EUROPEAN CENTRAL BANK

EUROSYSTEM

8 January 2024

Experimental Distributional Wealth Accounts (DWA) for the household sector
Methodological note

The purpose of the Distributional Wealth Accounts (DWA), produced by the European System of Central Banks (ESCB), is to meet the growing interest in adding distributional information to macroeconomic sector accounts. This methodological note complements the Overview note (available on the ECB Data portal) summarising the data available, and provides more detailed information on how the Distributional Wealth Accounts are compiled.

1. Introduction

The financial crisis of 2008, the coronavirus (COVID-19) pandemic and a host of other economic developments have increased the demand for more timely, coherent, and consistent distributional information on the household sector. This is not only helpful for monetary policy analysis by central banks, it also supports a wide range of additional economic analysis and research, The new data presented in this note support the ECB's monetary policy strategy, which aims to include a systematic assessment of the two-way interaction between income and wealth distributions and monetary policy[1].

These new requirements are also reflected in the G20 Data Gaps Initiative (DGI), which encourages the production and dissemination of distributional information on income, consumption, savings, and wealth for the household sector. The OECD has been mandated to coordinate this work, in close cooperation with the ECB and Eurostat. In 2022, the G20 agreed on the third phase. DGI3 includes two recommendations related to distributional data: Recommendation 8 focuses on income and consumption, while Recommendation 9 refers to household wealth.[2]

The European System of Central Banks (ESCB) has responded to these developments by devising Distributional Wealth Accounts (DWA), which aim to provide distributional information on the wealth of households, by reconciling sector accounts with household survey data.

The ESCB compiles Quarterly Sector Accounts (QSA) statistics for all euro area/EU countries and the euro area as a whole, showing financial transactions and positions, as well as non-financial transactions as compiled by national statistical institutes and Eurostat, for the main institutional sectors of the economy, including the household sector. These data use the methodology of the European System of Accounts (ESA 2010[3]). The time series start in the first quarter of 1999 and cover the last reference quarter with a lag of about three to four months.

In parallel, the ESCB also produces the Household Finance and Consumption Survey (HFCS), which provides information on the distribution of wealth among households in all euro area countries. Four waves of the survey have been released, approximating to the years 2010, 2013, 2017 and 2020.[4] These data are published with a lag of around 18 months.

The DWA aim to reconcile these two different datasets, with a view to providing an assessment of the distribution of wealth across different household groups that is consistent with the aggregates in the QSA. The method and results have been developed and compiled by the ESCB. A summary of the available

---

1 See the overview of the ECB's monetary policy strategy on the ECB's website.

2 See the IMF website.

3 See the Eurostat website.

4 Dates differ slightly across countries.

data and breakdowns is available in the Overview note (available on the ECB Data portal). The data for the euro area as a whole and most countries (Belgium, Estonia, Ireland, Greece, Spain, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Portugal, Slovenia, Slovakia and Finland) are currently compiled centrally by the ECB, using the agreed methodology and in close cooperation with national experts. Other countries (Austria, Germany, France, Italy and the Netherlands) compile the data themselves, using the same concept.

2. Reconciling HFCS and QSA data

The DWA results aim at full consistency with the QSA.[5] The distributional breakdown is achieved by combining information from the HFCS with additional estimates.

The QSA and the HFCS have different purposes and are therefore collected and compiled in different ways. The HFCS collects a self-assessment of wealth from a sample of households and provides results on the distribution of wealth at a given point in time, thus yielding a picture of the wealth distribution among household groups. The QSA are mainly based on reporting by various financial institutions acting as counterparts to the household sector[6], and aim at consistent time series for all sector assets and liabilities. The two datasets show different results: in most cases, estimates of aggregate totals based on the HFCS are lower than those in the QSA.

Section 2.1 summarises the principal generic differences that explain these different results. Section 2.2 presents the main steps implemented in the DWA to reconcile the two datasets.

2.1 Generic differences between HFCS and QSA

While the HFCS and the QSA both focus on measuring the wealth of households, the different aims and scope of these statistics lead to several generic differences that contribute to the different results observed between these datasets.[7]

Sources

The aim of the HFCS is to gain insight into the economic behaviour of households and the distribution of wealth and liabilities among households and household groups. The survey is usually conducted for a

[5] A few exceptions due to country-specific features are described in Section 3.

[6] e.g. banks reporting deposits received from households.

[7] Further explanations can be found in Section 3 of Expert Group on Linking macro and micro data for the household sector (2020)

sample covering about 80,000 households in the euro area by personal interview. Data collection in the HFCS is based on a set of common definitions and descriptive features and follows an output-oriented approach.[8]

The aim of the QSA is to provide timely macroeconomic information on the financing and investment of the entire household sector. They do not exclusively focus on the household sector but rather describe relationships between all institutional sectors. For the household sector, QSA data are mainly based on counterpart data, i.e. data reported by financial corporations, mostly produced under ECB statistical regulations. The definitions of instruments, sectors and the valuation to be applied are given by the European System of Accounts (ESA) 2010 and are mandatory in the EU.[9]

Definitions of household sector

The two data sources have slightly different definitions of a household. In the HFCS, those living in institutions such as prisons or retirement homes are excluded from the target population, as are homeless people. Non-residents can be members of a resident household if they are temporarily absent but otherwise fulfil the criteria for being a household member. The HFCS target population therefore consists of private households, 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"*.

In the QSA, the household sector consists of *"individuals or groups of individuals as consumers and as entrepreneurs (…) provided that the production of goods and services is not by separate entities treated as quasi-corporations"* (ESA 2010, 2.118). It covers the entire resident population and does not exclude any groups. Under ESA 2010, the unit is resident in the economic territory with which it has the strongest connection, expressed as its centre of predominant interest (ESA 2010, 18.08). The distinction between producer households (classified within the household sector) and quasi-corporations and corporations (classified within the non-financial corporation sector) in the QSA may also lead to country-specific differences in the scope of the HFCS and the QSA as regards the recording of assets and liabilities related to the business of a household.

Overall, because of the groups excluded from the HFCS target population, the population coverage in the HFCS is usually slightly lower than the corresponding QSA figure. Consequently, the data are adjusted for differences in the size of the target population before comparing wealth figures between macro and micro sources, using a simple proportional adjustment (see Section 2.2).

---

8 The participating institutions produce harmonised output (i.e. micro survey data) for their respective country, but do not necessarily use identical questionnaires. However, a common questionnaire template serves as a benchmark for the country questionnaires. Some countries also use administrative data for the HFCS (mainly on income). For more information see the Household Finance and Consumption Network page on the ECB's website .

9 For more information see the Sector accounts page on the ECB's website.

Timeliness and periodicity

The periodicity and timeliness of the two statistics are different. In most countries, the HFCS is conducted every three years, has different data collection periods across countries and displays a relatively long time lag between data collection and release. Most data in the HFCS refer to the time of the interview.

The QSA are published quarterly and available no later than four months after the end of the quarter. The balance sheet is as at quarter-end. Aligning the reference periods is another potential source of concern in macro-micro comparisons, particularly for types of financial assets (e.g. listed shares) whose values may vary significantly even within a quarter. For DWA compilation purposes, the QSA results that match best the mid-period of the HFCS interview period are chosen (see Section 2.2).

Valuation of assets and liabilities

Another generic difference refers to the valuation of households' assets and debt. In the HFCS, these are based on self-evaluation. However, a household's perception of asset values may not always be aligned with market values, particularly during times when prices are changing rapidly. Nevertheless, self-evaluation can be very accurate for indivisible assets, such as dwellings, for which market prices are highly dependent on a large number of idiosyncratic characteristics and rarely observable (only at the time of purchase/sale).

In the QSA, all financial and non-financial instruments are valued at market prices (or suitable proxies, e.g. nominal values for deposits and loans). For items with quoted market prices such as listed shares and debt securities, valuation is straightforward. However, the valuation for unlisted shares and, in particular, holdings of other equity is less accurate as assumptions and modelling are required. For QSA data on non-financial assets, the produced capital stock (in particular dwellings) is based on the perpetual inventory method (PIM)[10] in almost all countries. The estimation of QSA data on land is more complicated and varies from country to country.

Instruments covered

The instruments covered in the HFCS and the QSA are similar, but not identical. In addition, the terminology is often different. However, most instruments can be matched between the two datasets, and a wealth concept covering most items can be built, based on the breakdowns available on both sides (see also Section 2.2.2 below).

[10] The PIM method combines data on gross fixed capital information, consumption of fixed capital and estimates of service lives. It is recommended by ESA 2010 for calculating the stock of fixed assets when direct data sources are not available (ESA 2010, 3.141). It is expected to broadly reflect market value, as the stock is revalued at the purchasers' price for the current period.

Measurement issues

In addition to the generic differences mentioned above, there are also measurement features that can help explain the discrepancies between values on household wealth derived from the two sets of statistics.

Estimates in household surveys are affected by sampling variance, non-response bias and reporting bias. Sampling variance is measured by estimating the confidence intervals of the estimates derived from the HFCS data. The HFCS statistical tables report a standard error for each indicator in the tables, considering the complex sampling designs and imputation variance. The same method can be used to produce standard errors for the estimated total amounts and therefore of the coverage rates with respect to financial accounts. Biases may be present if the weighted structure of households who participate in a survey is different from the structure of the target population in a systematic way. In general, the bias in the HFCS caused by unit non-response is reduced by adjusting weight. Despite weighting, because the distribution of wealth is right-skewed, and because non-response tends to be higher among the very wealthy, the very top wealthy are typically underrepresented in household surveys. To increase the representation of the wealthy in the sample, many countries oversample wealthy households in the HFCS. Reporting bias is the measurement error that occurs when the response recorded for a household in a sample differs from the actual value. Finally, another frequently observed problem in household surveys is item non-response, i.e. participating households being unable to provide answers to some questions. The HFCS provides a full dataset for all balance sheet and income variables for each household surveyed and a value is imputed whenever a given variable is missing.

The QSA are typically based on different statistical sources and the validation of primary statistics. Errors in compilation may be due to one of two reasons: either the source statistics follow different concepts than the QSA and the gap between the QSA and source statistics is wrongly estimated or there is a measurement issue in the source statistics. In practice, the household sector is mostly based on counterpart reporting data, i.e. the QSA data reported by banks, investment funds, insurance corporations and pension funds. It is therefore necessary to review the quality of the different statistical sources to assess measurement issues. While the counterpart data can be considered to be of very good quality overall, there can be potential problems in allocating units to the right sectors (e.g. a reporting bank mistakenly allocating a deposit to resident households, while that household is in fact non-resident, or vice versa). Moreover, as indicated above, measurement issues are important when data sources are incomplete or low-frequency. Two relevant cases in the QSA are equity held by households other than listed shares, and non-financial assets (e.g. land). Finally, the statistical balancing process affects the QSA results. The QSA may need to allow some adjustments in the household sector to satisfy the balancing constraints of sector accounts when combining the results for all sectors (specifically, the sum of assets of all sectors has to be equal to the sum of liabilities, and the net impact of non-financial transactions has to be equal to the net impact of financial transactions). Some countries allocate a large part of the imbalances between assets and liabilities across sectors to the household sector when the data available for that sector is of lower quality than for other sectors (e.g. on the holdings of unlisted shares).

Impact of coverage differences on inequality indicators

Given that in most cases, QSA aggregates tend to be higher than the corresponding totals measured in the HFCS, adjustments to micro-data to fit with the QSA generally increase them. This inevitably has an impact on the assessment of inequality:

- Where the increase is generated by adding estimations for very rich households deemed not to be covered by the HFCS, the process tends to lead to an increase in inequality measures

- Where the increase is generated mainly by the final proportional allocation, there are two possible outcomes:

    - If the increase affects assets which are more equally shared across the population than others (e.g. housing wealth or deposits), this tends to decrease the proportion held by the very top of the distribution, and therefore decreases inequality measures;

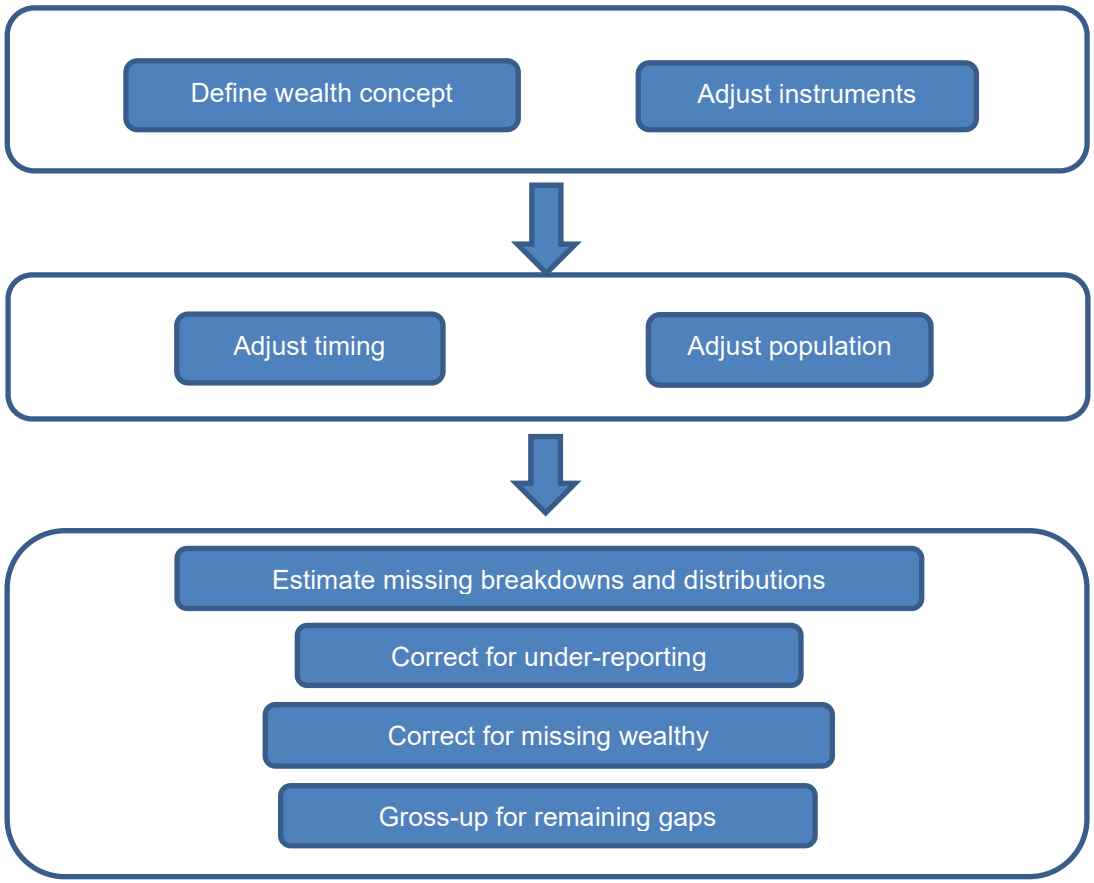
    - If the increase affects assets which are less equally shared across the population than others (e.g. listed shares), this tends to increase the proportion held by the very top of the distribution, and therefore increases inequality measures.

2.2 Standard/baseline reconciliation process

The process for reconciling HFCS results to QSA aggregates starts with the definition of a wealth concept covering the instruments for which HFCS and QSA sources can be matched. The amounts recorded in the HFCS for each of these instruments are then reconciled with the aggregates in the QSA.

Chart 1 below summarises the steps to reconcile the HFCS results with those of the QSA.

CHART 1: STEPS OF THE RECONCILIATION PROCESS IN DWA



2.2.1 Wealth concept and instruments covered in the DWA

As mentioned above, some of the instruments covered in the HFCS and the QSA cannot be easily compared. For this reason, the DWA data focus on an adjusted wealth concept, covering most, but not all of the instruments available in HFCS or QSA. In particular, currency holdings, non-life insurance reserves, occupational pensions, other accounts receivable and other accounts payable are covered only by the QSA (or covered differently in the HFCS) and hence currently excluded from this adjusted net wealth concept.[11] The net wealth concept used in the DWA covers:

[11] Financial derivatives held and loans granted by households are in principle covered in the sector accounts but, as in most countries these represent negligible amounts, they are not covered by the process linking them with the HFCS.

- deposits, debt securities, listed shares, unlisted shares and other equity, investment fund shares, life-insurance, housing wealth and non-financial business wealth[12] (i.e. non-financial assets used for production purposes[13]) under assets;

- mortgage and non-mortgage loans under liabilities.

This covers the most significant items of household net wealth as measured in the euro area QSA, representing more than 90% of the value of households' financial and non-financial assets as recorded in the QSA (Table 1).[14]

TABLE 1: FINANCIAL AND NON-FINANCIAL WEALTH IN QSA AND THEIR REPRESENTATION IN DWA – MID-2023

Code	Instruments (in QSA terminology)	Assets		Liabilities	
		Included in DWA	Not included	Included in DWA	Not included
F21	Banknotes and coins		1%		
F2M	Deposits	13%			
F3	Debt securities	1%			
F4	Loans		0%	88%	
F5	Equity	12%			0%
F62	Life insurance	6%			
F6O	Non-life insurance		0%		
F6M	Pension entitlements [a]		5%		
F8	Trade credits and other accounts receivable		1%		12%
NUN	Housing wealth [b]	54%			
	Business assets [c]	7%			
	Sub-total	**93%**	**7%**	**88%**	**12%**
	Total financial and non-financial wealth	**100%**		**100%**	

a: pension claims (excluding social security pensions, generally involving pay-as-you-go systems).
b: Dwellings and land underlying dwellings, in QSA terminology
c: Fixed assets minus dwellings and land underlying dwellings

[12] In QSA terminology: Fixed assets minus dwellings and land underlying dwellings

[13] Similarly, the term business wealth as used in the HFCS and this methodological note refers to financial and non-financial assets used by households for production purposes.

[14] Pensions are covered in the financial accounts to the extent that they are financed by current assets of each individual households, while pensions financed by social contributions paid by working households under pay as you go systems are not reflected.

2.2.2 Adjusting instrument coverage

While the instruments identified in the HFCS can in many cases easily be mapped one to one to an instrument in the QSA, some require more adaptation.[15]

Business wealth

In the HFCS, wealth from private businesses is split into self-employment and non-self-employment business wealth. Self-employment businesses are defined as businesses in which a household member is either self-employed or has an active role in running the business. These businesses can be either sole proprietorships, independent professionals, partnerships, or limited liability companies in which self-employed household members are actively participating. Non-self-employment business wealth refers to passive investment only.

In the QSA, there is no comparable "business wealth" concept. If a household runs a business, either this is recognised (according to certain criteria) as a corporation or quasi-corporation (i.e an unincorporated enterprise functioning as a corporation), or it is not, and the household is regarded as a "producer household". The HFCS data on business wealth may therefore be mapped to QSA categories as follows:

- In the first case, i.e. if the business is recognised (according to QSA criteria) as a corporation or quasi-corporation, the assets identified as business wealth in the HFCS would be recorded under F.512 Unlisted shares or F.519 Other equity, which represent the market value of unlisted shares and other equity held by households in corporations and quasi-corporations.

- In the second case, i.e. if the business is not recognised separately from the household as a corporation or quasi-corporation, the assets identified as business wealth in the HFCS are shown in the QSA as financial and non-financial assets of households, and are not distinguishable from non-business assets and liabilities of the household in its function as a consumer. A further difference is that the QSA record this wealth in gross terms on both sides of the balance sheet, while the underlying concept of the HFCS is to record the expected value of the business if sold, i.e. a net value of the assets minus the related liabilities.

To maximise the conceptual comparability of business-related assets and liabilities, the first step is to separate assets included in self-employed business wealth in the HFCS which correspond to the QSA aggregated item "unlisted shares and other equity". This is conducted in two stages. First, based on information available in the HFCS, all legal forms other than sole proprietors and partnerships are assumed to issue unlisted shares (F.512) and/or other equity (F.519). These enterprises are incorporated

[15] For a more detailed and comprehensive correspondence table between the QSA and the HFCS see Annex 2a of Expert Group on Linking macro and micro data for the household sector (2020).

businesses and recognised as such in the QSA, so that, as explained above, their assets and liabilities are recorded in the QSA balance sheets of the corporate sector and their equity is recorded as unlisted shares or other equity held by the household sector. Second, for unincorporated businesses (i.e. those called sole proprietors and partnerships in the HFCS), country-specific criteria are applied to make a distinction between those regarded in the QSA as producer households and those treated as quasi-corporations, along the lines of the incorporated businesses described above.

Depending on the legal setting and national data sources available, countries apply different practical borderlines between producer households and quasi-corporations in the QSA. In November 2014, Eurostat's National Accounts Working Group approved several "decision trees" to assist non-financial accounts compilers in approximating this sector delineation. In addition, information on the recording of business assets was collected in a questionnaire circulated (within the ESCB) in June 2016. This information has been used to reclassify HFCS self-employment business wealth to unlisted shares and other equity and other QSA instruments.[16]

Housing wealth

The ESA transmission programme, defining the breakdowns of sector accounts to be reported by all EU countries, does not contain a variable on household housing wealth. However, such data can be produced by adding together dwellings and land underlying dwellings. Further estimates are subsequently performed for countries where some of these breakdowns are not available, as described under Section 2.2.5.

Managed accounts

The concept of managed accounts is included in the HFCS, but not separately identified in the QSA. Conceptually, it can be matched mostly with investment fund shares, or in some cases life insurance. This adjustment has been implemented, generally with only a small impact on the overall results.

Mortgage/other debt

QSA data in most euro area countries do not distinguish between mortgage debt and non-mortgage debt, which are all included in the loans received by households. However, this split is available in the HFCS.

DWA data include a split between mortgage debt and other debt, achieved by dividing the QSA data on household loan liabilities between mortgages and other debt. This division is derived from the MFI balance sheet statistics, which provide the distinction for the loans granted to households by MFIs.

[16] The country-specific steps applied are described in more detail in Table 3.1 of Expert Group on Linking macro and micro data for the household sector (2020)

2.2.3 Timing adjustment

For each HFCS wave, interviews are carried out with households over a period of several months, called the fieldwork period.

Sector accounts data on household wealth are generally available with quarterly frequency, and refer to the end of a quarter.[17] Some sources are available only on an annual basis, though: where this is the case, quarterly results are estimated from the annual data, using temporal disaggregation methods (Fernandez, 1981) and the reported values from the available annual sector accounts.

To reconcile the two sources, the QSA data corresponding most closely to the mid-point of the fieldwork period are then selected, except in countries where the HFCS data refer explicitly to a specific reference date.

2.2.4 Population adjustment

As explained above, one reason for the discrepancies between the two instrument totals is that the QSA have a slightly broader household coverage than the HFCS (for example they also cover persons living in prisons and retirement homes).

To compile the DWA, the HFCS population has been adjusted to match that of the QSA. A proportional adjustment has been applied to rescale all household weights by the same factor, which is equal to the population total given by the QSA divided by the weighted sum of the corresponding number of households provided by the HFCS. For most countries, the adjustment has a very limited impact, affecting less than 3% of household assets and liabilities.

2.2.5 Adjustments to sources on housing wealth and business wealth

Another reason for discrepancies between the instrument totals in the HFCS and the QSA relates to the coverage of non-financial balance sheets. Three main differences need to be considered:

- Household (S.14) data are available for the financial instruments in the QSA. However, the ESA 2010 transmission programme of non-financial assets only requires countries to report the aggregation of households (S.14) and non-profit institutions serving households (NPISH, S.15) under the aggregated code “S.1M”.
- Under ESA 2010, countries only have to report total land , i.e. no distinction is drawn between land underlying dwellings and other land owned by households.[18]

---

[17] For certain non-financial assets, some sources of sector accounts are available only on an annual basis. These data, are generally fairly stable over time and are used to produce a temporal disaggregation into quarters.

[18] Some countries provide more detailed information on a voluntary basis.

- In addition, following ESA 2010, dwellings owned by households in other countries are not recorded in QSA under non-financial assets; instead, they are counted as holdings of unlisted shares and other equity (F.51M).[19]

The instruments related to non-financial assets are therefore adjusted to be more comparable with the HFCS. This is done by solving equations linking housing and business wealth with their components.

Equations to be fulfilled for housing wealth and business wealth

To refine the QSA numbers and improve comparability with the HFCS, the detailed specifications of the data are described in the following two linear equations, in which gaps K1 and K2 between the HFCS and the QSA are minimised:

(1) $Housing\ Wealth_{HFCS+Pareto\ Tail\ (\text{add rich})+Pop.adjustment} + Gap_{K1} = a \times Dwellings_{S.1M} + b \times c \times Total\ Land_{S.1M} + d \times Real\ Estate\ Abroad$

where:

- $a = {Dwellings_{S.14}}/{Dwellings_{S.1M}}$
- $b = {Total\ Land_{S.14}}/{Total\ Land_{S.1M}}$
- $c = {Land\ Underlying\ Dwellings_{S.14}}/{Total\ Land_{S.14}}$
- $d = {Housing\ Abroad_{S.14}}/{Real\ Estate\ Abroad}$

[19] Under ESA 2010, all dwellings are deemed by convention to be held by residents. Holdings of dwellings by non-resident households are recorded as if they were held by resident notional corporations, held themselves by non-resident households.

and:

(2) $Business\ Wealth_{HFCS+Pareto\ Tail\ (\text{add rich})+Pop.adjustment} + Gap_{K2} = e \times NonFinancial\ Assets_{S.1M} + UnlistedShares_{S.14} - a \times Dwellings_{S.1M} + b \times (1-c) \times Total\ Land_{S.1M} - d \times Real\ Estate\ Abroad$

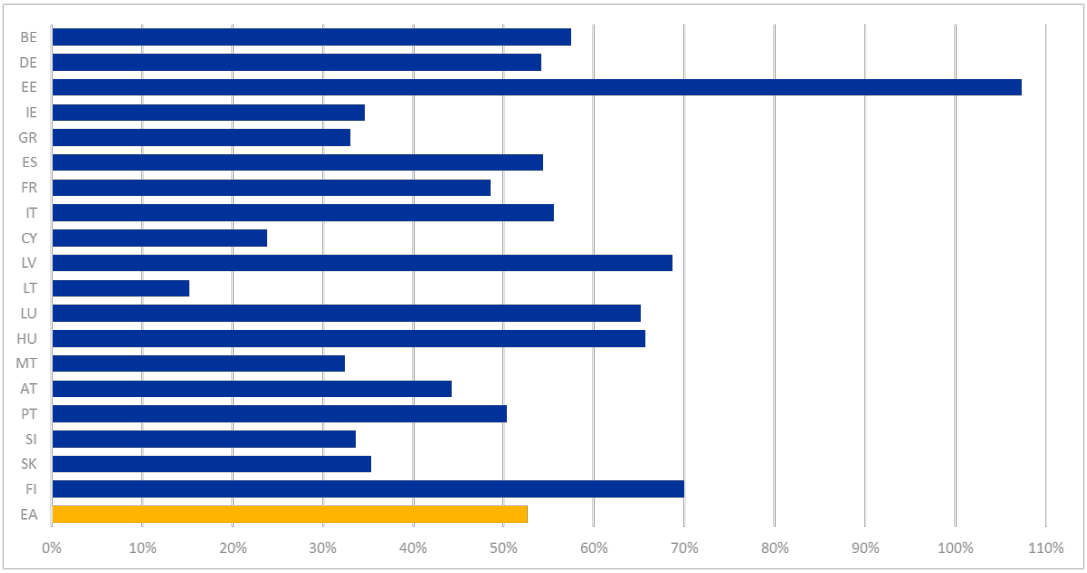
where:[20]

- $e = {NonFinancial\ Assets_{S.14}}/{NonFinancial\ Assets_{S.1M}}$

2.2.6 Corrections for under-reporting of deposits

As illustrated below, the coverage gap for household deposits in the HFCS as compared with the QSA is large in almost all countries. This may be due to a reluctance to provide correct or precise information in an interview, a lack of knowledge of current holdings of deposits (especially if held in several accounts) or timing differences between QSA and HFCS reference dates, (which could have a significant impact on low-value deposits in particular).

CHART 2: HFCS/QSA COVERAGE RATIOS OF DEPOSITS, HFCS WAVE 4



[20] This is obtained from the sum of two sub-equations:

1. $NonFinancial\ Business\ Wealth_{HFCS+Pareto\ Tail\ (\text{add rich})+Pop.adjustment} + Gap_{K2_A} = e \times NonFinancial\ Assets_{S.1M} - a \times Dwellings_{S.1M} + b \times (1-c) \times Total\ Land_{S.1M}$
2. $Financial\ Business\ Wealth_{HFCS+Pareto\ Tail\ (\text{add rich})+Pop.adjustment} + Gap_{K2_B} = UnlistedShares_{S.14} - d \times Real\ Estate\ Abroad$

The HFCS concept of financial business wealth is matched in the HFCS with the QSA instrument of unlisted shares and other equity (F.51M) after subtracting from the latter an estimate for dwellings owned abroad.

For the purpose of reconciling QSA and HFCS deposit data, a process has been designed to identify and correct low values of deposits reported in the HFCS which appear implausible in view of the following criteria:

- Deposits are not likely to be significantly lower than the reported monthly household income;
- At least some of the household portfolio should be in the form of deposits, even if the share is very small.
- Self-employed households report their business wealth data in net terms in the HFCS and so do not report business-related deposits separately; the QSA includes business-related deposits of those households.

a) Outliers as compared with income

Households with deposits of less than 10% of their monthly income are considered for a potential correction to their data. However, within this category of HFCS respondents, no adjustment is performed on households with very low income (i.e. annual gross income below €10,000) or those with credit card debt. These may have faced liquidity shortages, so very low deposit holdings are not implausible.

For other households reporting deposits of less than 1% of their monthly income, reported deposits are replaced with the average for households with a similar income, i.e. the weighted average deposit held by households with an income in the range of +/- €2,500 per year around the figure for the "outlier" household.

b) Outliers as compared with overall net wealth

It is possible for a household to own very low deposits at a given point in time, even though they have very large net wealth. However, households with an asset allocation showing less than 1% of total assets held in deposits are considered less plausible than others.

Within households in this category, no adjustment is performed on those plausibly facing shortages of liquid assets, i.e. holding mortgage or credit card debt. In such cases, total assets may be large due to a highly leveraged asset portfolio with a heavy weighting in housing, but only a very small percentage in deposits.

c) Outliers among self-employed households

In the HFCS, business wealth is reported as a net amount, i.e. total assets minus the debt related to business activities. When self-employed households report relatively low deposits, it is assumed that such netting plays a significant role, and data are adjusted.

More precisely, deposits of self-employed households are compared to those of employed households with incomes in a bracket of +/- €2500 per year. If the value for the self-employed household is lower than the average for employed households, it is replaced by this average value, under the assumption that

running a business requires liquid assets at least as high as those needed by average employed households.

As some households may be included in several of the three categories mentioned, only the largest of the three potential adjustments is implemented at the level of the individual household.

2.2.7 Adding rich households

Although household surveys aim to cover the whole population, they generally face difficulties in adequately capturing the richest households. This is because (i) these households are not sufficiently represented in the samples, and (ii) they tend not to reply to such surveys even if they are selected (unit non-response).

Most countries have implemented measures to remedy this by oversampling the very rich in the HFCS. However, not all have managed to do so (this is quite costly) and even where it could be done, the very top of the distribution is generally still not fully covered.[21]

The steps implemented to reconcile QSA with HFCS data involve estimating the wealth of very rich households and using the results to complement the HFCS dataset. In quantitative terms, this adjustment is the second most significant of the reconciliation steps used for DWA, after the final proportional allocation. The estimation process comprises four stages:

- *estimating the shape of the wealth distribution of the richest households;*
- *defining the intervals to be filled by estimated rich households (randomly drawn from the wealth distribution estimated in the first step);*
- *estimating the net wealth of these rich households added;*
- *estimating the liabilities and portfolio allocation of the rich households added.*

1. Estimating the shape of the distribution of the wealth of the richest households

A wide stream of economic literature considers that the top part of wealth distributions follows a Pareto distribution. Hence the missing wealth of rich households can be estimated based on a Pareto distribution fitted to the data available. Since the HFCS generally does not fully cover the wealthiest households, estimating the Pareto distribution solely on HFCS data usually leads to an underestimation of the upper tail. Vermeulen (2018) has shown that the estimation of the Pareto distribution improves significantly even when just a few very wealthy observations are added to the sample data. These are mostly available from "rich lists", i.e. lists of the richest households published in the press, such as Forbes World's Billionaires. Where better sources exist, the DWA use them.

---

[21] For more information on the measures taken by the HFCS to cover the wealthiest, see Section 4.3 of Household Finance and Consumption Network (HFCN) (2020a)).

The method of constructing the DWA follows this approach, i.e. it is assumed that the wealth of households above a certain threshold level follows a Pareto law. The first step therefore involves estimating a Pareto shape parameter from the data available. The cumulated distribution function (CDF) of the Pareto distribution (Type I) is given by:

$$F(w_i) = P(W \leq w_i) = \begin{cases} 1 - \left(\frac{\widetilde{w}_0}{w_i}\right)^{\alpha}, \text{for } w_i \geq \widetilde{w}_0 \\ 0 \qquad\qquad\quad, \text{for } w_i < \widetilde{w}_0 \end{cases}$$

where $\widetilde{w}_0, \alpha \in \mathbb{R}_{>0}$ are the scale and shape parameters of the Pareto distribution, respectively. The scale parameter $\widetilde{w}_0$ is a stochastic parameter, defined as the lowest wealth value observed in the survey exceeding a threshold $w_0 \in \mathbb{R}$, currently assumed to correspond to "millionaires" [22], i.e. $\widetilde{w}_0 = \min\{w_i | w_i > w_0\}$.

The approach involves estimating the shape parameter α from the sample of households surveyed by the HFCS (after the initial adjustments described above) where wealth is higher than or equal to $\widetilde{w}_0$ and observations from rich lists where available. The methodology is based on Vermeulen(2018) and is briefly summarised below.[23]

Let $w_1 \geq \cdots \geq w_n$ denote an ordered, independently and identically distributed (i.i.d.) sample. If the random variable w follows a Pareto distribution with scale parameter $\widetilde{w}_0 \in \mathbb{R}_{>0}$ and shape parameter $\alpha \in \mathbb{R}_{>0}$ then, from the Glivenko-Cantelli theorem, the empirical complementary cumulative distribution function (CCDF) approximates the CCDF of the given Pareto distribution almost certainly, provided n is large enough:

$$\frac{i}{n} \approx \left(\frac{w_{min}}{w_i}\right)^{\alpha}, \forall\, i = 1, \ldots, n$$

Adapting this approach to a complex survey setting, where each observation is associated with survey weights $d_1, \ldots, d_n \in \mathbb{R}_{>0}$, leads to[24]

$$\log\left(i\,\frac{\bar{d}_{fi}}{\bar{d}}\right) \approx \log\left(\frac{d}{\bar{d}}\right) + \alpha \log(w_{min}) - \alpha \log(w_i), \quad \forall\ i = 1, \ldots, n$$

---

[22] In practice, w_0 is set at €1 million for most countries.

[23] A growing share of the literature is devoted to the possibility of generalising this approach (see for instance Kennickell, 2021).

[24] For more information on the derivation, see Part III of Vermeulen (2018).

where

$$\bar{d} = \frac{1}{n}\sum_{j=1}^{n} d_j$$

$$\bar{d}_{fi} = \frac{1}{i}\sum_{j=1}^{i} d_j$$

As w_{min} is fixed before the estimation, it is constant, as are d and $\bar{d}$. Therefore, the first term can be collected into a constant, and α simply estimated using ordinary least squares (OLS):

$$\log\left(i\,\frac{\bar{d}_{fi}}{\bar{d}}\right) \approx \hat{C} - \hat{\alpha}\log(w_i)$$

Using the estimated constant $\hat{C}$, α can be reclaimed to show that the joint estimation of the parameters provides the same α. This can be considered a check as it only holds true under the rearrangement of the power law.[25]

2. Defining the intervals to be filled by estimated rich households

In many countries there is a large gap between the richest household sampled in the HFCS and the poorest observation of the rich list. Since it is implausible that there are no households with wealth in this interval, synthetic households are sampled within it from the estimated Pareto distribution to fill the gap where no observations are available. The size of the gap depends on the oversampling strategy applied by the HFCS and the national rich list available. Where the DWA national compilers deem it necessary, the add rich method draws additional net wealth observations from the estimated Pareto distribution, effectively extending the rich list.

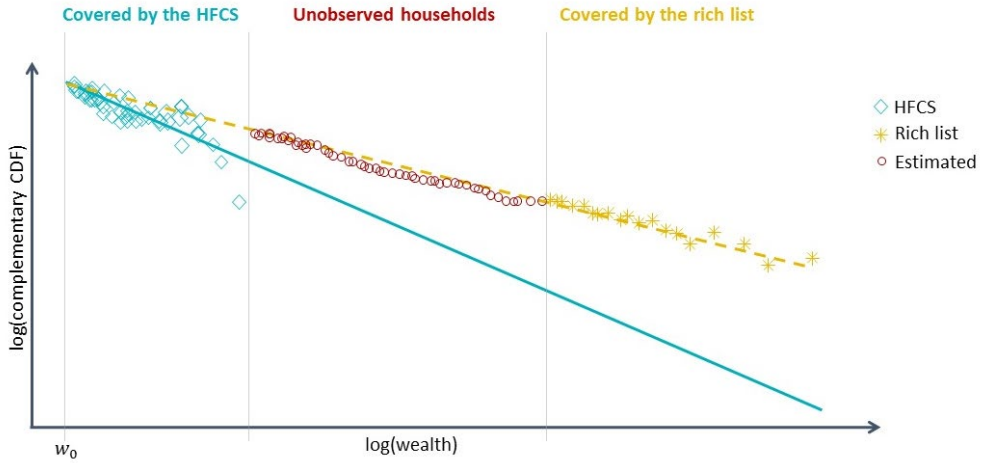
At the upper part of the net wealth distribution (i.e. above w_0), the following three distinct intervals can be identified:

- an interval that is usually well covered by the HFCS samples;
- an interval that in many countries is covered neither by the HFCS samples nor the rich list;
- an interval that contains the observations from the rich list.

[25] It may be noted that once the shape parameter α has been obtained, this information can be used in a number of ways, including to reweight existing survey observations (Blanchet et al., 2018) by adjusting individual weights by the ratio between the Pareto probability density function estimated with and without the use of auxiliary data for each recorded value of wealth. However, this process has not been incorporated into the baseline approach, as (i) it does not take into account the gap between the HFCS and the rich list, and (ii) it would mean changing the HFCS data referring to households with a certain level of wealth in order to adjust the data for richer households.

In a few countries, the second interval is extremely small (i.e. the least rich member of the rich list is nearly as rich as the richest household covered by the HFCS), due either to oversampling techniques applied in the HFCS to better cover rich households or to the availability of extensive rich lists. For most cases, however, it is substantial. The figure below shows a stylised illustration of the upper tail of the net wealth distribution, enhanced with synthetic households where necessary. The solid line represents the Pareto distribution fitted solely to the HFCS data, while the dashed line represents the Pareto distribution fitted to additional observations provided by the rich list as well.

CHART 3: STYLISED ILLUSTRATION OF THE UPPER TAIL OF THE NET WEALTH DISTRIBUTION



A sample of synthetic households is drawn from a Pareto distribution fitted to both the HFCS and the rich list, as represented in red in Chart 3 above.[26]

In other words, the support of the Pareto distribution, i.e. the interval $[w_0, \infty[$ is split into three intervals:

$$I_1 = [w_0, w_1],$$
$$I_2 =]w_1, w_2[,$$
$$I_3 = [w_2, \infty[,$$

for some $w_1, w_2 \in \mathbb{R}$ with $w_0 < w_1 < w_2$.

More precisely, for our data, we choose

$$w_1 := \max\{\text{household wealth in HFCS}\}$$

$$w_2 := \min\{\text{wealth in rich list}\}$$

To summarise:

$$I_1 = [\text{all HFCS households with wealth of at least } w_0],$$

$$I_2 =]\text{gap between HFCS observations and rich list}[,$$

$$I_3 = [\text{from the observations of the rich list to infinity}[,$$

[26] Chart 3 shows the case where the gap focuses on the second interval only. In cases where the rich list covers households with very heterogenous net wealth, or the top of the HFCS covers very few cases, notional households may be estimated in I_3 or I_1 as well.

Furthermore, we denote the number of households in interval I_i by m_i respectively for $i \in \{1,2,3\}$.

The total number of households in all intervals is denoted by m and given by

$$m = m_1 + m_2 + m_3.$$

We can observe the number of households m_1 in interval I_1, since it is the sum of the weights of the households in the HFCS with wealth of at least w_0. Likewise, the number of households m_3 in interval I_3 is given by the rich list (in practice, however, this value may be adjusted depending on the quality of the rich list). What is unknown is the number of households m_2 in interval I_2.

Let $\hat{m} \in \mathbb{N}$ denote an estimate for the total number of households in the Pareto distribution, m. If $\hat{m}$ random draws are taken from the Pareto distribution, the expected number of households in interval I_1 can be computed, giving $\hat{m}_1$:

$$\hat{m}_1 = \mathbb{E}\left[\sum_{i=1}^{\hat{m}} \mathbb{I}_{\{x_i \in I_1\}}\right]$$

Assuming the observations are i.i.d.[27], the summation can be simplified:[28]

$$\begin{aligned}
\hat{m}_1 &= \mathbb{E}\left[\sum_{i=1}^{\hat{m}} \mathbb{I}_{\{W_i \in I_1\}}\right] \\
&= \hat{m}\mathbb{E}\left[\mathbb{I}_{\{W_i \in I_1\}}\right], \text{ because i.i.d.} \\
&= \hat{m}P(W_1 \in [w_0, w_1]) \\
&= \hat{m}[P(W_1 \leq w_1)] \\
&= \hat{m}\left[1 - \left(\frac{w_0}{w_1}\right)^{\alpha}\right] \\
&= \hat{m}\frac{w_1^{\alpha} - w_0^{\alpha}}{w_1^{\alpha}}
\end{aligned}$$

Note that the only unknown variable in this equation is $\hat{m}$, as $\hat{m}_1$ is known, since it is simply the sum of the weights of the households in the HFCS with wealth of at least w_0[29]. Thus, the above equation can be reformulated to

$$\hat{m} = \hat{m}_1 \frac{w_1^{\alpha}}{w_1^{\alpha} - w_0^{\alpha}}.$$

and yields an estimate $\hat{m}$ for the total number of households.

---

[27] This is admittedly a simplification and further investigations are envisaged.

[28] However, given the use of complex survey design, future work will explore whether this simplification needs to be adjusted.

[29] In some cases, gaps are observed between the wealth of the observations at the top of the HFCS. For this reason, $\hat{m}1$ is actually calculated from w0 to the point in the HFCS interval where the first gap is observed (if any).

Using this estimate of the total population, it is straightforward to estimate $\hat{m}_2$:

$$\hat{m}_2 = \mathbb{E}\left[\sum_{i=1}^{\hat{m}} \mathbb{I}_{\{W_i \in I_2\}}\right]$$
$$= \hat{m} P(W_1 \in]w_1, w_2[)$$
$$= \hat{m}\left[\left(1 - \left(\frac{w_0}{w_2}\right)^{\alpha}\right) - \left(1 - \left(\frac{w_0}{w_1}\right)^{\alpha}\right)\right]$$
$$= \hat{m}\left[\left(\frac{w_0}{w_1}\right)^{\alpha} - \left(\frac{w_0}{w_2}\right)^{\alpha}\right]$$

This can be simplified by substituting $\hat{m}_1$ into the function for $\hat{m}_2$, making it a function of the sum of HFCS weights:

$$\hat{m}_2 = \hat{m}\left[\left(\frac{w_0}{w_1}\right)^{\alpha} - \left(\frac{w_0}{w_2}\right)^{\alpha}\right]$$
$$= \hat{m}_1 \frac{w_0^{\alpha} w_2^{\alpha} - w_0^{\alpha} w_1^{\alpha}}{w_1^{\alpha} w_2^{\alpha} - w_0^{\alpha} w_2^{\alpha}}$$

Once we have estimated the number of unobserved households in interval I_2, we can add these by randomly sampling them according to the given Pareto distribution. This process is described below.

3. Estimating the net wealth of the rich households added

The objective is to randomly draw households from a specific interval of the Pareto distribution:

We can draw $\hat{m}_2$ households from I_2 via inverse transform sampling. Let U~Unif $[F(w_1)\,;\, F(w_2)]$. Applying the inverse of the Pareto distribution $F^{-1}(U)$ yields random variables following the Pareto distribution in I_2. More precisely, $[F(w_1), F(w_2)] = \left[1 - \left(\frac{w_0}{w_1}\right)^{\alpha}, 1 - \left(\frac{w_0}{w_2}\right)^{\alpha}\right]$

and for $w \geq w_0$, the inverse of the Pareto distribution is given by the following. Let $F(w) \equiv y$. Then:

$$y = 1 - \left(\frac{w_0}{w}\right)^{\alpha}$$

$$\Leftrightarrow w = w_0 (1 - y)^{-\frac{1}{\alpha}}$$
$$\Rightarrow F^{-1}(y) = w_0 (1 - y)^{-\frac{1}{\alpha}}$$

4. Estimating the liabilities and portfolio allocation of the rich households added

As described above, the observations from the rich list and the synthetic households are given in terms of their net wealth. In order to estimate gross assets and liabilities, two further steps are required: (i) an estimation of the size of liabilities these households are most likely to hold, and (ii) an estimation of a realistic portfolio allocation, i.e. the instruments they are most likely to own.

Step (i): Estimating the liabilities held by the wealthiest households

In most countries the debt-to-asset ratio decreases when moving from the poorest to the richest deciles of net wealth. The process generally sets the debt-to-asset ratio for the rich added at a level between 5% and 10%.[30] The debt added is allocated between mortgage debt and other debt in proportion to the corresponding gaps between the HFCS and the QSA.

Step (ii) Estimating the instruments held by the wealthiest households

The total assets of all wealthy households added can be estimated from the previous step as follows:

$$estimated\ net\ wealth\ +\ liabilities\ attributed\ via\ step\ 1\ =\ total\ assets$$

A survey conducted in 2018 by UBS/Campden and published by "The Economist" estimated average portfolios for more than 300 households rich enough to have their wealth managed by a family office. This information, combined with the size of the gaps between the QSA and the HFCS for each instrument in each country, is used to estimate the allocation of the estimated total assets of the wealthiest households across the various instruments.[31]

2.2.8 Fitting the data to QSA results: final proportional allocation

The steps above partly close the gaps observed between the totals reported by the HFCS and the QSA but not fully. One final step reconciles the remaining difference. In the absence of information on distribution, a method is chosen that has no impact on the distribution at the level of individual instruments shown by the DWA (though it does impact the joint distribution of the different instruments).

Proportional allocation implicitly assumes a) all households under-report by the same proportion, and b) under-reporting behaviour is not correlated across instruments. A scale factor is calculated from the inverse coverage ratio:

$$\omega_x = \frac{x^{FA}}{\sum_{i=1}^{n} w_i x_i^{HFCS}}$$

All household holdings of instrument x are then adjusted by the scale factor to give new instrument holdings x_i', so the total of HFCS holdings of instrument x is equal to the respective QSA total:

$$x_i' = \omega_x x_i^{HFCS}$$

$$x^{FA} = \sum_{i=1}^{n} w_i x_i'$$

By construction, this yields 100% coverage of each instrument. It is important to note, however, that the approach changes the relative composition of household portfolios of instruments, since the coverage ratio

[30] The exact figure depends on country data and is set where the debt-to-asset ratio of the richest deciles broadly reaches these levels. In some cases, it is higher than the debt-to-asset ratio of the richest households covered in the HFCS, where this ratio appears particularly low compared with other countries.

[31] Some countries have more detailed information from local sources. In these cases, this is used instead.

(before adjustment) differs across instruments. Because of the proportional adjustment, the Gini coefficient therefore remains stable at the instrument level, but not necessarily at higher aggregation levels. This means that inequality measures for total assets, total liabilities and total net wealth may change due to the proportional allocation, though not for each individual instrument.

An alternative to this approach has been considered: the multivariate calibration. This method estimates the adjustment factor a_i to meet the benchmark constraints:

$$\boldsymbol{t_z} = \sum_{i=1}^{S} p_i a_i \boldsymbol{z_i}$$

where $\boldsymbol{t_z}$ is a k-dimensional vector of true population totals for a set of variables, $\boldsymbol{z_i}$ is a vector of k individual observations and p_i are the weights.

As the problem will have infinite solutions, the survey calibration specifies a criterion to minimise distortions from the original survey data:

$$\hat{t}_w^{cal} = \sum_{i=1}^{S} p_i a_i w_i$$

This method has not been incorporated in the baseline reconciliation process, however, mainly due to the fact that it duplicates the “add rich” step by increasing the weight of some rich households to minimise changes, and frequently requires a number of practical adjustments (e.g. bounds to the adjustments performed) to achieve convergence.

Finally, the proportional allocation is implemented in a specific manner for liabilities, as simple proportional allocation leads to an implausible increase in the negative net wealth of some households in the DWA. The following approach is therefore employed when fitting liabilities to QSA data:

1. Standard proportional allocation is performed (as for other instruments);
2. Observations with negative net wealth where liabilities have increased by more than assets in the previous step, are identified;
3. For these observations, the value of liabilities is taken before proportional allocation, and liabilities may only increase by as much as assets;
4. The previous step may create a new gap in liabilities. This is closed by rerunning the regular proportional allocation, applied only to unadjusted observations;
5. The previous step may again generate observations with negative wealth where liabilities have increased by more than assets, so an iteration is performed until no such cases recur.

3. Specific features of country and euro area data

The data for 18 euro area countries (Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Austria, Portugal, SIovenia, Slovakia and Finland) and one other EU Member State (Hungary) generally follow the baseline computation steps described in Section 2[32].

However, it should be kept in mind that the HFCS/QSA coverage ratios differ across countries, and the quality of each of the instrument breakdowns used in the process may vary by country or change over time. Furthermore, if supplementary information such as administrative data or other survey results is available at the national level, this may be included in the estimation process. For these reasons, several country-specific adaptations have been introduced, although in some cases they are implemented only on specific reference dates.

The main country features refer to (a) the use of different national results for specific instruments, (b) different micro-data sources, (c) adjustments to the process of reconciling the HFCS with the QSA. The latter covers: c1) skipping some steps from the baseline scenario, (c2) selecting wealth intervals to be filled by estimated rich households and (c3) other adjustments to the reconciliation process. Finally, as shown in sub-section (d), there are a few further country-specific features.

In addition, it should be kept in mind that for some countries, the QSA reference amounts for housing wealth and non-financial business wealth include estimations, when required components are not available or are voluntary items under the ESA transmission programme (see also Section 2.2.5).[33] Similarly, rich lists used to identify the added rich have been partly estimated for some reference dates on the basis of other reference dates, in particular where the quality/coverage was very uneven over time. Finally, it should be kept in mind that the portfolio allocation of the added rich is in all cases adapted to a certain extent to the size of the gaps in each instrument, as explained in Section 2.

(a) Changes to QSA reference values for specific instruments

While in general the DWA results match the published QSA data for each country and instrument, a few deviations have been introduced in specific cases. This is generally done in situations where specific weaknesses or uncertainties have been identified in the national QSA, but improvements are not possible for the time being, because no quarterly source is available, for instance, or work to improve the data is still under way. In such cases, the final aggregates for specific instruments are taken from different sources, in most cases the HFCS.

---

[32] The Netherlands publishes distributional accounts consistent with National Accounts totals for some years. These data are used as input for the DWA of the Netherlands, instead of the HFCS. The methodology applied for the DWA for the Netherlands in the ESCB dataset therefore differs from the methodology explained in this note.

[33] Detailed information is available in Sections 3.2. and 3.3. of Expert Group on Linking macro and micro data for the household sector (2020).

TABLE 2: ADJUSTMENTS TO QSA REFERENCE VALUES BY COUNTRY AND INSTRUMENT

Country	Instrument	Explanation
Belgium	Housing wealth	The QSA target value for housing wealth is replaced by the HFCS data since these are considered more accurate.
Germany	Financial business wealth	Unlisted shares and other equity issued by non-financial corporations in Germany are considered to be underestimated in the QSA. Hence, QSA data are adjusted to fully capture family-owned firms (estimated to be 90% of all German firms). To achieve this, the QSA target value is increased by a factor of 4.8 in the fourth quarter of 2017. In order to have a time series for the correction factor available, it is further assumed that the outstanding amount was correct in the fourth quarter of 1991, implying a correction factor of 1. Based on these two data points a correction factor time series is produced by linear interpolation/extrapolation.
Estonia	Housing wealth	The QSA target value for housing wealth is replaced by the HFCS data since these are considered more accurate.
Ireland	Housing wealth	The QSA target value for housing wealth is replaced by an estimate from the Irish Central Bank for housing assets[34] (with some small adjustments for housing abroad and NPISH), which is considered more accurate.
	Debt securities, investment fund shares	The QSA target values for debt securities and investment fund shares are replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate due to the absence of custodians inside the country.
	Non-financial business wealth	The QSA target values for non-financial business wealth is replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.
Cyprus	Deposits	QSA data are adjusted to remove deposits identified from the HFCS as held by non-residents and sole proprietors, which are included in the DWA as business wealth.

[34] See the Central Bank of Ireland website

	Non-financial business wealth, housing wealth	Based on information on other comparable countries, the split of housing wealth between land and dwellings is estimated to be 65% land and 35% dwellings.
Latvia	Housing wealth	Land underlying dwellings is estimated to represent around 20% of total land, which is the weighted average of the Baltic countries.
	Debt securities, investment fund shares, listed shares	The QSA target values for debt securities, investment fund shares and listed shares are replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate than the QSA data.
	Non-financial business wealth	Land not underlying dwelling is estimated to represent around 80% of total land, which is the weighted average of the Baltic countries.
Lithuania	Housing wealth	The QSA target value for housing wealth is replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.
	Debt securities and listed shares	The QSA target values for debt securities and listed shares are replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate due to the absence of custodians inside the country.
Luxembourg	Housing wealth	The QSA target value for housing wealth is replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.
Malta	Housing wealth	The QSA target value for housing wealth is replaced by the HFCS data, since these are considered more accurate.
	Non-financial business wealth	Based on information on other comparable countries, the value of housing wealth is assumed to be composed of 30% dwellings and 70% land. The HFCS data are taken for housing wealth; this assumption will therefore have an impact on the estimation of land not underlying dwellings, and hence on non-financial business wealth.

Portugal	Housing wealth	Land underlying dwellings is estimated to be in line with other countries, based on the ratios of (a) land underlying dwellings to total land, and (b) dwellings to total land.
	Financial business wealth	The QSA target value for financial business wealth is replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.
	Non-financial business wealth	The QSA target value for non-financial business wealth is replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.
Slovakia	Financial business wealth and housing wealth	The QSA target values for financial business wealth and housing wealth are replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.
Finland	Housing wealth, mortgages	The QSA target values for housing wealth and mortgages are replaced by the HFCS data plus an estimation for the added rich, since these are considered more accurate.

(b) Different micro-data sources

TABLE 3: USE OF DIFFERENT MICRO-DATA SOURCES

Country	Step	Explanation
Netherlands	Initial source	For most instruments, the household individual data used come from administrative records rather than a household survey[35].
Austria	Initial source	Split of life insurance policies from savings deposits is obtained from additional national HFCS information.
Finland	Initial source	For many instruments, the household individual data used come from administrative records rather than a household survey.

(c) Country adjustments to the DWA reconciliation process

(c1) Skipping some steps from the baseline scenario

In a few cases, some steps in the baseline scenario have been deemed inappropriate.

[35] The Netherlands publishes distributional accounts consistent with National Accounts totals for some years. These data are used as input for the DWA of the Netherlands, instead of the HFCS. The methodology applied for the DWA for the Netherlands in the ESCB dataset therefore differs from the general methodology explained in this note.

TABLE 4: CHANGES AND IMPROVEMENTS TO THE BASELINE ESTIMATION BY COUNTRY AND STEP

Country	Step	Explanation
Germany	Deposit adjustment	The deposit adjustment applied in the baseline method is not implemented (for all waves), as a proportional adjustment is deemed more appropriate.
Estonia	Deposit adjustment	The deposit adjustment applied in the baseline method is not implemented (for all waves) since the difference between the HFCS and QSA data for deposits is small and hence it is assumed that deposits are not significantly under-reported.
Italy	Deposit adjustment	An alternative method for adjusting deposits is implemented for all waves. The method can be summarised as follows: first, a subset of highly reliable households is selected by exploiting the data linkage with administrative records on fiscal incomes at the individual level; second, a relationship between deposits and some socio-demographic characteristics for the group of highly reliable households is estimated; third, the estimated coefficients are used to predict the value of deposits for the less reliable ones. Moreover, before the final proportional allocation step, calibration techniques are applied to match aggregate distributive information from banking supervisory reports.[36]
Cyprus	Add rich method	Contrary to most other countries, the data for Cyprus show totals larger in the HFCS than the QSA. For this reason, the add rich method is not implemented; the wealthiest households seem to be broadly covered.
Hungary	Deposit adjustment	The deposit adjustment applied in the baseline method is not implemented (for wave 3), since the difference between the HFCS and QSA data for deposits is small and hence it is assumed that deposits are not significantly under-reported.
Malta	Add rich method	Contrary to most other countries, the data for Malta show totals larger in the HFCS than the QSA. For this reason, the add rich method is not implemented; the wealthiest households seem to be broadly covered.
Austria	Deposit adjustment	The deposit adjustment applied in the baseline method is not implemented (for all waves), as a proportional adjustment is deemed more appropriate.

[36] More details can be found in Neri, A., Spuri, M. and Vercelli, F., 2023, "Combining survey and administrative data to estimate the distribution of household deposits", Occasional papers (Questioni di economia e finanza), no.802, Bank of Italy.

	Add rich method	Synthetic rich households are added starting from an explicit threshold of 500 EUR million, in order to ensure additional consistency across waves.

(c2) Selecting wealth intervals to be filled by estimated rich households

Based on the coverage of rich households in the HFCS (i.e. those with net wealth above the w_0 threshold, set at €1 million), the completeness of the national rich list and the gap between the HFCS and the rich list, estimated rich households can be added to the following intervals:

$$I_1 = [\text{all HFCS households with wealth of at least } w_0],$$

$$I_2 =]\text{gap between HFCS observations and rich list}[,$$

$$I_3 = [\text{from the observations of the rich list to infinity}[.$$

In other words, depending on the gaps observed in the source data in the three intervals, a decision has been made whether to estimate "notional" rich households in each of them.

TABLE 5: SYNTHETIC RICH HOUSEHOLDS ADDED BY INTERVAL, WAVE AND COUNTRY

Interval	wave	BE	DE	EE	IE	GR	ES	FR	IT	CY	LV	LU	LT	HU	MT	AT	PT	SK	FI
Add-rich	1					✓		·✓											✓
in	2							✓	✓									✓	✓
I 1	3							✓	✓		✓		✓						
	4							✓	✓				✓						
Add-rich	1	✓	✓		✓	✓		✓	✓					✓		✓	✓	✓	✓
in	2	✓	✓		✓	✓		✓	✓					✓		✓	✓	✓	✓
I2	3	✓	✓		✓	✓		✓	✓		✓			✓		✓	✓	✓	
	4	✓	✓		✓	✓		✓	✓		✓			✓		✓	✓	✓	
Add-rich	1	✓							✓								✓		
in	2								✓								✓		
I3	3	✓							✓		✓						✓		
	4								✓								✓		

(c3) Other adjustments related to the reconciliation process

Where analysis of country-specific sources shows very different features as compared with other countries, the reconciliation process takes this into account.

In particular, the portfolio allocation estimated for the added rich is generally based on the survey run by UBS/Campbell (as described in Section 2.2.7). However, given the limitations of this source it is in a few cases replaced by higher quality national sources or additional information:

TABLE 6: CHANGES TO THE PORTFOLIO ALLOCATION OF THE ADDED RICH BY COUNTRY AND INSTRUMENT

Country	Instrument	Explanation
Germany	Housing wealth and business wealth	The portfolio weightings of housing wealth and business wealth (both financial and non-financial business wealth) are adjusted to 20% and 60% respectively, to match results compiled by the German Institute of Economic Research (DIW) following an ad hoc survey of wealthy German households (SOEP-P). This yields a portfolio composition of millionaires in the DWA quite similar to the results presented by the DIW.
	All other instruments	The portfolio weighting of all other instruments is rescaled proportionally.
	All assets	The portfolio composition of millionaires published by the DIW in the SOEP-P data is used as a benchmark to estimate the allocation of added rich households to the various instruments.
Estonia	All	The standard portfolio of the added rich is adapted to reflect additional information available.
Greece	All	The threshold w_0 used to estimate the shape of the wealth distribution of the richest households is adjusted to €0.5 million.
Latvia	Non-financial business wealth	In wave 2, the portfolio weighting allocated to non-financial business wealth (where a significant gap is observed) is increased to 35%.
	Debt securities, investment fund shares and listed shares	In wave 2, the portfolio weighting allocated to holdings of debt securities, investment fund shares and listed shares is decreased to 1%.
	All other instruments	In wave 2, the portfolio weightings of all other instruments are rescaled accordingly.
Lithuania	All	The threshold w_0 used to estimate the shape of the wealth distribution of the richest households is adjusted to €0.5 million.

Austria	All	The portfolio allocation available from the SOEP-P survey carried out in Germany (see above) is used, as this better reflects the portfolio allocation of very rich Austrian households.
Slovakia	All	The threshold w_0 used to estimate the shape of the wealth distribution of the richest households is adjusted to €0.5 million.
	Listed shares	Portfolio weighting of listed shares are adjusted to 1% to allow for the low holdings of listed shares in Slovakia.
	All other instruments	The portfolio weighting of all other instruments are rescaled accordingly.

Finally, a number of additional adjustments related to the reconciliation process have been performed, generally to adapt to limitations in the coverage or quality of some sources, or to better take methodological discrepancies between the HFCS and QSA into account (such as the fact that business wealth tends to be reported on a net basis in the HFCS, while it should appear gross in the QSA):

TABLE 7: CHANGES TO THE BASELINE RECONCILIATION PROCESS BY COUNTRY AND INSTRUMENT

Country	Instrument	Explanation
Belgium	All	The estimation of the shape parameter α of the Pareto distribution used for the add rich method is performed only on wave 2 and then applied to the other periods also, due to a lack of rich list observations in other waves.
Estonia	Investment fund shares	Following the pension system reform implemented in 2021, pillar II of this system is no longer mandatory and pensions from pillar II were therefore reclassified from pension entitlements to investment fund shares in the QSA. To better reflect the distribution of investment fund shares in the DWA after the reform, the HFCS data on public pensions have been used in the QSA to produce the distribution for time series from the first quarter of 2021 onwards.
	All	The working status of the added rich is set to self-employed, as this is considered a good proxy based on the information available on households included in the rich list. (The working status breakdown represents the working status of the reference person only).
	Other debt	The HFCS data for other debt are enriched with additional data on leasing, which is not covered by the HFCS survey but included under the QSA definition of other debt.
	Mortgage debt, other debt	Since most mortgage debt to households is provided by MFIs, the split between mortgage debt and other debt is adjusted so as to set the former to the amount shown in MFI balance sheet statistics; the residual amount of QSA data on households' loan liabilities has been assigned to other debt.
Greece	Business wealth	All steps to link business wealth data to QSA are carried out after pooling the two components of business wealth in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split before the final grossing up according to the proportions in the QSA.

Spain	Business wealth	All steps to link business wealth data to QSA are carried out after pooling the two components of business wealth in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split before the final grossing up (and the "undoing netting" adjustment described below) according to the proportions in the QSA.
	Non-financial business wealth, other debt	Since the HFCS-QSA gap in non-financial business wealth is large compared to other countries, the QSA target values for non-financial business wealth and other debt are adjusted based on the assumption that other debt is in fact netted out from non-financial business wealth in the HFCS data. The reason for this is that liabilities pertaining to business activities are recorded as other debt in the QSA, but embedded in the net value of private businesses in the HFCS, which results in a wider gap for both instruments. Under this "undoing netting" approach, two thirds of the gap in other liabilities (remaining after the add rich step) is attributed to non-financial business wealth holders from the HFCS (i.e. excluding the added rich): this proportion aims to broadly reflect the proportion of "other debt" not related to consumer loans and deemed to cover mainly business-related debt. The same amounts are added to the non-financial business wealth of the same observations.
France	Business wealth	All steps to link business wealth data to QSA are carried out after pooling the two components of business wealth in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split before the final grossing up (and the "undoing netting" adjustment described below) according to the proportions in the QSA.
Cyprus	Financial business wealth and investment fund shares	The final proportional allocation is modified for financial business wealth and investment fund shares to reduce non-zero observations in the top quintile only; the HFCS shows large amounts for that quintile, covering very few respondents, hence the data for these instruments might not be as reliable as in the other quintiles.

Italy	Non-financial business wealth, other debt	Since the HFCS-QSA gap in non-financial business wealth is large compared to other countries in waves 1 to 3, the QSA target values for non-financial business wealth and other debt are adjusted based on the assumption that other debt is in fact netted out from non-financial business wealth in the HFCS data. The reason for this is that liabilities pertaining to business activities are recorded as other debt in the QSA but embedded in the net value of private businesses in the HFCS, which results in a wider gap for both instruments. Under this "undoing netting" approach, two thirds of the gap in other liabilities (remaining after the add rich step) is attributed to non-financial business wealth holders from the HFCS (i.e. excluding the added rich): this proportion aims to broadly reflect the proportion of other debt not related to consumer loans and deemed to cover mainly business-related debt. The same amounts are added to the non-financial business wealth of the same observations. However, this method is not used in wave 4 as the gap in non-financial business wealth is not large.
Lithuania	Business wealth	All steps to link business wealth data to QSA are carried out after pooling the two components of "business wealth" in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split before the final grossing up according to the proportions in the QSA.
Luxembourg	Business wealth	All steps to link business wealth data to QSA are carried out after pooling the two components of "business wealth" in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split before the final grossing up according to the proportions in the QSA.
Hungary	Housing wealth	The adjustment to sources on housing wealth is not performed, since the housing wealth totals (which are larger in the HFCS) are deemed to provide a good estimate of holdings by households excluding NPISH.
	Business wealth	In wave 4, all steps to link business wealth data to QSA are carried out after pooling the two components of business wealth in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split

		before the final grossing up according to the proportions in the QSA.
Portugal	Business wealth	All steps to link business wealth data to QSA are carried out after pooling the two components of "business wealth" in the HFCS data, i.e. financial business wealth (corresponding to the QSA concept of unlisted shares and other equity) and non-financial business wealth. The pooled business wealth is then split before the final grossing up according to the proportions in the QSA.
Slovakia	Alpha parameter	The estimation of the shape parameter α of the Pareto distribution used for the add rich method is performed on waves 1 and 3 and then applied to wave 2, as a result of a number of limitations affecting the wave 2 data.

(d) Other country-specific features

TABLE 8: OTHER COUNTRY SPECIFIC FEATURES

Country	Instrument	Explanation
Estonia	Investment fund shares	Following the pension system reform implemented in 2021, pillar II of this system is no longer mandatory and pensions from pillar II were therefore reclassified from pension entitlements to investment fund shares in the QSA. To better reflect the distribution of investment fund shares in the DWA after the reform, the HFCS data on public pensions have been used in the QSA to produce the distribution for time series from the first quarter of 2021 onwards.
Latvia	Debt securities, investment fund shares, listed shares and deposits	The HFCS values in wave 3 for debt securities, investment fund shares, listed shares and deposits are adjusted based on more reliable data from wave 4.

Luxembourg	All	The results of the 2021 HFCS (i.e. wave 4) are only comparable with previous waves to a limited extent due to a number of methodological changes. First, in contrast to previous waves, the 2021 survey included residents employed in extraterritorial institutions (the EU Institutions, NATO, etc.), who represent around 10% of the total population. This improves the coverage of the target population, but these households differ from other households in Luxembourg in several important respects: they tend to have higher net wealth, mainly due to the value of financial assets invested in listed stocks and mutual funds, and over half of them rent their current residence, in contrast to 32% of other households resident in Luxembourg. Second, the pandemic required a shift in the survey method from computer assisted personal interviewing (CAPI) to computer-assisted web interviewing (CAWI), resulting in a significantly reduced response rate. This change likely influenced sample composition, with a greater proportion of highly educated households participating in the 2021 survey. The weighting procedure is not able to correct all dimensions of the selection process. Finally, one section was modified in 2021 to take better account of country-specific factors, resulting in a substantial increase in participation rates from 2018 to 2021.
Netherlands	Pension entitlements	The Netherlands publishes distributional accounts consistent with National Accounts totals for some years now. These data are the basis for the DWA results as well. Wealth components that are not used in the DWA common wealth concept are filtered out of the dataset (most importantly pension entitlements), and the output in terms of background characteristics and frequency is constructed using the standard DWA methodology.

4. Computing time-series

Four waves of the HFCS are currently available, approximately covering the years 2010, 2014,2017 and 2021. To produce quarterly DWA covering the periods between HFCS waves and show trends as observed in the QSA, a model for interpolation/extrapolation is applied by combining detailed information from the HFCS periods with aggregate quarterly changes of the components of wealth as reported in the QSA.

The relative stability of the HFCS results across subsequent waves supports the assumption that the distribution of wealth generally only changes slowly. Changes in the distribution of wealth between two periods can be caused by changes due to transactions and by the revaluation of the holdings of wealth. In both cases, the changes in wealth holdings recorded in the aggregate QSA also provide relevant information for deriving quarterly DWA. For example, a strong increase in share prices will change the interpolated or extrapolated distribution of net wealth towards the typically wealthier households that hold shares. However, no information can be derived from the QSA regarding possible changes in household participation rates in a given financial instrument, if the household investor base in a financial instrument changes significantly between two periods, for instance. Information on the latter changes are only available from the following HFCS wave.

Quarterly estimates of finer measures of inequality, such as the Gini coefficient, can only be obtained by applying the interpolation and extrapolation approach to the micro dataset.

- *Interpolating micro data between HFCS waves*

Let t_1 and t_2 denote two consecutive HFCS reference dates (e.g. the fourth quarter of 2010 and the fourth quarter of 2014) and let $t_1 \leq t_1 + l\,\delta \leq t_2$. Moreover, let $n(t)$ be the number of households in the micro dataset as time point t.[37] To obtain the distribution of the interpolated data for time point $t_1 + l\,\delta$, information from both time points, t_1 and t_2, needs to be taken into consideration. With this, the sample at time point $t_1 + l\,\delta$ includes $n(t_1) + n(t_2)$ households, i.e. all households from the two consecutive micro datasets, with the weights and shares of household holdings of each instrument interpolated accordingly.

Interpolated weights $d_i(t_1 + l\,\delta,)$ for household i at time point $t_1 + l\,\delta$ are obtained with a linear interpolation factor, such that the weights assigned to the "preceding" observations decrease linearly and vice versa for the "subsequent" observations. They are also adjusted such that the total population varies linearly between the two HFCS wave periods.

In this way, for period $t_1 + l\,\delta$ the weights for observations from the "preceding" and "subsequent" datasets are given by, respectively,

$$d_i(t_1 + l\,\delta) = \frac{d_i(t_1)}{\sum_{i=1}^{n(t_1)} d_i(t_1)}\, d_{total}(t_1 + l\,\delta)\, \frac{l\,\delta}{t_2 - t_1}$$

and

$$d_{n(t_1)+i}(t_1 + l\,\delta) = \frac{d_i(t_2)}{\sum_{i=1}^{n(t_2)} d_i(t_2)}\, d_{total}(t_1 + l\,\delta) \left(1 - \frac{l\,\delta}{t_2 - t_1}\right)$$

where $d_{total}(t_1 + l\,\delta)$ denotes the total household population for the interpolated time point, given by a linear interpolation of the population total of both reference dates, i.e.

[37] Of course, the notation introduced should not be interpreted as a certain household i appearing in all waves. In other words, i at t_1 and at t_2 refer to two different households, having comparable rankings in their respective HFCS waves.

$$d_{total}(t_1 + l\,\delta) = \left[\sum_{i=1}^{n(t_1)} d_i(t_1)\right] + l\,\delta \left\{\left[\sum_{i=1}^{n(t_2)} d_i(t_2)\right] - \left[\sum_{i=1}^{n(t_1)} d_i(t_1)\right]\right\}.$$

Let $\tilde{x}_{ij}(t)$ denote the share of household i's holdings in instrument j at time point t, i.e.

$$\tilde{x}_{ij}(t) = \frac{x_{ij}(t)}{\sum_{i=1}^{n(t)} d_i(t)\, x_{ij}(t)} = \frac{x_{ij}(t)}{T_j(t)},$$

where $x_{ij}(t)$ denotes the holdings of household i in instrument j at time point t and $d_i(t)$ the corresponding household weight.

The shares of household holdings at time point $t_1 + l\,\delta$ are adjusted such that the total population varies linearly between the two micro dataset periods:

$$\tilde{x}_{ij}(t_1 + l\,\delta) = \frac{x_{ij}(t_1)}{T_j(t_1)} \frac{\sum_{i=1}^{n(t_1)} d_i(t_1)}{d_{total}(t_1 + l\,\delta)}$$

and

$$\tilde{x}_{n(t_1)+\,i,j}(t_1 + l\,\delta) = \frac{x_{i,j}(t_2)}{T_j(t_2)} \frac{\sum_{i=1}^{n(t_2)} d_i(t_2)}{d_{total}(t_1 + l\,\delta)}.$$

Following the above equations, the weighted shares of household holdings at time point $t_1 + l\,\delta$ could be then calculated as:

$$\tilde{x}_{ij}(t_1 + l\,\delta)\;\; d_i(t_1 + l\,\delta) = \frac{x_{ij}(t_1)\, d_i(t_1)}{T_j(t_1)} \frac{l\,\delta}{t_2 - t_1}$$

and

$$\tilde{x}_{n(t_1)+\,i,j}(t_1 + l\,\delta)\;\; d_i(t_1 + l\,\delta) = \frac{x_{\,i,j}(t_2)\, d_i(t_2)}{T_j(t_2)} \left(1 - \frac{l\,\delta}{t_2 - t_1}\right).$$

Finally, by multiplying the interpolated household shares $\tilde{x}_{ij}(t)$ with the corresponding QSA instrument totals, a complete adjusted micro dataset is achieved.

- *Extrapolating from the most recent HFCS to the latest available QSA*

In the absence of more recent data on the distribution of asset holdings, distributional time series for the latest quarters are computed based on the last available HFCS wave. This provides a first indication of how recent aggregate developments might have impacted the distribution of wealth, with the caveats mentioned above.

More precisely, if t_2 denotes the latest available HFCS wave, the shares for any subsequent time point $t_2 + l\delta\; > t_2$, for which the QSA instrument totals are available, is given by

$$\tilde{x}_{ij}(t_2 + l\,\delta) = \tilde{x}_{ij}(t_2)$$

5. Computing euro area aggregates

Euro area DWA aggregates are computed by merging the estimated DWA data computed for each country. The following features may be highlighted:

- DWA data are computed for all euro area countries.
- The method used by the ECB to compute the data for the 20 euro area countries included in the euro area aggregate closely follows the baseline approach described in Section 2.2. .
- Finally, as the euro area QSA are not exactly equal to the sum of the QSA country data, the sum of the DWA data computed for the 20 euro area countries is slightly adjusted to fit with the euro area aggregates available from the QSA.

a) Incorporating country data into the euro area aggregates

Due to issues with the sharing of micro data sources, the euro area aggregates do not always incorporate exactly the same micro data as used at country level. However, the differences are expected to be very limited.

b) Adjusting to fit with the actual euro area aggregates

The QSA for the euro area does not simply consist of the sum of the figures for the individual countries but is subject to certain balancing adjustments needed to compile sector accounts which show consistent results for all sectors. Therefore, the aggregated euro area micro dataset also needs to be adjusted to properly match the euro area QSA. Since these adjustments are generally fairly minor, a simple proportional adjustment for each instrument has been implemented.

More precisely, the holdings of all euro area households i=1,2,…,n (where n denotes the sum over all households given by interpolation and across all euro area countries) are adjusted for each instrument j by

$$x_{ij}^{(new)} = x_{ij} \frac{T_j^{EA}}{\sum_{i=1}^{n} d_i \, x_{ij}},$$

where $T_j^{EA} \in \mathbb{R}_{>0}$ denotes the euro area total of instrument j given by the QSA and d_i the household weights (adjusted to the QSA population total, as explained in Section 3.1.3).

6. Sensitivity analysis

Given that the process to link HFCS data with the QSA inevitably makes use of several assumptions, various simulations were performed to assess the variability of the results depending on these assumptions.
The scenarios considered in this exercise covered a range of alternatives, focusing on plausible scenarios.

Two rounds of sensitivity analysis were conducted on the data:

- one in autumn 2021 involving nearly 90 scenarios, but covering only the 12 countries closely involved in the project at that time – the results are summarised in Annex 1;
- another in November 2023 covering 19 countries[38] but using a reduced set of scenarios.

The scenarios that were tested in November 2023 were the following:[39]

- *Alternatives to the linking method applied for DWA:*
  - pure HFCS data were used;[40]
  - the differences between HFCS and QSA were allocated on a purely proportional basis, instrument by instrument.

- *Changes to the parameters (or computation) applied in the DWA linking steps:*
  - changes were made to the add rich method – the alpha parameters of the Pareto distribution were amended to the maximum and minimum typically observed across countries,[41] as too were the intervals where notional rich households are added (this was done at all three possible intervals, i.e. at the top of HFCS data, between the rich list and the HFCS, and within the rich list).

- *Changes to computations applied in the linking step:*
  - adjustments were applied to non-financial business wealth and other debt based on the assumption that the gap in other liabilities is mainly because business wealth is reported in net terms in the HFCS;[42]

[38] All countries except Croatia and the Netherlands.

[39] All scenarios used were deemed sub-optimal compared with the DWA actual results.

[40] Pure HFCS data refer to the survey data as available, focusing on the DWA wealth concept but without making any further adjustment.

[41] The maximum and minimum values applied were computed as the mean value plus/minus one standard deviation in the observed alpha values.

[42] Under the assumption that non-financial business wealth is reported net of corresponding liabilities, new values for business wealth and other liabilities were simulated by increasing these two items (namely, adding a fraction of the gap in other liabilities).

- calculations on financial and non-financial business wealth were computed as one total figure for business wealth, and the final results split based on the QSA proportions (instead of grossing up financial and non-financial business wealth as two independent instruments);
- liabilities were not grossed up on a fully proportional basis, but assuming under-reporting by the richest deciles (with different proportions for the richest three deciles).

In other words, the exercise involved similar simulations as in autumn 2021, the main exception being the changes in HFCS source data. These were not repeated, as they require more time and had not led to any specific issues being identified in 2021.

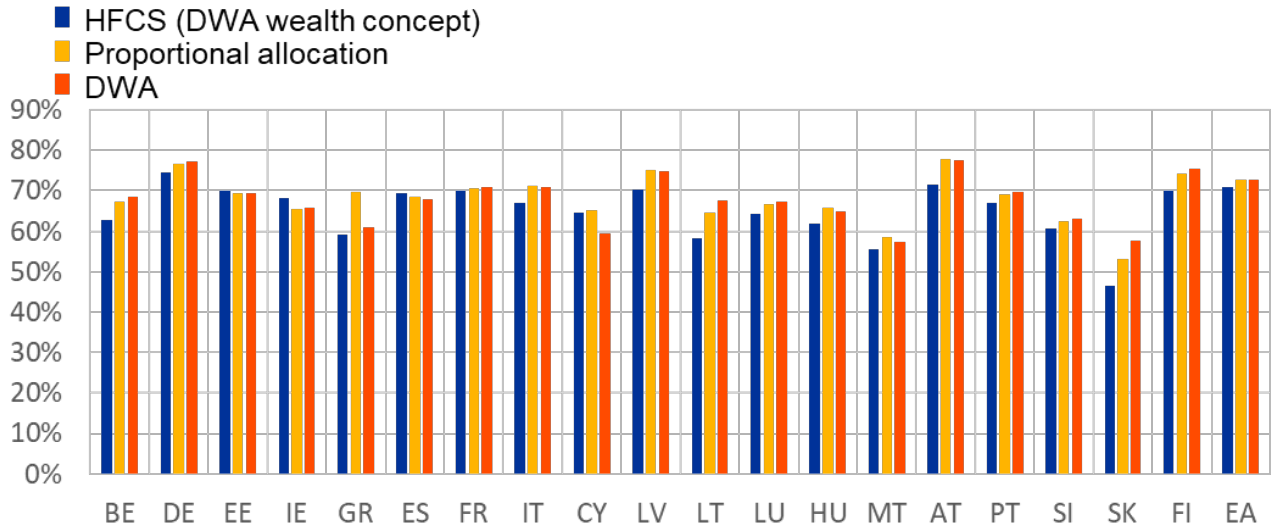
Results

Similar to the exercise performed in autumn 2021 (described in Annex 1), results did not change substantially when the alternative scenarios were applied.

The comparison between DWA results and (i) HFCS and (ii) pure proportional allocation shows two categories of countries:

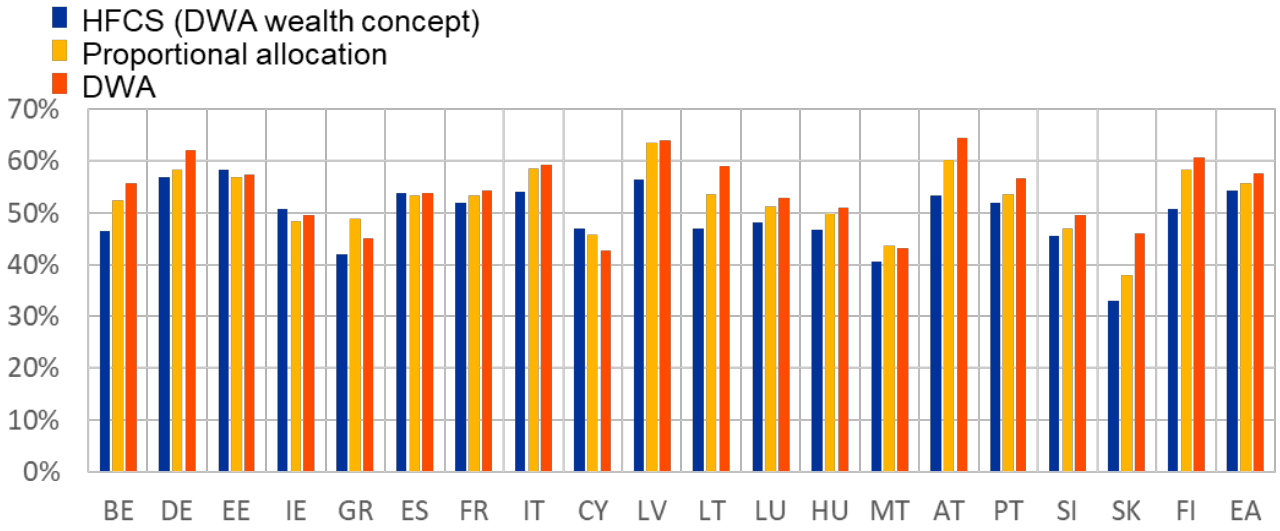
- in many cases DWA results are close to the pure proportional allocation;
- however, for other countries the pure proportional allocation leads to a very high increase in inequality as measured by the Gini coefficient: in these cases the DWA results are often much closer to the HFCS starting point.

CHART 4: COMPARISON DWA - HFCS - PROPORTIONAL ALLOCATION. CHANGES IN GINI COEFFICIENT FOR WAVE 4



Similarly, for the share of wealth held by the richest decile the DWA results are often close to the proportional allocation, except in a few countries where the amounts are significantly higher. In addition, for a few other countries the DWA results are slightly higher than with both HFCS data and proportional allocation.

CHART 5: COMPARISON DWA - HFCS - PROPORTIONAL ALLOCATION
PERCENTAGE OF TOTAL NET WEALTH BY THE RICHEST DECILE FOR WAVE 4



Running the DWA compilation process with various parameters also gives result very similar to those observed in autumn 2021, i.e. there are only limited changes in the final outcome. The following tables summarise the results for Gini coefficients, net wealth held by the richest decile and net wealth held by the poorest 50% households in wave 4 for all countries.[43]

[43] Except the Netherlands, for which the micro data do not come from the HFCS, and Croatia, for which no data are currently compiled, and Hungary.

Overall, the Gini coefficient results are generally within a range of 4% or less.

TABLE 9 - SENSITIVITY ANALYSIS - GINI COEFFICIENTS (WAVE 4)

	DWA as disseminated	Average	Min	Max	Range Max-Min (p.p.)	Max - DWA (p.p.)	DWA - Min (p.p.)
SK	57.5%	57.0%	55.2%	59.2%	4.1%	1.8%	2.3%
LT	67.4%	67.8%	67.1%	70.9%	3.8%	3.5%	0.3%
BE	68.6%	68.7%	67.8%	71.0%	3.2%	2.4%	0.8%
IT	70.9%	71.1%	70.6%	73.6%	3.0%	2.7%	0.3%
MT	57.4%	57.2%	55.8%	58.5%	2.7%	1.1%	1.6%
PT	69.8%	69.8%	68.9%	71.3%	2.4%	1.4%	1.0%
SI	63.2%	63.3%	62.2%	64.4%	2.2%	1.2%	1.0%
AT	77.4%	77.3%	76.1%	78.2%	2.1%	0.8%	1.3%
LU	67.4%	67.5%	67.0%	69.0%	2.0%	1.6%	0.4%
GR	60.9%	60.9%	60.2%	62.0%	1.8%	1.1%	0.7%
CY	59.6%	59.4%	58.4%	60.2%	1.8%	0.6%	1.1%
EA	72.8%	72.8%	72.2%	73.7%	1.5%	0.9%	0.6%
DE	77.3%	77.3%	76.3%	77.8%	1.5%	0.5%	1.0%
IE	65.7%	65.7%	64.9%	66.3%	1.3%	0.6%	0.8%
FR	70.7%	70.6%	69.9%	71.3%	1.3%	0.5%	0.8%
FI	75.3%	75.4%	75.1%	76.1%	1.0%	0.9%	0.1%
HU	65.0%	65.0%	64.5%	65.4%	0.9%	0.4%	0.5%
LV	74.8%	74.9%	74.5%	75.3%	0.8%	0.5%	0.3%
EE	69.5%	69.6%	69.2%	69.9%	0.7%	0.4%	0.2%
ES	67.9%	67.9%	67.5%	68.1%	0.5%	0.2%	0.4%

The results on the net wealth of the richest decile range increase by as much as 5.2 percentage points for one country, but the figure is generally below 3 percentage points.

TABLE 10 - SENSITIVITY ANALYSIS - NET WEALTH BY THE RICHEST DECILE (WAVE 4)

	DWA as disseminated	Average	Min	Max	Range Max-Min (p.p.)	Max - DWA (p.p.)	DWA - Min (p.p.)
SK	45.9%	45.5%	42.9%	48.1%	5.2%	2.2%	3.0%
LT	59.0%	59.5%	58.7%	63.3%	4.6%	4.3%	0.3%
BE	55.8%	56.1%	54.7%	59.1%	4.4%	3.3%	1.1%
IT	59.2%	59.6%	58.8%	63.0%	4.2%	3.9%	0.3%
AT	64.5%	64.3%	62.3%	65.6%	3.3%	1.1%	2.2%
PT	56.6%	56.6%	55.5%	58.6%	3.0%	2.0%	1.0%
MT	43.2%	43.1%	42.2%	44.8%	2.6%	1.6%	0.9%
DE	62.2%	62.1%	60.6%	63.0%	2.4%	0.8%	1.7%
LU	53.0%	53.2%	52.8%	55.2%	2.4%	2.3%	0.2%
SI	49.6%	49.9%	49.1%	51.4%	2.3%	1.7%	0.6%
GR	45.0%	45.2%	44.4%	46.6%	2.2%	1.6%	0.6%
EA	57.7%	57.8%	57.0%	59.1%	2.1%	1.4%	0.7%
CY	42.8%	42.7%	42.0%	43.7%	1.7%	0.9%	0.8%
FI	60.8%	61.0%	60.6%	62.0%	1.4%	1.2%	0.2%
FR	54.3%	54.3%	53.9%	55.1%	1.3%	0.8%	0.5%
IE	49.5%	49.7%	49.2%	50.4%	1.2%	0.8%	0.4%
HU	50.9%	51.0%	50.7%	51.6%	1.0%	0.7%	0.3%
EE	57.3%	57.4%	57.2%	58.0%	0.8%	0.7%	0.1%
LV	64.0%	64.1%	63.8%	64.5%	0.7%	0.5%	0.2%
ES	53.8%	53.8%	53.7%	54.0%	0.4%	0.2%	0.2%

The net wealth held by the poorest decile is in a range of up to 2.2%.

TABLE 11 - SENSITIVITY ANALYSIS - NET WEALTH HELD BY THE POOREST 50% (WAVE 4)

	DWA as disseminated	Average	Min	Max	Range Max-Min (p.p.)	Max - DWA (p.p.)	DWA - Min (p.p.)
SK	14.6%	14.9%	14.1%	16.3%	2.2%	1.6%	0.6%
MT	13.2%	13.4%	13.0%	14.5%	1.5%	1.3%	0.3%
LT	11.0%	10.9%	9.7%	11.3%	1.5%	0.3%	1.2%
BE	8.2%	8.2%	7.5%	8.8%	1.3%	0.6%	0.7%
PT	7.3%	7.4%	7.0%	8.1%	1.1%	0.7%	0.4%
SI	10.6%	10.7%	10.3%	11.3%	1.0%	0.7%	0.3%
CY	11.4%	11.5%	11.1%	12.1%	1.0%	0.8%	0.2%
IT	7.5%	7.5%	6.9%	7.8%	0.8%	0.2%	0.6%
LU	8.1%	8.1%	7.7%	8.4%	0.7%	0.3%	0.4%
IE	8.1%	8.2%	8.0%	8.7%	0.7%	0.5%	0.1%
GR	10.9%	11.0%	10.6%	11.3%	0.6%	0.4%	0.3%
FR	5.0%	5.1%	5.0%	5.6%	0.6%	0.6%	0.1%
HU	9.6%	9.7%	9.6%	10.0%	0.4%	0.4%	0.1%
EA	4.9%	5.0%	4.8%	5.4%	0.6%	0.4%	0.2%
DE	2.4%	2.5%	2.3%	2.8%	0.4%	0.3%	0.1%
AT	3.5%	3.5%	3.3%	3.7%	0.4%	0.2%	0.2%
ES	8.2%	8.2%	8.1%	8.4%	0.3%	0.3%	0.0%
LV	6.0%	6.0%	6.0%	6.2%	0.3%	0.2%	0.0%
EE	7.9%	7.9%	7.8%	8.1%	0.2%	0.2%	0.1%
FI	4.1%	4.0%	3.9%	4.1%	0.2%	0.0%	0.2%

All in all, the sensitivity analysis carried out so far suggests that the choice of parameters used does not lead to major differences in the results, and that the DWA results are plausible as compared with HFCS and proportional allocation methods. Further exercises should be run in future.

Annex 1: Sensitivity analysis performed in autumn 2021

This exercise was conducted on the 12 countries involved in the project at the time.

The alternative scenarios considered for these simulations may be summarised as follows:

- *Alternatives to the linking method applied for DWA:*
  - pure HFCS data were used;[44]
  - the differences between HFCS and QSA were allocated on a purely proportional basis, instrument by instrument.

- *Changes to parameters (or computation) applied in the DWA linking steps:*
  - changes to the thresholds applied in the deposits adjustment: the R-code adjusted holdings of households with deposits of less than 10% of their income, and those with deposits of less than 1% of their wealth. A range of different thresholds were applied.
  - changes to the add rich method: the alpha parameters of the Pareto distribution were amended to the maximum and minimum typically observed across countries, as too were the intervals where notional rich households are added (rich households were added at all three possible intervals, i.e. at the top of HFCS data, between the rich list and the HFCS and within the rich list).

- *Changes to computations applied in the linking step:*
  - adjustments were applied to non-financial business wealth and other debt based on the assumption that the gap in other liabilities is mainly because business wealth is reported in net terms in the HFCS.[45]
  - calculations on financial and non-financial business wealth were computed as one total for business wealth, and the results split based on the QSA proportions (instead of grossing up financial and non-financial business wealth as two independent instruments).
  - liabilities were not grossed up on a fully proportional basis, but assuming under-reporting by the richest deciles (with different proportions for the richest three deciles).

- *Changes to selected individual replies in the HFCS:*
  - adjustments were made to the instruments generally showing the largest discrepancies with QSA,[46] i.e. housing wealth, non-financial business wealth, deposits, mortgage debt and other debt. HFCS data were multiplied by coefficients ranging from 2 to 5 for a varying proportion of

[44] Pure HFCS data refers to the survey data as available, focusing on the DWA wealth concept but without making any further adjustment.

[45] Under the assumption that non-financial business wealth is reported net of corresponding liabilities, new values for business wealth and other liabilities are simulated by increasing these two items (namely adding a fraction of the gap in other liabilities).

[46] i.e. the largest actual gaps.

randomly selected answers to the HFCS questionnaire, for all deciles. The agreed linking process was then run to close the remaining gaps.

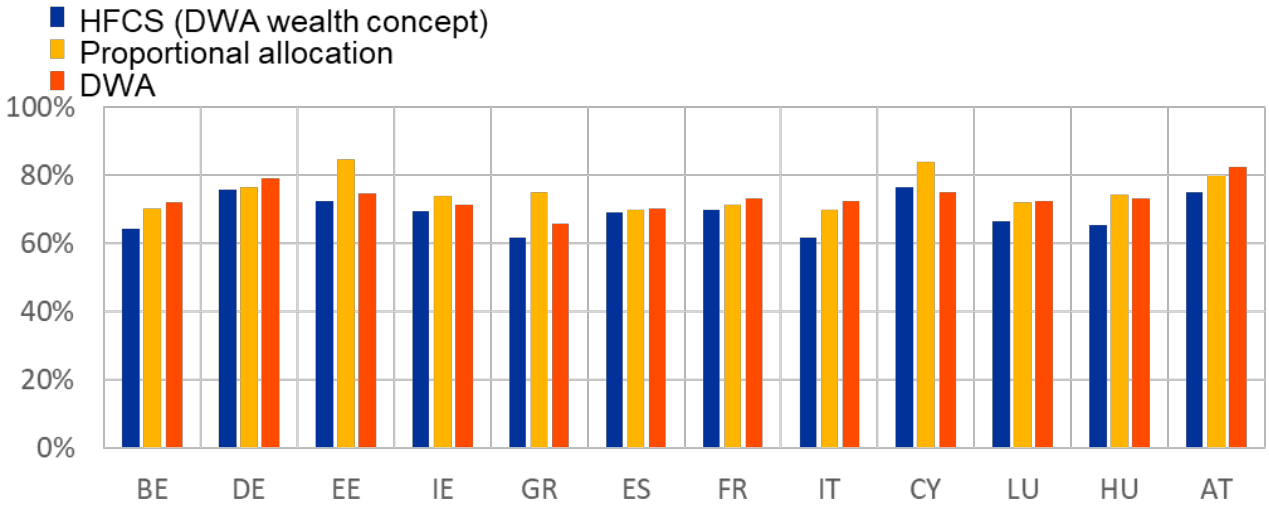
These scenarios aimed to assess how stable the DWA results were when parameters or input data were changed. The results depended not only on the DWA data, but also the scenarios selected. What they indicate is not so much the accuracy of the results, more their stability and sensitivity to changes in assumptions, parameters or source data.

Results

The comparison between DWA results and (i) HFCS and (ii) pure proportional allocation produced two categories of countries:

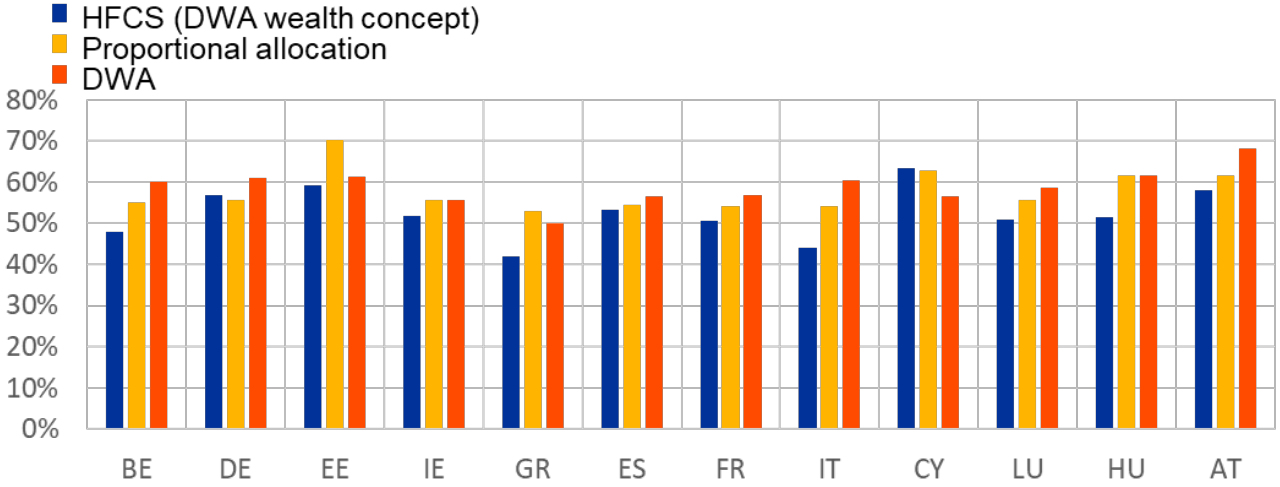
- in many cases, DWA results were close to the pure proportional allocation;
- however, for other countries, the pure proportional allocation led to a very high increase of inequality as measured by the Gini coefficient – in these cases, the DWA results were much closer to the HFCS starting point.

CHART 6 - COMPARISON DWA - HFCS - PROPORTIONAL ALLOCATION. CHANGES IN GINI COEFFICIENT FOR WAVE 3



A relatively similar picture was observed when focusing on the net wealth held by the richest decile. However, in a few countries, the published data showed a higher gap between the DWA results and the proportional method.

CHART 7 - COMPARISON DWA - HFCS - PROPORTIONAL ALLOCATION
PERCENTAGE OF TOTAL NET WEALTH BY THE RICHEST DECILE – WAVE 3



As described above, the other comparisons performed involved simulations of the compilation process with different parameters (about 20 cases) or random changes to the source data (about 70 cases). The range of results was generally quite limited, except in a very few cases which showed a larger band. As expected, the countries with the largest initial gaps and/or limited information about the rich list showed less stable results. Nevertheless, apart from a couple of specific scenarios, the results of the simulations performed mostly showed Gini coefficients within a range of ±1 to 2 percentage points around the actual DWA results.

The following tables summarise the results for Gini coefficients, for wealth held by the richest decile and net wealth held by the poorest 50% households for wave 3.

TABLE 12 - SENSITIVITY ANALYSIS - GINI COEFFICIENTS (WAVE 3)

	DWA as disseminated	Average	Min	Max	Range Max-Min (p.p.)	Max-DWA (p.p.)	DWA-Min (p.p.)
GR	65.7%	66.0%	63.9%	68.8%	4.8	3.0	1.8
BE	72.1%	72.1%	68.9%	73.3%	4.4	1.2	3.2
LU	72.3%	72.1%	69.7%	73.6%	3.9	1.3	2.6
IT	72.3%	72.3%	70.0%	73.2%	3.3	0.9	2.3
EE	74.4%	74.1%	71.9%	74.8%	3.0	0.5	2.5
DE	79.0%	79.1%	77.0%	79.7%	2.7	0.7	2.1
AT	82.3%	82.0%	80.8%	83.3%	2.5	1.0	1.5
FR	73.0%	73.0%	71.9%	73.9%	2.0	0.9	1.1
ES	70.2%	70.4%	69.7%	71.5%	1.8	1.4	0.5
CY	75.1%	75.3%	74.3%	76.0%	1.7	0.9	0.8
HU	73.3%	73.4%	72.6%	74.3%	1.6	1.0	0.6
IE	71.4%	71.4%	70.4%	71.9%	1.6	0.5	1.0

Similarly, the different simulations performed resulted in proportions of net wealth held by the richest decile that remained relatively stable, albeit with a larger range of up to 6 percentage points.

TABLE 13 - SENSITIVITY ANALYSIS - NET WEALTH BY THE RICHEST DECILE (WAVE 3)

	DWA as disseminated	Average	Min	Max	Range Max-Min (p.p.)	Max-DWA (p.p.)	DWA-Min (p.p.)
BE	60.2%	60.2%	55.6%	61.8%	6.2	1.6	4.6
LU	58.7%	58.4%	55.1%	60.6%	5.5	1.9	3.6
AT	68.3%	67.3%	65.6%	70.7%	5.1	2.5	2.7
EE	61.4%	61.1%	57.9%	62.1%	4.2	0.7	3.5
IT	60.4%	60.3%	57.1%	61.1%	4.0	0.7	3.3
GR	50.0%	50.2%	48.1%	52.0%	3.8	2.0	1.9
CY	56.4%	56.6%	56.0%	58.8%	2.7	2.3	0.4
IE	55.8%	55.7%	54.9%	56.8%	1.8	1.0	0.8
DE	60.9%	61.0%	59.9%	61.7%	1.8	0.8	1.0
FR	56.9%	57.0%	56.5%	57.7%	1.3	0.8	0.5
ES	56.5%	56.6%	56.3%	57.3%	1.0	0.8	0.2
HU	61.5%	61.6%	61.3%	62.1%	0.7	0.5	0.2

The sensitivity analysis for the bottom 50% showed an even tighter range of results.

TABLE 14 - SENSITIVITY ANALYSIS - NET WEALTH HELD BY THE POOREST 50% (WAVE 3)

	DWA as disseminated	Average	Min	Max	Range Max-Min (p.p.)	Max-DWA (p.p.)	DWA-Min (p.p.)
GR	9.0%	8.8%	7.4%	10.1%	2.7	1.1	1.6
LU	5.9%	6.0%	5.6%	7.5%	2.0	1.6	0.3
AT	1.2%	1.1%	0.4%	2.2%	1.8	1.0	0.8
CY	3.5%	3.4%	3.0%	4.7%	1.6	1.2	0.5
DE	0.9%	0.8%	0.5%	2.2%	1.6	1.3	0.3
FR	4.3%	4.2%	3.7%	5.0%	1.4	0.8	0.6
BE	6.9%	6.9%	6.5%	7.7%	1.2	0.8	0.4
IT	7.0%	6.9%	6.4%	7.6%	1.1	0.6	0.5
ES	7.2%	7.1%	6.5%	7.6%	1.1	0.4	0.7
IE	5.7%	5.7%	5.3%	6.3%	1.0	0.6	0.3
EE	5.2%	5.2%	4.9%	5.9%	1.0	0.7	0.3
HU	6.7%	6.7%	6.2%	7.2%	0.9	0.4	0.5

These fairly consistent results exclude a few very specific cases which were considered implausible.

Annex 2: References

Reports:

- Batty, M., Bricker, J., Briggs, J., Holmquist, E., McIntosh, S., Moore, K., Nielsen, E., Reber, S., Shatto, M., Sommer, K., Sweeney, T. and Henriques Volz, A. (2019), "Introducing the Distributional Financial Accounts of the United States," Finance and Economics Discussion Series, No 2019-017. Board of Governors of the Federal Reserve System.
- Eurostat/European Commission, European System of Accounts (ESA) 2010 (2013), Publications Office of the European Union, Luxembourg.
- Expert Group on Linking macro and micro data for the household sector (2020), "Understanding household wealth: linking macro and micro data to produce distributional financial accounts", Statistics Paper Series, No 37, European Central Bank.
- Financial Stability Board (FSB) and International Monetary Fund (IMF) (2018), "Second Phase of the G-20 Data Gaps Initiative (DGI-2)", Third Progress Report.
- Household Finance and Consumption Network (HFCN) (2020a), "The Household Finance and Consumption Survey: Methodological report for the 2017 wave", Statistics Paper Series, No 35, European Central Bank.
- Household Finance and Consumption Network (HFCN) (2020b), "The Household Finance and Consumption Survey: results from the 2017 wave", Statistics Paper Series, No 36, European Central Bank.
- Zwijnenburg, J., Bournot, S., Grahn, D. and Guidetti, E. (2021), "Distribution of household income, consumption and saving in line with national accounts: Methodology and results from the 2020 collection round", ", OECD Statistics Working Papers Series , No 2021/01, Organisation for Economic Cooperation and Development.

Research papers:

- Alstadsæter, A., Johannesen, N. and Zucman, G. (2018), "Who owns the wealth in tax havens? Macro evidence and implications for global inequality", Journal of Public Economics, Vol. 162, pp. 89-100.
- Alvaredo, F., Atkinson, B.A., Chancel, L., Piketty, T., Saez, E. and Zucman, G. (2016), "Distributional National Accounts Guidelines: Methods and Concepts used in WID.world", WID.world Working Paper Series, No 2016/2, World Inequality Database.
- Ampudia, M., Pavlickova, A., Slacalek, J., Vogel, E. (2016), "Household heterogeneity in the euro area since the onset of the Great Recession", Journal of Policy Modelling, Vol. 38, Issue 1, pp. 181-197.
- Andreasch, M. and Lindner, P. (2016) "Micro- and macro data: a comparison of the Household Finance and Consumption Survey with Financial Accounts in Austria", Journal of Official Statistics, Volume 32.
- Antoniewicz, R., Bonci R., Generale A., Marchese G., Neri A., Maser K. and O'Hagan P. (2005), "Household Wealth: Comparing Micro and Macro Data in Cyprus, Canada, Italy and United States", LWS Workshop – Construction and Usage of Comparable Microdata on Wealth: the LWS, Banca d'Italia, Perugia, Italy, 27-29 January.
- Bach, S., Thiemann, A. and Zucco, A. (2015), "The Top Tail of the Wealth Distribution in Germany, France, Spain, and Greece", Discussion Papers, No 1502, DIW

- Bach, S., Thiemann, A. and Zucco, A. (2018), “Looking for the missing rich: Tracing the top tail of the wealth distribution”, JRC Working Papers on Taxation and Structural Reforms, No 4/2018, European Commission.
- Beaumont, J.-F. and Bocci, C. (2008), “Another look at ridge calibration”, Metron - International Journal of Statistics, Vol. LXVI, No 1,pp. 5-20.
- Blanchet, T., Fournier, J. and Piketty, T. (2017), “Generalized Pareto Curves: Theory and Applications”, WID.world Working Paper Series, No 2017/3, World Inequality Database.
- Chakraborty, R., Kavonius, I. K., Pérez-Duarte, S. and Vermeulen, P. (2019), “Is the top tail of the wealth distribution the missing link between the Household Finance and Consumption Survey and national accounts?”, Journal of Official Statistics, Vol. 35, Issue 1, pp. 31–65.
- Chakraborty, R. and Waltl, S. R. (2018), “Missing the wealthy in the HFCS: micro problems with macro implications”, Working Paper Series, No 2163, European Central Bank.
- Choi, J. H. and Painter, G. (2017), “Self-Reported vs. Market Estimated House Values: Are Homeowners Misinformed or Are They Purposely Misreporting?”, Real Estate Economics, Vol. 46, Issue 2, pp. 487-520..
- Davies, J. B. and Shorrocks, A. F. (2000), “The distribution of wealth”, ”, in Atkinson, A. and Bourgignon, F. (eds), Handbook of income distribution, Vol. 1, Elsevier, pp. 605-675.
- D’Alessio, G. and Neri, A. (2015), “Income and wealth sample estimates consistent with macro aggregates: some experiments”, Occasional Papers, No 272, Banca d’Italia.
- Engel J., Gayà Riera P., Grilli J. and Sola P. (2022), “Developing reconciled quarterly distributional national wealth – insight into inequality and wealth structures”, Working Paper Series No 2687, European Central Bank.
- Fernández, P.E.B.(1981), “A methodological note on the estimation of time series”, The Review of Economics and Statistics.
- Fesseau, M. and Mattonetti, M.L. (2013), “Distributional Measures Across Household Groups in a National Accounts Framework”, *OECD Statistics Working Paper Series*, No 2013/04, Organisation for Economic Cooperation and Development.
- Garbinti, B., Goupille-Lebret, J. and Piketty, T. (2016), “Accounting for Wealth Inequality Dynamics: Methods, Estimates and Simulations for France (1800-2014)”, *Working Paper Series*, No 633, Banque de France.
- Gürer, E. and Weichenrieder, A. (2018), “Pro-Rich Inflation in Europe: Implications for the Measurement of Inequality”, Working Paper Series, No 209, SAFE.
- Henriques, A.M. and Hsu, J. W. (2013), “Analysis of Wealth Using Micro and Macro Data: A Comparison of the Survey of Consumer Finances and Flow of Funds Accounts”, in Jorgenson, D.W., Landefeld, J. S. and Schreyer. P. (eds), Measuring Economic Sustainability and Progress, Studies in Income and Wealth, Vol. 72, National Bureau of Economic Research, Cambridge, MA.
- Honkkila, J. and Kavonius, I. K. (2013), “Micro and Macro Analysis on Household Income, Wealth and Saving in the Euro Area”, Working Paper Series, No 1619, European Central Bank.
- Kavonius, I. K. and Honkkila, J. (2013), "Reconciling Micro and Macro Data on Household Wealth: A Test Based on Three Euro Area Countries," Journal of Economic and Social Policy, Vol. 15, Issue 2, pp. 42-73..
- Kennickell, A. (2008), “The Role of Over-Sampling of the Wealthy in the Survey of Consumer Finances”, *IFC Bulletin*, No 28, Bank for International Settlements, pp. 403-408.

- Kennickell, A. (2021), “Chasing the Tail: A Generalized Pareto Distribution Approach to Estimating Wealth Inequality”, *Working Paper Series*, No 37, Stone Center on Socio-Economic Inequality.
- Roymans, I. (2016), “Documenting the statistical editing process with process tables, a case study of the Luxembourg Financial Accounts”, Statistical Journal of the IAOS, Vol. 32, , No 4, pp. 659-665.
- Vermeulen, P. (2016), “Estimating the top tail of the wealth distribution”, American Economic Review: Papers & Proceedings, Vol. 106, No 5, pp. 646–650.
- Vermeulen, P. (2018), “How fat is the top tail of the wealth distribution?”, Review of Income and Wealth, Vol. 64, Issue 2, pp. 357-387.
- Waltl, S. R. (2020), “Multidimensional Wealth Inequality: A Hybrid Approach toward Distributional National Accounts in Europe”, INEQ Working Paper Series No 16, Vienna University of Economics and Business.
- Zwijnenburg, J. (2016), “Further enhancing the work on household distributional data: Techniques for bridging gaps between micro and macro results and nowcasting methodologies for compiling more timely results”, paper prepared for the 34th IARIW General Conference, Dresden.