coefficient of variation over the categories is shown. Age groups are: less than 25, 26 to 44, 45 to 64, 65 and over.
*For age, only the coefficient of variation on the standard age categories is shown, since different age groupings were used in different countries to calibrate replicate weights.
** The French data are based on preliminary replicate weights used for the HFCS 2017 wave reports.

7.2.5 Extension to multi-stage sampling

In each stage, the sampling of units (primary, secondary, and so on, up to ultimate) induces an additional component of variability. In multi-stage designs, the usual assumption in this case is that the sampling variance comes mostly from the first stage of sampling (i.e. the selection of PSUs and not the selection of secondary sampling units (SSUs) in each PSU). This allows both a simplification of variance formulae and a reduction of the computation burden (although this does not apply to the bootstrap), with a negligible loss of information in the presence of small sampling fractions in the subsequent stages.

The approach proposed by Preston (2009) is an alternative. This is an extension of the without-replacement bootstrap to multistage sample designs. Osiewicz and Pérez-Duarte (2012) apply the same methodology in the case of a with-replacement bootstrap, making it a direct extension to the Rao-Wu bootstrap. It is applicable to multi-stage stratified sample designs where the sampling fraction at the first stage is not negligible. Its use is transparent to final users of the data, since all the information

is included through the replicate weights. The multi-stage rescaled bootstrap shows an improved estimation of the variance when two stages are used in the calculation of the replicate weights, but the gain of a third stage is minor.

7.3 Combining replicate weights and multiple imputation

In the description below, we consider the general features of a multiply-imputed sample survey, as is described in Chapter 6 of this report. Each observation has a final estimation weight w_i. There are M implicates (multiple imputation) indexed by m, and B replicate weights w_{ib} indexed by b. In the HFCS, $M = 5$ and $B = 1000$.

For each implicate m, the estimator of interest θ_m is calculated using the estimation weight w_i (for example the population total of a variable y, as $\sum_i w_i y_{im}$). The variance of this estimator is estimated using the bootstrap weights as follows: for each of the B replicates, using the replicate weight w_{ib}, calculate θ^*_{mb}, with mean across replicates $\bar{\theta}^*_m = \frac{1}{B}\sum_{b=1}^{B}\theta^*_{mb}$. The partial variance for implicate m is $U_m = \frac{1}{B-1}\sum_{b=1}^{B}(\theta^*_{mb} - \bar{\theta}^*_m)^2$. This is the standard bootstrap variance used in complete case analysis.

The total variance is then calculated according to the MI formula

$$T = W + \left(1 + \frac{1}{M}\right) Q,$$

where W is the within variance $W = \frac{1}{M}\sum_{m=1}^{M} U_m$ and Q is the between-imputation variance, $Q = \frac{1}{M-1}\sum_{m=1}^{M}(\theta_m - \bar{\theta})^2$and the final estimator of interest is $\bar{\theta} = \frac{1}{M}\sum_{m=1}^{M}\theta_m$.

7.3.1 Test statistics

According to multiple imputation theory, the quantity $(\theta - \bar{\theta})T^{-\frac{1}{2}}$ is approximately distributed as a t-distribution with ν_M degrees of freedom, with $\nu_M = (M - 1)\left(1 + \frac{W}{\left(1+\frac{1}{M}\right)Q}\right)^2$. Barnard and Rubin (1999) recommend an alternative measure in the case of small samples, since in that case, the ν_M can be much larger than the complete data degrees of freedom. This recommended measure is $\nu^*_M = \left(\frac{1}{\nu_M} + \frac{1}{\nu_{obs}}\right)^{-1}$, where $\nu_{obs} = \frac{\nu_0+1}{\nu_0+3}\nu_0(1-\gamma)$, ν_0 is the complete-data degrees of freedom, and $\gamma = \frac{\left(1+\frac{1}{M}\right)Q}{T}$.

In the context of sample surveys, the degrees of freedom are customarily calculated as $n - L$, where n is the number of PSUs and L is the number of strata. For the HFCS, at the euro area level as a whole, it is likely that the large sample assumption holds, and that the measure ν_M is more appropriate. However, when looking at country-level data, when the number of PSUs is not large, it may be more appropriate to use the small sample formulas. It is proposed to leave this decision to final users.

7.4 Variance estimation of changes between waves

In addition to estimating variances of indicators at a given time t, the three waves of the HFCS add the time series dimension to the data analysis. It is therefore necessary to understand the principles of estimating the variance of changes between time t and $t+1$ for different estimators. The estimator for a parameter Y at a given time t for a probability sample s_t is denoted as $\hat{Y}_t$. $\hat{Y}_t$ appropriately reflects the sampling design used to select s_t. Correspondingly, $\hat{Y}_{t+1}$ denotes the estimator for the same parameter at time $t+1$, which again appropriately reflects the sampling design used to select s_{t+1}.

The change in the estimator of parameter $\hat{Y}$ between t and $t+1$ can be denoted as $\hat{D} = \hat{Y}_{t+1} - \hat{Y}_t$. The variance of $\hat{D}$ is given by:

$$\text{Var}(\hat{D}) = \text{Var}(\hat{Y}_t) + \text{Var}(\hat{Y}_{t+1}) - 2\text{Cov}(\hat{Y}_t, \hat{Y}_{t+1}),$$

where $\text{Var}(\hat{Y}_t)$ and $\text{Var}(\hat{Y}_{t+1})$ denote the unconditional variances of $\hat{Y}_t$ and $\hat{Y}_{t+1}$ respectively, and $\text{Cov}(\hat{Y}_t, \hat{Y}_{t+1})$ denotes the unconditional covariance between $\hat{Y}_t$ and $\hat{Y}_{t+1}$.[26] When the sampling designs at time t and $t+1$ are statistically independent, the estimators of the parameter Y are also independent. Consequently, the covariance between the two estimators of parameter Y is 0 and the variance of the change in the parameter is equal to the sum of variances of $\hat{Y}_t$ and $\hat{Y}_{t+1}$. If the two samples are not statistically independent, usually $\text{Cov}(\hat{Y}_t, \hat{Y}_{t+1}) > 0$ and the estimates of change are more efficient.

The HFCS includes samples that have a panel component, which means that the cross-sectional samples of t and $t+1$ are not statistically independent. On the other hand, there are no instances where the net samples at t and $t+1$ would consist of exactly the same population, due to refresher samples, attrition and other types of entries to and exits from the sample population.

While it is important to acknowledge the impact of sample coordination on the variance of changes in parameter values, calculating exact measures of such variance is far from being trivial. There is no universally recognised methodology for the estimation of the covariance between $\hat{Y}_t$ and $\hat{Y}_{t+1}$.[27] Furthermore, taking the covariance between these estimators as zero in two household surveys conducted with identical sampling designs at different times will lead to conservative estimates of the precision of changes and overstate variance.

7.5 Software routines for estimating total variance

For the HFCS statistical tables, standard errors have been computed for all countries and the euro area by looping over the 1,000 replicates for each of the five implicates and combining the results according to the formulas given above, using SAS software.

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[26] See Eurostat (2013).

[27] Several papers (see e.g. Berger, 2004; Berger and Priam, 2010) propose methodologies to estimate covariance matrices for estimators measured at different points of time for overlapping samples using various kinds of information on sampling designs.

In this section, we provide examples of directly usable routines for HFCS variance estimation in Stata, SAS and R using multiply imputed data and replicate weights. The input dataset has to include the variables of interest, the original sampling weight, the implicate number, and the HFCS replicate weights.

7.5.1 Application in Stata

Stata has an official system for dealing with multiply imputed data called mi. It also has procedures for using bootstrap replicate weights using the standard svy command. The mi command has a mi svyset command, which accepts replicate weights, but the mi estimate: svy: command does not allow bootstrap weights unless used with the (undocumented) option “vceok”.

Stat code for the HFCS multiply imputed dataset

```
                    /* import the data to mi */
              mi import flong, m(im0100) id(sa0100 sa0010)
          /* set the survey weights and bootstrap weights */
    mi svyset [pw=hw0010], bsrweight(wr0001-wr1000) vce(bootstrap)
           /* estimation of mean and variance of DA1110 */
           mi estimate, vceok esampvaryok: svy: mean da1110
```

7.5.2 Application in SAS

The SAS statistical system has several routines, which allow the estimation of variance under multiple imputation and replicate weights. The core routines are PROC SURVEYMEANS (and the related ones in the SURVEY… family of procedures) and PROC MIANALYZE.

The example below shows how the mean of the derived variable DA1110 can be calculated with PROC SURVEYMEANS. The resulting file (outex1) is analysed with PROC MIANALYZE, which expects the input dataset to contain one line per implicate identified with a variable called _imputation_.

SAS code for the HFCS multiply imputed dataset

```
proc surveymeans data=HFCS varmethod=bootstrap;
var da1110;* variable of interest;
repweights wr0001-wr1000; * replicate weights;
by im0100;* implicates;
weight hw0010;* estimation weight;
ods output Statistics = outex1 (rename=(IM0100=_imputation_));
run;

proc mianalyze data=outex1;
modeleffects mean;
stderr stderr;
run;
```

7.5.3 Application in R

R has two packages, mitools and survey, that can be used for variance estimation from multiple imputed data using replicate weights. First, the dataset of interest is loaded and merged with the weights table, and five new data frames created (named in the coding example imp1…imp5). The W table, which contains the replicate weights, is then loaded. The svrepdesign command is then used to specify the data structure of the survey. The object hfcs.design offers a wide range of estimation functions. For example, svymean enables the mean to be computed, and MIcombine allows the multiple imputation scheme to be managed.

R code for the HFCS multiply imputed dataset

```
#load W file and select the replicate weights
rep_weights= select(W, "wr0001":"wr1000")

hfcs.design=svrepdesign(repweights=rep_weights,weights=~HW0010,data=imputa
tionList(list(imp1,imp2,imp3,imp4,imp5)),scale=1,rscale=rep(1/999,1000),
mse=FALSE, type="bootstrap", combined.weights=TRUE)

#compute the variance for the mean of DA1110 variable
MIcombine(with(hfcs.design,svymean(~DA1110, na.rm=T)))
```

8 Statistical disclosure control

Statistical disclosure control for the HFCS has two facets: safe data and safe users. The latter refers to the procedure for granting access to the HFCS dataset, such as the confidentiality declaration necessary before the data can be disseminated to third parties. The former is the process by which the data collected during the survey are anonymised, i.e. are treated in such a way that the effort necessary to re-identify a particular respondent, either a household or a person, is disproportionately high. This chapter deals with this anonymisation process.

8.1 General principles in the HFCS

The anonymisation procedure is applied either by the NCB (or NSI, i.e. before submitting the data to the ECB) or at the ECB level, and is designed to ensure, insofar as possible, data comparability. Country-specific anonymisation techniques may also be applied centrally by the ECB in close coordination with the NCB (NSI) concerned, to ensure the confidentiality of responses where necessary.

The anonymisation procedure has two main components: a “general procedure” and “country-specific modules”. The general procedure is applied to the data of all countries, while country-specific modules, imposed by different data protection regulations, different assessments of disclosure risk or different traditions, are applied on a case-by-case basis, where needed.

In addition, more information than provided for in the general procedure may be included in the dataset. In that case, as many variables as required containing the additional information are added to the research dataset.[28]

It consists of the following techniques:

- The following variables are kept unchanged: country and type of dwelling. In the case of a panel survey, the following variables are kept unchanged: vintage of last interview and survey vintage. In addition, unique household identification numbers in a randomised form for the current and past (in the case of a panel) survey wave are kept unchanged. All other variables relative to the sample are deleted.
- Only those households that participated in the survey are included in the research dataset (according to the survey database outcome variable); non-respondents are not included.

[28] For example, the research file contains two versions of the variable HB0100 (size of main residence in square metres), one as a continuous measure (only for those countries where releasing such information does not pose substantial disclosure risks), the other in brackets of 10 square metres.

8.2 Top-coding of variables

Age is top-coded at 85 years. In Ireland and Malta, only age in five-year brackets is provided in a separate variable. Due to the top-coding, several other variables related to age have been either top- or bottom-coded (e.g. how long has the household been living in their main residence). Country of birth is recoded in four categories, showing only the country where the survey took place, other euro area countries, other European Union countries, and other countries. This also applies to the non-core variable Country of citizenship.

Education is coded in four categories, according to the International Standard Classification of Education (ISCED), version 1997, namely ISCED1, ISCED 2, ISCED 3+4 and ISCED 5+6+7+8. This also applies to the non-core variable 'Education of the parents'.

In addition to age-related coarsening, the size of the household main residence is bracketed into ten categories in one country. The number of employees in self-employment businesses owned by the household is bracketed into four categories in several countries. For variables on employment, pensions and inheritances only age-related coarsening has been applied.

8.3 Random rounding

This approach is proposed in Kennickell and Lane (2007) for the US Survey of Consumer Finances (SCF). The idea is to avoid identification through matching with amounts provided with full detail by the household. The solution is to round the numbers to a specified precision, randomly, in a way that does not bias the results (either up or down, based on how far the amount is from the rounded values above and below).

This procedure is equivalent to adding random noise of mean 0 to each amount, with heteroscedastic variance. For example, 12,345 would get rounded to 12,000 approximately two-thirds of the time, and to 13,000 one-third (if we are rounding to two digits). This is done independently across implicates.

Altogether, this is a minor measure of statistical disclosure control whose effect is limited, as respondents often spontaneously round many amounts. It only needs to be applied when there is a clear case of re-identification risk (e.g. matching with administrative data). Internal tests have shown that rounding to two digits has a minimal effect on sample means, while, when rounding to three digits, the effect is also minimal on medians.

Random rounding to three digits was applied to certain variables in Estonia, namely the amounts outstanding of credit lines and overdrafts, and values of sight and savings accounts, mutual funds, bonds, publicly traded shares, social security plans and voluntary pension plans, and income from public pensions, unemployment benefits and social transfers.

9 Comparability issues

9.1 Data comparability between survey waves

A continuous effort is made in all countries to improve coverage, reduce non-response, minimise response bias, and improve sampling, imputation and other methodologies of the survey. This implies that the surveys in all countries undergo changes in terms of coverage and methodology over time. Therefore changes in results between survey waves have to be viewed with some caution as they may to some extent reflect improvements in the survey.

Detailed metadata covering various aspects of data collection are collected from all NCBs and NSIs participating in the HFCS. To conclude the description of methodologies, this chapter describes the most important methodological changes between the most recent and the previous survey wave in various countries.[29]

In **Estonia** information on non-collateralised loans and leasing in the 2017 wave are based on register data, whereas in the second wave the information was collected via interviews. In the second wave information on private loans was included in other non-collateralised loans, whereas in the 2017 wave this information was collected separately.

The **Spanish** results for the 2017 wave are based on preliminary data used for the publication of the main results of the Survey of Household Finances (EFF), which is the national version of the HFCS. This preliminary data include fully imputed balance sheet variables, total household income and a subset of consumption variables, as well as the relevant demographic information.

In **Finland** information on whole life insurance policies was not collected in the second wave, but is included in the value of voluntary pensions and whole life insurance policies in the 2017 wave.

In the imputation of real estate wealth in **Latvia,** data from the cadastral value base provided by the State Land Service are used. Despite the same source of administrative data having been used in 2014 and 2017, real asset values increased significantly. This is driven by the improved coverage of real estate values in the source data. Consequently, the development of real estate wealth in Latvia between the two most recent HFCS waves must be interpreted with caution.

In **the Netherlands**, the first two waves were based on smaller samples (1,200 households) than in 2017 and information on assets and liabilities was derived from existing Dutch surveys. The 2017 wave used a sample of 2,500 households and followed the wording of the HFCN questionnaire exactly. Therefore, the previous two waves may show more sampling uncertainty, and differences in the wording may also

[29] The methodologies for the second HFCS wave are described in Household Finance and Consumption Network (2016b).

have influenced the outcomes. Overall, the 2017 wave data are better aligned with the data on household wealth published by Statistics Netherlands.

In **Poland,** the outstanding value of deposits was collected in the second wave as one variable combining both sight and savings accounts. In the 2017 wave, sight and savings accounts were collected separately.

9.2 Data comparability between countries

Household net wealth varies substantially across euro area countries, with the median ranging from €21,000 to €499,000 and the mean from €43,000 to €898,000. A great deal of work has gone into making figures comparable across the euro area. Nevertheless, cross-country differences should be interpreted with great caution. Both institutional and methodological issues have an impact on the indicators across countries.

Household characteristics and institutional factors vary across countries. For example, in this survey, wealth is measured at the household level, but the average size of a household differs from country to country. The share of one-person households is more than 40% in Germany, Lithuania and Finland, but only 25% or less in Spain, Croatia, Cyprus, Malta, Poland, Portugal and Slovakia. Since higher levels of household wealth are generally observed for larger households, differences in the demographic structure should be taken into account when comparing indicators on household assets.

The same holds true for rates of home and land ownership, and for households' preferences with respect to holding real or financial assets. Most importantly, recent house price developments and the extent to which households take up loans to acquire property differ markedly across countries. Homeownership rates, in particular, have a strong impact on wealth differences across countries. In Germany and Austria less than 50% of households own their main residence, while this share is higher than 80% in Croatia, Lithuania, Hungary, Malta and Slovakia. In Cyprus, the homeownership rate is 68%, and in addition 45% of households own other types of real estate properties. The share of non-financial assets in households' portfolios has an impact on the survey results – in particular on mean values of wealth – since financial assets are usually not reported in surveys as comprehensively as real assets. Furthermore, the definition of household wealth excludes some items that are relevant for individual countries. Most notably, defined benefit schemes for occupational pensions are significant components of household wealth in the Netherlands and Finland[30].

The magnitude of "public" wealth (including pensions, social housing and the provision of public services) varies across countries, and the expected value of public pensions, for example, can have a significant impact on the saving behaviour of households. It is

[30] A non-core variable on occupational pension schemes without an account balance is included in the HFCS User data base, to enable the adjustment for the otherwise distorted net median and mean wealth position of Dutch and Finnish households in comparison with other countries.

crucial to understand that the HFCS measures household wealth only and does not provide any insight into the wealth of the public sector.

From the methodological point of view, in complex surveys like the HFCS, any data production step might influence the statistical inference based on the final dataset. All decisions made with regard to the construction of the questions asked, sampling design, non-response, protocols for survey execution, editing, imputation, weighting design, tools for variance estimation and all other steps of survey production may have an important influence on the bias and variance of estimates based on final data.

In the case of survey execution protocols, there are important known differences, which are recorded in this report. As regards statistical processing, the HFCS established high-level frameworks and in some instances made fairly detailed prescriptions. But there is inevitably room for interpretation and judgement, and the resulting variation has the potential to affect true bias, true uncertainty of estimates and the degree of true bias or uncertainty that is actually measured. Often, there is a trade-off between measured bias and uncertainty in choices made in statistical processing. It should therefore be taken into consideration that datasets based on a data production process in which substantial variance was traded against bias will more often deliver “significant” results, even though they may have a larger true bias, which cannot be measured.

9.3 Demographic information in the HFCS compared to other statistics

The HFCS provides a unique data source on household-level wealth, indebtedness, income and consumption, for the euro area, Croatia, Hungary, and Poland. While this kind of data, where all these topics are covered by one data source at the individual level, are not available elsewhere, individual components of the survey are measured by other statistics. The definitions of variables and data production approaches are sometimes, though, quite different compared with those used in the HFCS. Following three chapters shows comparisons between the HFCS and other data sources producing personal- or household-level information.

The target population of the survey are private households residing in the national territory at the time data are collected and their current members. For the results of the survey to be reliable, it is essential that the structure of the survey population by age, household size, economic activity, etc. is coherent with the target population. In a sample survey, the structure of the population is determined by sampling and weighting procedures, described earlier in this document.

A variety of external sources measure the structure of the household population in each euro area country. The first benchmark source used in this report is population statistics by Eurostat, which is available in each EU country for the survey reference periods. Population statistics provide accurate measures of the population size, along with several breakdowns, e.g. by age and gender.

Population statistics enable the comparison of basic personal-level data. For comparison of household-level data with identical definitions of households, as well as for some more detailed individual level characteristics, data from other surveys are the only feasible benchmark. In this chapter, HFCS data are compared with EU Statistics on Income and Living Conditions (EU-SILC), which is a harmonised survey conducted annually in every EU country. When comparing the two surveys, it should be kept in mind that EU-SILC faces the same challenges of a household survey like the HFCS, and differences between the outcomes of these two data can be caused by methodological issues in either of the two surveys.

In the following chapters, the demographic structure of the HFCS data is compared with external benchmarks with respect to age, household size and labour status.

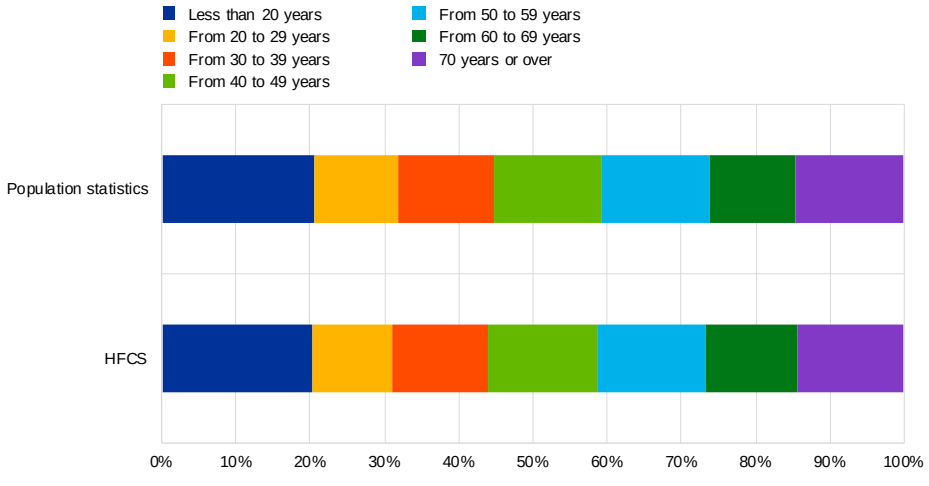
9.3.1 Age structure

The development of net wealth follows a hump-shape profile over the age of the household reference persons. Net wealth rises approximately to the age of 60, and declines gradually thereafter. Wealth differences between the youngest age groups and the age groups close to retirement age are substantial. It is therefore crucial that the survey population by age provides a good representation of the target population.

Chart 1 shows the age structure of persons in the HFCS and population statistics. Note that this age structure is different from that used in the reporting of the results, where wealth data are analysed at the household level and the age structure shown in the results is determined by the age of the household reference person. Chart 1 shows the age structure of all household members, including children. The age structure of the total adult population is on average younger, because younger household members are less frequently classified as reference persons e.g. in households that comprise several generations.

Chart 1

Euro area population structure by age in the HFCS and population statistics



Sources: ECB – HFCS and Eurostat – Population statistics.

The age structure of persons in the survey population is a very close match to the corresponding structure of population statistics in the euro area. In the HFCS, there is a slight underrepresentation of young working-age adults, while the share of the older working-age groups is slightly higher than in the population statistics. Overall, the differences in the euro area age structures between the two statistics are small.

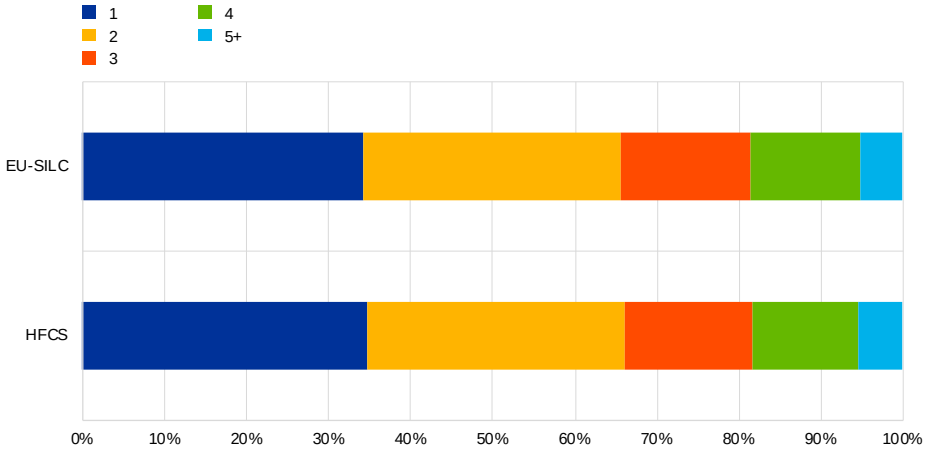
9.3.2 Household size

Wealth in the HFCS is reported at the household level and no equivalence scales are used, as in most income distribution statistics, such as EU-SILC. This is consistent with international recommendations on having households as the preferred unit of analysis for household wealth statistics (OECD, 2013).Therefore the distribution of the survey population by household size is an important aspect, not only in the comparison of wealth levels, but also in assessing the representativeness of the sample. Bigger households hold on average more wealth than smaller households. This is obviously driven by the larger number of adult members with wealth holdings. Additionally, larger households tend to live in larger and more valuable homes. This is crucial to acknowledge, given the significance of the household main residence in the wealth portfolios of households. Consequently, most countries included household size as one of their calibration variables, using data either from the census or other surveys.

While the definition of age is straightforward in any statistics, the definition of household is different in survey data compared with statistics based on administrative data or census data, in which the household-dwelling concept is applied (Eurostat, 2011b). In the HFCS, persons living in the same dwelling can belong to one or more different households, or one household can consist of individuals registered in different dwellings. The household composition, as defined in the HFCS, can only be determined during the interview. Consequently, it is feasible to compare the household size distribution using another survey statistics with identical household definition as a benchmark. The HFCS household definition has been adapted from the recommendations of the EU-SILC survey. However, in individual countries differences remain, e.g. Austrian EU-SILC uses a household definition that is closer to the dwelling unit classification.

Chart 2

Euro area household structure by household size in the HFCS and EU-SILC



Sources: ECB – HFCS and Eurostat – EU-SILC.

Compared with EU-SILC, the HFCS produces a very similar distribution of the household population by household size in the euro area (see Chart 2). As in the case of the age distribution, the small differences should not lead to significant bias in the interpretation of the HFCS results.

9.4 Comparing the HFCS and macro data on financial wealth and liabilities

Data on household sector wealth and liabilities are also available in national accounts and other macro sources. While it is useful to compare wealth data from micro and macro statistics, it must be kept in mind that there are significant differences between the definitions and methodologies applied in the two statistics. Consequently, differences in the levels of wealth between the two data sources are expected to be observed, especially if one compares the concepts of aggregate wealth used in each source.

There are several reasons for the discrepancy between total wealth levels derived from micro and macro sources. Coming from different traditions and addressing different purposes, the micro and macro approaches have developed quite independently. Thus, there is significant variability in the practices in assessing the boundaries of the household sector, in the valuation of assets and reference periods and in the definition of wealth and individual wealth items.

These kinds of discrepancies between micro and macro data have been analysed in recent years, e.g. by Andreasch and Lindner (2014) and Honkkila and Kavonius (2013). An expert group coordinated by the ECB has been working on understanding and quantifying the differences between survey and national accounts data on household wealth. This chapter acknowledges these conclusions on the differences between the methodologies. Instead of analysing total (financial) wealth with the

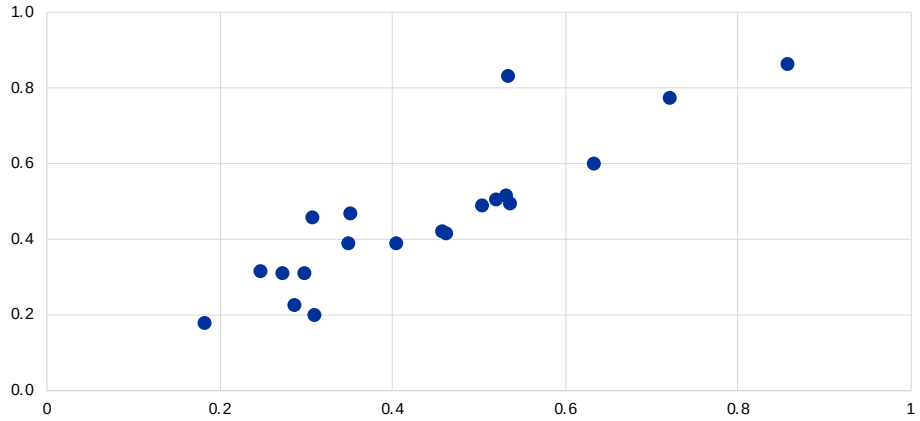
concepts applied in micro and macro statistics, this chapter concentrates on comparing wealth items that are conceptually comparable across the two sources.

9.4.1 Financial assets

The levels of financial wealth in survey data are generally lower than the levels produced by national accounts, and to a larger degree than in the case of real assets. Cross-country differences in the ratio between HFCS financial wealth and national accounts financial wealth can be observed. It is fair to assume that a portion of these cross-country differences is caused by divergences in the methodologies applied in the country-level production processes of both statistics. Comparing data from different HFCS survey waves allows the testing of this hypothesis by evaluating whether the ratios between the levels of wealth are stable across time in various countries.

Chart 3

Ratio of adjusted financial wealth per capita in the HFCS to national accounts, 2014 (horizontal axis) and 2017 (vertical axis)



Sources: ECB – HFCS and ECB – Annual Sector Accounts.

According to previous literature, financial wealth items with similar definitions in surveys and national accounts are deposits, mutual fund shares, listed shares and bonds. This concept will be called *adjusted financial wealth* in the remainder of this chapter. These items are summed up for both statistics, and the ratio of HFCS per capita totals to national accounts per capita totals are shown for all countries that participated in the two latest HFCS waves in Chart 3.

Chart 3 shows that the HFCS produces lower levels of per capita financial wealth than macro data, even if only comparable items are used in the comparison. There is also significant cross-country variability between the ratios of adjusted financial wealth. However, in most countries, these ratios are remarkably stable across the two HFCS waves in 2014 and 2017. This suggests that the differences between the results from the two data sources are predominantly caused by methodological and conceptual differences between macro and micro statistics. These issues may be country- and

asset-specific, but do not change considerably over time. While the existence of some reporting and sampling bias in the survey data should be recognised, the impact of the bias in the results is not completely random and the survey data provides a reliable source for looking at the distributions of household wealth and their changes over time.

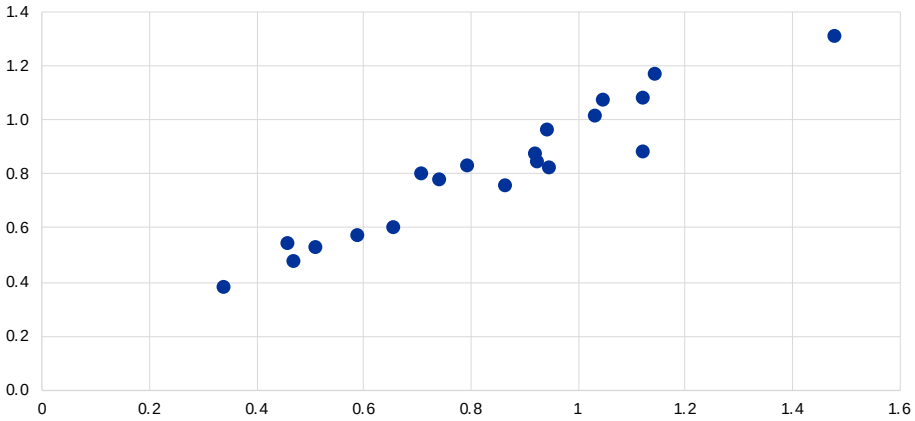
9.4.2 Liabilities

On the liabilities side of the households' balance sheets, there are minimal conceptual differences in the definitions between micro and macro statistics. In the HFCS, debt is collected by collateral. In addition, private loans, i.e. loans from other households, are collected separately. Households' liabilities in macro statistics are classified by the duration of the loan, and there is usually no differentiation between mortgages and other loans. However, the definition of the aggregate loans in macro statistics is almost identical to the HFCS definition. The only exception is private loans, which are usually not recorded in macro statistics. This has a limited impact on the evaluation, and the share of private loans in total household debt is approximately 1% in the HFCS.

The benchmark data for liabilities used in this chapter are the ECB statistics on the balance sheets of monetary financial institutions (MFIs). These data give information on loans provided by monetary financial institutions, classified by the institutional sector of the lender. The statistics are harmonised at the euro area level. Data are collected directly from the institutions providing loans, and unlike the data from national accounts, are thus not subject to any balancing adjustments. MFI statistics have recently included data on loans adjusted for sales and securitisation, incorporating more comprehensive information on loans originated by MFIs but which are no longer recorded on their balance sheets. In addition, loans given to sole proprietors can be separated from household loans. Sole proprietors are to a large extent considered as a part of the household sector in national accounts, but in survey data their liabilities are recorded in the balance sheets of self-employment businesses, not as household liabilities. The drawback of MFI data is that they do not differentiate between households and non-profit institutions serving households.

Chart 4

Ratio of households' liabilities per capita in the HFCS to MFI statistics, 2014 and 2017



Source: ECB – HFCS and ECB – statistics on balance sheets of Monetary Financial Institutions.

The results of the comparison of the levels of households' liabilities between micro and macro statistics are shown in Chart 4. The levels of debt produced by the survey are generally closer to the levels of macro data than the levels of adjusted financial wealth shown in the previous chapter. This is not surprising, since the sampling bias caused by having fewer of the richest households in the sample than in the population is smaller for liabilities than for financial wealth. A significant share of financial assets is held by extremely wealthy individuals, but the distribution of debt is much less skewed. However, cross-country differences in the HFCS/MFI ratio of liabilities can be observed. As in the case of adjusted wealth, the difference between levels of debt in micro and macro statistics in individual countries is very stable across the two HFCS waves.

9.5 Comparison of income data between the HFCS and EU-SILC

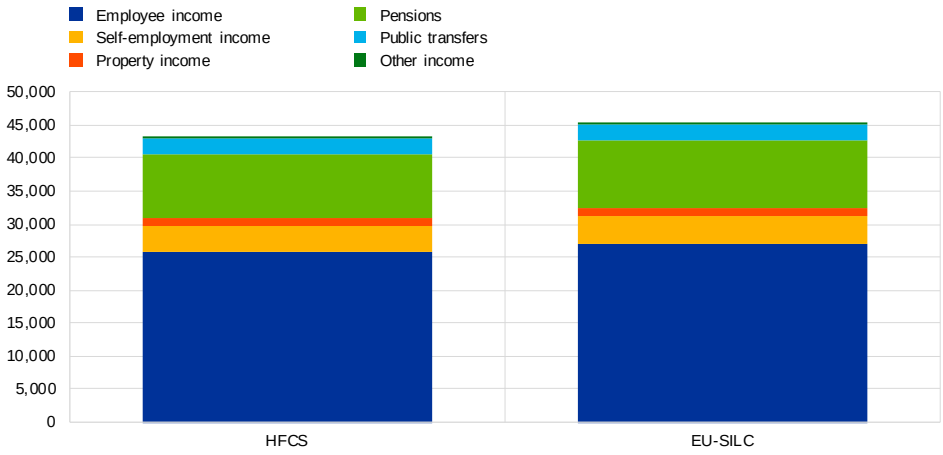
The main purpose of the HFCS is to collect data on households' balance sheets. Data on income are not first priority, but the collection of reliable income data is essential for several analytical purposes. For example, it is useful to analyse indicators on wealth and liabilities by household groups classified by their level of income. Furthermore, indicators on financial vulnerability, such as the debt-income ratio or the debt service-income ratio, are frequently used to assess financial stability of households. The drawback is that it is not possible to comprehensively collect both wealth and income data in a single survey, because it may excessively increase respondent fatigue. Consequently, only gross income is collected in all national datasets of the HFCS.

The concept of gross income in the HFCS is identical to the one used in EU-SILC, which is the most complete harmonised survey on household income in Europe. The structure and distribution of gross income can thus be compared between the two data sources. Chart 5 shows the levels of income per capita in the euro area in the two

sources. Data from EU-SILC are taken from reference year 2016, which is the most frequent reference year for income in the third wave of the HFCS. In EU-SILC, average gross income per household is €44,400, while it is €42,900 in the HFCS[31]. The relatively small difference of 4% indicates good comparability for a survey not specialised in the collection of income. The levels of employee income, pensions and other social transfers are to a similar extent higher in EU-SILC. On the other hand, the HFCS produces higher (unconditional) averages of property income and very similar levels of self-employment income, which can be expected. During a wealth survey, there is probably less recall bias for income items related to wealth.

Chart 5

Structure of gross income in the HFCS and EU-SILC, EUR per household



Sources: ECB – HFCS and Eurostat – EU-SILC.

Given that the main motivations of collecting income data in the HFCS arise from distributional and vulnerability analysis, it is not only the correct levels of income that matter. The HFCS should also produce a reliable picture of income distribution. The main purpose of the following comparison is to assess the comparability of HFCS income data used in the reporting of the results with EU-SILC. It does not intend to draw a different picture of income distribution than that given by EU-SILC. For this, the HFCS data is not ideal, given the definition of household gross income.

Income distribution statistics (such as EU-SILC) use equivalised household disposable income in measuring inequality, and income is measured at personal rather than at the household level. This income measure is calculated by first assigning the household-level total net income to all household members, regardless of age, and dividing it by the number of consumption units in the household.[32] Compared with measuring just household-level gross income, this is a better approach for distributional analysis.

The HFCS uses gross income and measures distributions by households. This is consistent with the approach on collecting and measuring wealth information at the

[31] This chart includes total gross income from Spain. Spanish data are excluded from Chart 5, since the preliminary Spanish data do not include detailed information from different income components.

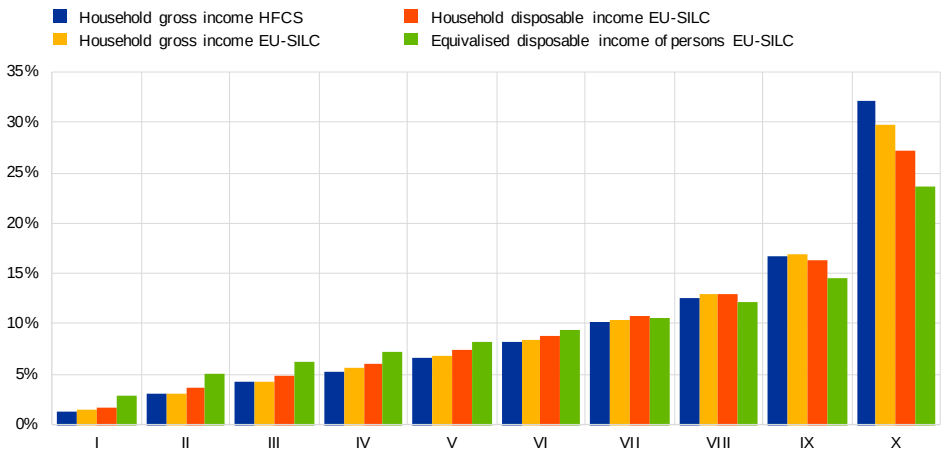
[32] The equivalence scale used in EU-SILC assigns a value of 1 for the first adult member of the household, a value of 0.5 to all other members aged 14 or over, and 0.3 to all members aged 13 or under.

household level. Thus, data on distributions in HFCS publications is very different from such data in EU-SILC publications. However, it is possible to calculate income distribution data with definitions identical to the EU-SILC data.

Chart 6 shows three different distributions of income derived from EU-SILC data, and compares them with the distribution produced from the HFCS.[33] The columns indicate the share of total income in each income decile. Only comparisons between the distributions of gross income should be used to assess the coherence of HFCS data with EU-SILC data. The other two data series are shown here solely to illustrate how different income concepts result in very different outcomes in the reporting of the HFCS and EU-SILC.

Chart 6

Share of total income by income deciles in the HFCS and EU-SILC with various income concepts



Sources: ECB – HFCS and Eurostat – EU-SILC.

The left-most series is that drawn from the HFCS data, which shows the distribution of gross income by households. The second series is produced from EU-SILC data with identical definitions. The difference between these two columns indicates the comparability of income data between the two datasets.

Even with identical definitions, the HFCS shows a somewhat more unequal distribution of income than EU-SILC, although the differences are not dramatic. In EU-SILC data, the share of gross income of the bottom 50% of the distribution is 21.5%, while it is 20.5% in the HFCS. The biggest difference is observed in the shares of the top income decile. In EU-SILC data, their share of total household gross income is 29.7%, and in the HFCS 32.0%.

These divergences can be explained by the differences in the structure of income described earlier. HFCS provides higher estimates for property income while EU-SILC provides higher estimates of transfer income, which usually has an equalising impact

[33] The HFCS data, as well as household level data series from EU-SILC are for the euro area to enable a comparison between identical or similar concepts. The data from EU-SILC on equivalised income is from the reference year 2016 (EU-SILC 2017) for all euro area countries, to enable a comparison with figures published by Eurostat.

on income distribution. Additionally, oversampling of wealthy households may have an impact on the share of households with very high income in the HFCS.

The third and fourth data series in Chart 6 point to the difference in the income definitions between the HFCS and income distribution statistics. These charts should not be used to assess the coherence of the HFCS data, and are shown to point out why income distribution measures published by other statistics yield different results to the HFCS.

The third series shows the distribution of net disposable income by households, and the fourth series the distribution of equivalised disposable income of persons. Both data are from EU-SILC, the latter being that available in the public Eurostat EU-SILC database.[34] As expected, net income by households is more equally distributed than gross income. Income taxation is progressive in most European countries, and social transfers are targeted at income-poor households. However, the main difference between the income distribution charts published by the HFCS and EU-SILC comes from shifting from household-level to personal-level equivalised income (series on the right-hand side).

To conclude, the level, structure and distribution of household gross income produced by the HFCS is fairly coherent with the corresponding information produced by EU-SILC. However, the concepts and methodologies used in the reporting of the results of the two statistics are very different and are not comparable.

[34] EU-SILC figures for equivalised disposable income are for the whole euro area.

Appendices

HFCS definitions of financially knowledgeable person and HFCS household definition

HFCS definition of Financially knowledgeable person (FKP)

The Financially knowledgeable person (FKP) is defined as the person who is most knowledgeable on financial matters regarding both the household as a whole and its individual members. He/she will be invited to provide a large part of the information requested during the interview.

HFCS Household definition

The target reference population for national surveys is all private households and their current members residing in the national territory at the time of data collection. Persons living in collective households and in institutions are generally excluded from the target population.

Household is defined as a person living alone or a group of people who live together in the same private dwelling and share expenditures, including the joint provision of living essentials. Employees of other residents (i.e. live-in domestic servants, au-pairs, etc.) and flatmates without other family or partnership attachments to household members (e.g. resident boarders, lodgers, tenants, visitors, etc.) are considered separate households.

Subject to the further and specific conditions shown below, the following persons must, if they share household expenses, be regarded as household members:

1. persons usually resident, related to other members
2. persons usually resident, not related to other members
3. persons usually resident, but temporarily absent from dwelling (for reasons of holiday travel, work, education or similar)
4. children of the household being educated away from home
5. persons absent for long periods, but having household ties: persons working away from home
6. persons temporarily absent but having household ties: persons in hospital, nursing home, boarding school or other institution

Further conditions for inclusion as household members are as follows:

for persons usually resident, but temporarily absent from the dwelling (3):

- the person currently has no private address elsewhere and the actual or intended duration of absence from the households is less than six months

for children of the household being educated away from home (4) and persons absent for long periods, but having household ties, such as persons working away from home (5):

- irrespective of the actual or intended duration of absence, if the person is the partner or child of a household member, continues to retain close ties with the household, regularly returns to this address (for instance, at the end of the academic term) and considers it to be his/her main residence[35].

for persons temporarily absent but having household ties: persons in hospital, nursing home, boarding school or other institution (6):

- the person has clear financial ties to the household and the actual or expected duration of absence from the household is less than six months

Sharing in household expenses includes benefiting from expenses (e.g. children, persons with no income) as well as contributing to expenses. If expenses are not shared, then the person constitutes a separate household at the same address.

A person will be considered a usually resident member of the household if he/she spends most of his/her daily night-rest there, evaluated over the past six months (this includes children in joint custody and elderly parents if they spend more days living in the household dwelling than anywhere else).

Persons forming new households or joining existing households will normally be considered members at their new location; similarly, those leaving to live elsewhere will no longer be considered members of the original household. The above mentioned “past six months” criteria will be replaced by the intention to stay for a period of six months or more at the new place of residence. Account has to be taken of what may be considered as “permanent” movements in or out of households. Thus a person who has moved into a household for an indefinite period or with the intention to stay for a period of six months or more will be considered a household member, even though the person has not yet stayed in the household for six months, and has in fact spent a majority of that time at some other place of residence. Similarly, a person who has moved out of the household to some other place of residence with the intention to stay away for six months or more will no longer be considered a member of the previous household.

If the person who is temporarily absent is in private accommodation, then whether they are members of this (or their other) household depends on the length of their absence.

[35] The definition of household membership differs slightly in Italy, as it includes persons in cases (4) and (5) as members of the households only if they are absent for less than six months.

Exceptionally, certain categories of persons with very close ties to the household may be included as members irrespective of the length of absence, provided they are not considered members of another private household. In particular, students that live elsewhere but retain close ties with the household, regularly return to this address and consider this address to be their main residence are to be considered part of the household irrespective of their length of stay at the other address.

Coverage issues: in the application of these criteria, the underlying intention should be to minimise the risk that individuals who have two private addresses at which they might potentially be enumerated are not double-counted in the sampling frame. Similarly, the intention should be to minimise the risk of some persons being excluded from membership of any household, even though in reality they belong to the private household sector.

Persons living in collective households and the institutionalised population are excluded from the survey population and not covered:

Collective household: refers to a non-institutional collective dwelling such as a boarding house, dormitory in an educational establishment or other living quarters shared by more than five persons without sharing household expenses. Also included are persons living as lodgers in households with more than five lodgers.

Institution: refers to old persons' homes, health care institutions, religious institutions (convents, monasteries), and correctional and penal institutions. Basically, institutions are distinguished from collective households, in that in the former, the resident persons have no individual responsibility for their housekeeping. In some cases, old persons' home can be considered collective households on the basis of this last rule.

Coverage of the core items in the 2017 wave of the HFCS – to be updated

For various reasons the whole content of the HFCS list of core output variables may not always be fully covered in all countries. In particular this applies to countries having adapted existing national surveys to the HFCS, i.e. Spain, France, Italy and Finland. Box 2 provides information on the incomplete coverage of the HFCS core questions in the 2017 wave of the HFCS.

Box 2
HFCS core variables not covered in HFCS 2017 wave

Real assets and their financing

The variables on how long the household has lived in the current household main residence (HMR), on the year the HMR was acquired and its value at the time of acquisition are not collected in Finland. Variables on house price expectations are not collected in France, Hungary or Finland.

Variables on both HMR and other property mortgage refinancing, initial amount borrowed, the year when the mortgage was taken or refinanced, length of loan, adjustable interest rate and current interest rate are not collected in Finland. Reasons for HMR and other property mortgage refinancing and their current remaining maturity are not collected in Finland, Italy or Poland. Questions on other property mortgage refinancing, and the reasons for refinancing are not asked in Spain. In Finland information on other property mortgages are not collected by property by which the mortgage is collateralised.

The number of cars is not collected in Italy. The variables on the ownership and value of valuables (such as jewellery, works of art, antiques) are not collected in Finland. Variables on the purchase of vehicles are not collected in Finland or Poland.

Other liabilities, credit constraints

The amount of outstanding credit line/overdraft balance was not collected in Poland. The variables on private loans are not collected in France or Poland. In Finland, variables on the number and purpose of private loans are not collected, but the outstanding amount on private loans is given as the outstanding amount on additional private loans. Variables on the amount initially borrowed, the initial length and current interest rate of non-collateralised loans are not collected in Finland.

The variable on re-applying for credit after refusal is not collected in Spain. The variables on 'was denied credit' and re-applying for credit were not collected in Hungary.

Private businesses, financial assets

The variable on household members working in self-employment businesses is not collected in Finland, Hungary or Poland. The variable on the percentage of self-employment business ownership is not collected in Finland.

Values by type of mutual fund are not separately collected in Portugal. Sub-items on mutual funds predominantly investing in real estate and in hedge funds are not separately collected in Italy. The sub-item on mutual funds predominantly investing in hedge funds is not separately collected in Spain or France. The variables on types of bonds owned are not collected in France and Finland. Variable on foreign shares in the owned shares' portfolio, money owed to the household and extra assets in managed accounts are not collected in Finland.

Employment

Variables on time spent in the current main job, total time spent in employment, expected retirement age and probability of losing/finding a job are not collected in Finland. Information on the type of secondary employment is not collected in Finland or Poland. The status in previous job for unemployed or other inactive are not collected in Poland. Variables on previous job description are not collected in Italy or Poland. Variables on previous main employment (NACE) are not collected in France, Poland or Finland.

Pensions and life insurance policies

Information on whether the respondent is still contributing to a pension plan is not collected in Austria. The number of years contributed to the pension plan is not collected in Finland. The monthly contribution to pension plans is not collected in Austria or France. The variable on whether the pension plans carries a balance is not collected in Luxembourg. Information on whether the pension

plan is mandatory or voluntary is not collected in Austria or Luxembourg. The age at which the respondent expects to receive payments is not collected in Austria, France or Finland.

Income

Variables on income from private businesses other than self-employment are not collected in France and Italy. Variables on gross income from other income sources are not collected in France. Income from private and occupational pension plans is not separately collected in Spain, but rather provided together with income from public pension plans. The variables on the character of collected annual income (higher/normal/lower) and on future income expectations are not collected in Finland. Variables on financial assistance received from relatives and friends are not collected in Poland.

Intergenerational transfers, gifts

In Finland, only the variable on whether a substantial gift/inheritance was received is collected, the rest of the gift/inheritance block is not collected. The gift/inheritance block is not collected in Italy. Questions on from whom the gift/inheritance was received and whether the household expects to receive a gift/inheritance are not asked in Spain.

Consumption and saving

The amount spent on food outside the home is not collected separately, but rather provided together with amount spent for food at home in Spain. The amount spent on trips and holidays is not collected in Finland. The variable on the comparison of the balance between income and expenses is not collected in Finland. Variables on the sources of extra income to meet expenses in households with expenses above income are not collected in Italy or Finland. Variables on an unexpected windfall gain are not collected in Estonia, Finland, Hungary or Poland.

Collection of the non-core items

Table A.1 provides an overview of non-core variables covered in one or more of the HFCS country files in the 2017 wave.

Table A.1

HFCS non-core variables collected in national surveys

Demographics	
RNA0200 Citizenship	France, Italy, Luxembourg, Portugal
PNA0100 Field of study	Spain, Italy
PNA0200 Health	Luxembourg, Spain
PNA0300 Siblings	France
PNA0400 Are you the eldest	France
PNA0500 RP's/partner's father alive	France
PNA0501 RP's/partner's mother alive	France
PNA0510x Age of father and mother	France
PNA0600x Education of father/mother	Italy, Luxembourg, Portugal
PNA0700 Occupation of father	Spain, France, Portugal
PNA0701 Occupation of mother	Spain, France, Portugal
PNA0850 Legal arrangements for marriage or recognised partnership	Spain, France
PNA0851 Sort of legal arrangement for marriage or recognised partnership	Spain, France
Real assets and their financing	
HNB0800 HMR/any part used for business purposes?	France
HNB0810 HMR – year of construction	Cyprus, Greece, Spain, Italy, Portugal, Finland
HNB0910x HMR – External support for housing acquisition	Greece , France, Luxembourg, Portugal
HNB0920 HMR/Imputed rent	Greece, Italy, Finland
HNB1150 Expected price of your home	Greece
HNB130$x HMR mortgage1: institution you have loan with	Spain, France
HNB140$x HMR mortgages: work for institution granting the loan	Portugal
HNB1700 Overpaying/voluntary step-up payments on HMR mortgages	Portugal
HNB1710 Monthly amount of extra voluntary payments on HMR mortgages	Portugal
HNB1800 Rent net or including other charges	France
HNB190$x Other property: how property was acquired	Cyprus, Spain, France, Italy
HNB2000 Remaining other properties: renting out of property	France, Italy
HNB2010 Other properties: how much rent is collected	Italy
HNB2300 Overpaying/voluntary step-up payments: loans on other properties	Portugal
HNB2310 Monthly amount of voluntary payments: loans on properties other than HMR	Portugal
HNB2800 Sold properties or consumer durables	Spain
HNB2820 Amount received – sale of properties or and consumer durables	Spain
HNB3000 Reasons for moving	Portugal
Other liabilities, credit constraints	
HNC004$x non-collateralised loan: year the loan was taken	France, Italy, Portugal
HNC005$x non-collateralised loan: nature of the lender	Spain, France
HNC0125 Late or missed payments on loans	Cyprus, Estonia, Spain, France, Italy, Portugal
HNC0126 Any outstanding overdue payments	Cyprus, Estonia, Portugal
HNC0127 Any overdue payments by more than 90 days	Portugal
HNC0200x Reasons for being refused credit	Spain, France
Private businesses, financial assets	
HND010$x Business: year the business was started	Spain, France, Portugal
HND020$x Business: last year's total business sales	France, Portugal

HND0400 Any guarantees provided to businesses	Spain, Portugal
HND0410 Value of the guarantees provided to businesses	Spain
HND0420 Any guarantees provided to non-HH members	Portugal
HND0600 Is interest paid on sight accounts	Spain
HND0800 Are all accounts in euro	Portugal
HND1000x Market value by type of bond	Italy
HND1800 Number of different shares (companies)	Spain
HND1900 Any shares in company you work for	Spain
HND1910 Value of shares of the employer company	Spain
HND2200 Assets deposited abroad	Portugal
HND3000x Largest assets in HH balance sheet	Belgium
HND3010 Portfolio shifts last two years?	Belgium
HND3020 Portfolio shifts last two years: money out	Belgium
HND3030 Portfolio shifts last two years: money in	Belgium
HND3040 Would not invest again?	Belgium
HND3050x Assets HH would not invest again	Belgium
HND3100 Net worth past two years	Belgium, France, Portugal
HND3200 Net worth next two years	Belgium, Portugal
HND3300 Asked bank for financial advice?	Greece
HND34000 Financial planning horizon	Greece
HND3500 risk taking attitude	Portugal
HNF0100x Has other insurance policies (accidents, theft, fire etc.)	Spain

Employment

PNE0100 Seasonal employment	Greece, Italy, Portugal, Slovakia
PNE0110 Number of working weeks per year	Italy, Portugal, Slovakia
PNE0200 Gross monthly income – main job (employees)	France, Spain, Portugal, Slovakia
PNE0300 Gross monthly income from self-employment	France, Spain, Portugal, Slovakia
PNE0500 Private-public organization	France, Italy, Luxembourg, Portugal, Finland
PNE0600 Number of employees – main employer	Spain, Portugal
PNE0700 Hours worked – additional employment contracts (as an employee)	Spain, Italy, Slovakia
PNE0800 Gross monthly income from additional jobs	Spain, Slovakia
PNE0900 Probability of losing job	Spain
PNE1000 Looking for job	Spain, Greece, Slovakia
PNE1100 Expect find new job in next 12 months	Greece, Spain
PNE1300 Hours a week would like to work in new job	Slovakia
PNE1400 For what minimum wage would work	Spain, Slovakia
PNE1600 Year they stopped being employed (for retirees)	Portugal
PNE1700 Employment status in last main job	France
PNE1800 Full time/part time – last job	France
PNE1900 What did firm/organisation you worked for make or do	Spain, France
PNE2000 Former job title and description / ISCO	Spain, France, Portugal
PNE2100 Time in former employment	France
PNE2200 Total time in full-time employment	Spain, France, Luxembourg
PNE2210 Total time in all part-time employment	Spain, France
PNE2300 Prevailing employment situation in working life	Spain
PNE2400 No of different employers	Spain, Italy
PNE2500 Longest time with one employer	Spain

PNE2700x Worsening of job conditions past 2 years	Greece, Portugal
PNE2800x Expected worsening of job conditions next 2 years	Greece

Pensions and life insurance

PNF0720 Current value of all occupational plans that do not have an account.	Netherlands, Finland
PNF100$x Occupational pension plan: is employer contributing	Spain, France
PNF180$x Occupational pension plan: expected age of collecting pension	Spain, France
PNF310$x Voluntary pension plan: whole life insurance policy: cash value	Spain, France
PNF3600 Has private health insurance	Spain, Italy
PNF3610 Monthly payments for health insurance policy(ies)	Italy

Income

HNG0110 Net income from regular social transfers	Italy
HNG0210 Net income from regular private transfers	Italy, Portugal
HNG0310 Net rental income from real estate property	Italy, Portugal
HNG0410 Net income from financial investments	Italy, Portugal
HNG0510 Net income from private business other than self-employment	Portugal
HNG0610 Net income from other sources	Italy, Portugal
HNG0710 Income taxes and social contributions	Italy, Finland
PNG0110 Net employee income	Italy, Poland, Portugal
PNG0210 Net self-employment income	Italy, Poland, Portugal
PNG0310 Net income from public pensions	Italy, Poland, Portugal
PNG0410 Net income from private and occupation pension plans	Italy, Poland, Portugal
PNG0510 Net income from unemployment benefits	Italy, Poland

Intergenerational transfers, gifts

HNH0500 Substantial gift made to children/other people outside household	France
HNH0600 Who was the beneficiary of the gift	France
HNH0700 Year donation was made	France
HNH0800 How much was donation made worth	France

Consumption and saving

HNI0200 Meet any regular payments	Portugal, Slovakia
HNI0210 Expenditure on regular payments	Portugal, Slovakia
HNI0500 Comparison of future expenses with current level	Spain
HNI0700 More or less savings in the next year	Belgium, Slovakia
HNI0800 General price expectations	Belgium, Slovakia
HNI1000 General personal financial situation expectations	France, Slovakia

Payment habits and financial literacy (non-core section)

HNJ1100 Any debit or/and ATM cards	Spain, Italy
HNJ1200 How frequently uses debit card	Spain
HNJ1300 Frequency of cash withdrawals in ATMs	Spain
HNJ1400 Use of direct debit	Spain
HNJ1500x Type of payments by direct debit	Spain
HNJ1600x Reasons for not using direct debit	Spain
HNJ1800 Payments by bank cheques	Spain
HNJ2000 Any payments received by credit transfer	Spain
HNJ2300a No of credit cards	Italy
HNJ2800x Ever used other means of payment	Spain

HNJ2900 Link used for info or payments	Spain
HNJ3100 A computer at home	Finland
HNJ3200 Any household member use the internet	Spain
HNK0400 General economic situation expectations	Slovakia
HNM0100 Financial literacy Variable/fixed interest rates	Slovakia
HNM0200 Financial literacy Inflation	Slovakia
HNM0300 Financial literacy Portfolio diversification	Greece, Slovakia
HNM0400 Financial literacy Riskiness	Greece, Slovakia

Revisions to data previous waves

Some countries have revised the datasets from the first two waves. This means that some indicators presented in the 2017 wave publications may be different from the same indicators published previously. In all cases, the need for revisions stems from improvements in the data production methodologies or data sources available.

The most comprehensive revision is for the Spanish data from the first two waves. To enhance comparability, the Spanish data for the first wave now refer to the survey conducted in 2011-12, which in the previous publication was labelled as second-wave data. The Spanish data for the second wave now refer to the survey conducted in 2014-15. The methodological reports for the first and second wave have not been revised, but additional publications including tables with revised information are available.

In Italy there have been minor revisions to the second-wave loan variables. Malta has revised values of self-employment income, self-employment business wealth and some employment-related variables for panel households based on the information received in the first and second-wave interviews. In Poland, gross income variables of the second wave have been re-estimated with an improved model also used in the third wave.

In Portugal, values of some second-wave variables for other real estate properties and self-employment business wealth have been revised. The imputed values have been replaced with new values estimated using similar methods as in the third-wave imputations.

In Finland, some second-wave variables have been revised so that they are comparable with the practices of the third-wave data. The value of mutual funds now includes funds recorded under “foreign collective investment institutions/funds”. The values of other residential properties and forest assets have been revised to take households’ share of ownership better into account. Negative values of self-employment businesses have been set to “missing”. In addition, weights for the second-wave Finnish data have been revised by adding level of education to the calibration model to correct the over-estimation of the well-educated in the sample.

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Abbreviations

Countries

AT	Austria
BE	Belgium
BG	Bulgaria
CH	Switzerland
CY	Cyprus
CZ	Czech Republic
DK	Denmark
DE	German
EE	Estonia
IE	Ireland
ES	Spain
FI	Finland
FR	France
GR	Greece
HR	Croatia
HU	Hungary
IT	Italy
JP	Japan
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom
US	United States

Other

CAPI	Computer Assisted Personal Interview
CATI	Computer Assisted Telephone Interview
CAWI	Computer Assisted Web Interview
ESA	European System of Accounts
EU-SILC	EU Statistics on Income and Living Conditions
FKP	Financially knowledgeable person
HFCN	Household Finance and Consumption Network
HFCS	Household Finance and Consumption Survey
HMR	household main residence
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
MI	multiple imputation
NACE	European Classification of Economic Activities
NCB	national central bank
NSI	national statistical institute
PSU	primary sampling unit
RP	reference person
UDB	User Database

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