# Mind the mode: lessons from a web survey on households finances

Romina Gambacorta[1], Martina Lo Conte[2], Manuela Murgia[2]
Andrea Neri[1], Roberta Rizzi[2], Francesca Zanichelli[1]
[1]Banca d'Italia, Via Nazionale, 91 - 00184 Rome
[2]Istat, Via Cesare Balbo, 16 - 00184 Rome, Italy

**Abstract**
Surveys on household income and wealth are generally carried out through personal interviews. In recent years, Internet has been increasingly used as a data collection method, both for economic reasons and for the timeliness with which the collected data are available. To the best of our knowledge, however, there are no many studies on the use of web for collecting information on household income and wealth. This work contributes to fill this gap by illustrating the results of an experimental survey conducted in 2016 by the Banca d'Italia in collaboration with Istat (Italian National Institute of Statistical). Data quality is assessed through the use of fiscal administrative data and the comparison with a parallel survey conducted through personal interviews. Our results suggest that the web can represent a valid alternative for qualitative questions and to gather information on less sensitive sources of income (such as those for employees and retirees). To reduce the bias associated with the use of this instrument, it is essential to have auxiliary information on the whole selected sample.

**Key Words:** web survey, mode effects, non-sampling errors

## 1. Introduction

Face-to-face surveys are potentially those able to ensure the greatest data accuracy, especially when the CAPI (Computer Assisted Personal Interviewing) methodology is used. This data collection mode also allows to reach any population of interest as each selected unit can be contacted, reached and interviewed.
An alternative method of data collection is based on self-compiled electronic questionnaires in a web environment (Computer Assisted Web Interviewing, CAWI). This method has obvious advantages in terms of costs and timeliness with which the collected information is available. Moreover, there are at least three other aspects that make this survey mode appealing. First, the Internet allows the transmission of audio and video material, as well as text. For example, the use of Voice over Internet Protocol (VoIP), such as Skype, would allow "in-person interviews" to be conducted via the Internet. Second, social networks could be useful for making snowball-type sampling designs (Salganik and Heckathorn, 2004, Heckathorn 2002, Poynter 2010). A third interesting element is that the absence of the interviewer could lead to a more truthful reporting behavior in the case of sensitive questions (Tourangeau and Yan, 2007; Kreuter et al., 2008). For these reasons, Banca d'Italia and Istat have decided to collaborate in carrying out an experimental web survey aimed at collecting economic information on Italian households. The experimentation has two main purposes. The first is to investigate the impact of the use of a different survey mode on the quality of answers to complex

questions such as those on income and on forms of savings; the second aim is to identify the socio-demographic and income characteristics of population subgroups with greater propensity to participate in web surveys.

## 2. The use of Internet in sample surveys

Despite its growing spread, the use of Internet in large-scale probabilistic surveys is still limited (Tourageau et al. 2013). A major impediment in most cases is the lack of an exhaustive list of the population of interest that includes, for each unit, individual information on the availability of a web connection for each unit. There are essentially four ways to get around this issue (Couper, 2000). A first strategy is to select a random sample of visitors to a specific website and invite them to take part in the survey via pop-ups. A second approach consists in selecting the sample from an available list (such as the population registers) and send an invitation to participate via traditional mail or e-mail. A third solution is to give a part of the respondents to a survey conducted using a traditional methodology (e.g. CAPI mode) the possibility to participate via web. The fourth alternative is to select a large probability sample, carry out a short screening interview to identify those who have Internet access and then invite them to participate to a web survey. To our knowledge, the only large-scale web survey on household income and wealth is the Dutch component of the harmonized European survey HFCS (Household Finance and Consumption Survey). The survey is conducted on a panel of individuals initially selected from a random sample of postal addresses.[1]

Advantages and disadvantages of using the Internet as a survey mode are widely discussed by Couper (2011) and in the proceedings of the conference organized by Eurostat in 2014.[2] The most relevant aspects for our purposes are summarized as follows.

First, in the absence of an interviewer, the respondent is fully responsible for the understanding of the questions, for the completion of the survey and for its final transmission. Therefore, particular attention should be paid to the wording of questions, to the instructions given to the respondent (in order to avoid ambiguity) and to the flow of the questionnaire (e.g., the respondent should be prevented from scrolling the entire questionnaire and decide to which questions and in which order to answer).

Second, in web surveys it is crucial to give incentives or to adopt other strategies, such as sending reminders, in order to get acceptable participation rates. Infact there is no interviewer that convinces and motivates the respondents to participate.

Third, web surveys seem to be particularly suitable to collect sensitive information, since the absence of third persons during the interview reduces the potential distortion of answers due to fear of social judgment (*social desirability bias*) and in this sense they perform better than other collection modes (Tourangeau and Yan, 2007; Kreuter et al., 2008).

Moreover, the web has other features that can increase data quality (Dillman et al. 2009, Fricker et al., 2005, Martin e Lynn, 2011). The absence of the interviewer and the

[1]The sample is merged with a register of telephone numbers (with a rate of success around 50 per cent). The selected individuals are then invited via telephone or letter to participate to a short interview. Those who accept to participate are further asked to take part in a long-term panel. In order to encourage participation, the panel individuals are provided with a computer to take part in the survey and they get a reimbursement of Internet connection fees. Furthermore, for every completed questionnaire they get credits that can be converted in cash or in other economic benefits (Teppa, 2012).

[2]Eurostat investigated the state of the art of survey techniques in a recent project ESSnet, ended in 2014 with the workshop "Data collection for social surveys using multiple mode" at the German Statistics Institute Destatis.

possibility to fill in the survey without any time constraints give the respondent the possibility to check additional documentation (such as bank account statements, tax records, etc…) and to freely consult with other household members. Another important aspect is that web surveys are usually carried out over a shorter fieldwork than face-to-face interviews. Long time gap between the interviews may influence results (D'Alessio e Iezzi, 2015), especially for questions that relate to economic conditions (such as the occupational status of the respondent or the value of properties) or to expectations about the future (performance of the stock market, changes in the employment status). Lastly, some studies have shown that the interviewers often induce opportunistic behaviors (satisficing behavior) in the attempt to reduce the time and, in general, the effort required to complete the questionnaire (Simon 1957; Zhang 2013).

Even though many studies have focused on the comparison between web and other survey modes, to our knowledge there are no other studies on web surveys on household income and wealth. The only exception is a study on the Dutch survey that, comparing the data with the official statistics released by Statistics Netherland, shows that the web survey adequately represents some socio-demographic characteristics of the population (such as age, geographical area and gender), but less others (educational qualification, household composition, citizenship, marital status) (Teppa, 2012). The aim of this work is to contribute to fill the information gap on web surveys on households economic conditions.

## 3. The Italian Web Survey on Households (WEBIT)

The web survey on Italian households (WEBIT) was carried out during the first six months of 2016 on a probabilistic sample of about 1.000 individuals. The initial sample was composed of about 10.000 households that were randomly selected from the population registers in 250 municipalities.

The selected households were invited to participate to the survey with a letter signed by both Institutes. The letter contained a brief presentation of the survey, the link to the website and a personal code to access the questionnaire. The questionnaire was implemented on the platform LimeSurvey, prepared by the IT Development Directorate of the Banca d'Italia, and it could also be accessed by smartphone or tablet.

A portion of the sample (about 80 per cent) was randomly selected to take part in a prize contest to win 5 IPads. In order to encourage the earliest participation possible, the five extractions took place progressively during the survey field and the respondents could participate in all the draws after the date of completion of the interview.

In order to reassure respondents, two dedicated web pages were created on the Istat and the Banca d'Italia's websites, containing all the useful information on the survey aims, on the sample selection, on the use of data, on the integration with the fiscal archives held by Istat and a copy of the letter sent to the selected households. Istat local branches were informed about the survey content and organization in order to provide support to the respondents. During the field, Istat staff conducted telephone calls to the selected households, in order to raise the participation rate and to reassure the respondents.

An important feature of the WEBIT survey is that the selected sample was merged with the tax records archives through respondents' personal ids.[3] The merging was possible for almost 95 per cent of the sampled persons. The main cause of failure was the lack of tax records for some types of individuals.

[3]The merging was performed by Istat staff in compliance with the current privacy policy and as established in an agreement signed by the two institutions. The full archive was available only to Istat researchers.

The survey was conducted in parallel with the CAPI survey on the economic conditions of Italian households in 2015 (SHIW-I) carried out by the Banca d'Italia on a sample of about 2.000 households, selected from those who had participated to the 2014 edition of the Survey on Household Income and Wealth. The interviews were conducted in the same municipalities, adopting almost the same questionnaire and identical question wording. The questionnaire included questions on the demographics of the household members, on the employment status, on income and life conditions, on the use of bank accounts, on financial investments and liabilities and on consumption.
In order to make the two surveys comparable, SHIW-I included the following questions: "Do you, or does any member of your household, at home or anywhere else, have access to the Internet using a computer?" and "Do you, or does any member of your household, at home or anywhere else, have access to the Internet using a smartphone or a tablet?". The answers to these questions allowed to identify and analyze the population eligible for a web survey. Furthermore, the more complex questions in the web survey, such as the ones on income and wealth, were completed with instructions and a glossary in order to make up for the absence of the interviewer. The Web survey included also some experimentations: some questions were asked with different wording on random subsamples of the sample in order to test the effect of the wording on the final results.

## 4. The theoretical framework for the analysis of the results

The Total Survey Error approach is the theoretical framework that can be used to evaluate the results of the web survey (TSE, Bethlehem 2010, Biemer 2010).
The main objective of any sample survey is to minimize the difference between the sample estimate of a statistics of interest and the corresponding population value (total survey error, TSE). This discrepancy is the result of many types of errors that can occur during the design stage, during the interview and the analysis of the data. The errors can be grouped in two main categories: sampling errors and non-sampling errors. According to the literature (see for example Bethlehem 2010 and Tourangeau et al. 2013), the main types of non-sampling errors that affect web surveys are coverage, non-response and measurement errors. Each of these sources of errors may have an impact both on the bias and on the efficiency of the estimators. This work mainly focuses on the bias effect.
Let assume that the statistics of interest is the mean of a given characteristic $\overline{Y}$ in the Italian population (e.g. the household income) and that the population is divided in two mutually exclusive groups (of unknown sizes $N_I$ and $N_{NI}$ ) based on the Internet access. Let $\overline{Y}_I$ and $\overline{Y}_{NI}$ be the unknown population means in the two groups and let $\overline{Y}_{I,R}$ be the mean in the sub-population of respondents with access to the Internet ($N_{I,R} \subseteq N_I$.). The bias of the sample mean $\bar{y}_r$ can be written as:

$$[1] \qquad B(\bar{y}_r) = E(\bar{y}_r) - \overline{Y} = B_{COV} + B_{NR} + B_{MIS}$$

where $B_{COV}$, $B_{NR}$ and $B_{MIS}$ are the bias components due respectively to coverage errors, non-response and measurement errors.
The bias due to coverage errors is given by the difference between the expected value of the sample mean computed on a sample selected from the population that has access to the Internet and the mean in the entire population of interest ($B_{COV} = E(\bar{y}_I) - \overline{Y},\ E(\bar{y}_I) = \overline{Y}_I$). This bias component is due to the fact that part of the population has no Internet and therefore cannot be interviewed using this method (differently from what happens in case of face-to-face interviews).

The second type of error is due to the fact that part of the sample does not accept to participate to the survey (total non-response). The expected value of the estimator of the mean based on the sub-sample of respondents $\bar{y}_{I,r}$ is equal to the mean of Y in the population of respondents $\bar{Y}_{I,R}$, which might be different from the one of the total population that has access to the Internet ($B_{NR} = E(\bar{y}_{I,r}) - \bar{Y}_I$, $E(\bar{y}_{I,r}) = \bar{Y}_{I,R}$). The presence of the interviewer generally contributes to the reduction of this type of error, since interviewers have strong incentives to persuade households to participate to the survey. There is no strategy in web surveys that can lead to the same result, therefore participation rates are usually low.

The third type of error is the measurement error. This category includes a wide range of errors such as those made by the interviewees in answering, typos and voluntary data falsification. The expected value of the estimator $\bar{y}_r$ is consequently different from the true value ($B_{MIS} = E(\bar{y}_r) - \bar{Y}_{I,R}$). The literature mainly focuses on measurement errors related to the respondents' behavior. Tourangeau et al. (2000) identify three phases in the cognitive process that leads to the answer: understanding, retrieval of information and choice of a response strategy. Each of these three phases may generate errors, whose entities may depend on the survey mode. A first potential source of error is the lack of understanding of the questions, due to ambiguity, complexity, vagueness or presence of unknown words. The interviewer may help in these cases, while in WEB survey respondents are more likely to give different interpretations to the questions. A second potential source of error is related to the retrieval of the requested information (Groves 2004). The interviewer forces respondents to give an answer in a short time span and this might lead to approximation and rounding (Pudney, 2008). Web survey respondents are instead free to complete the questionnaire without time constraints and they can retrieve all the necessary information (also consulting the appropriate documentation). Lastly, the respondent chooses a response strategy. The main source of error in this phase is due to under-reporting of income sources or wealth. The presence of an interviewer may have both positive and negative effects in this regard. On one side, the interviewer may reassure the respondent on the confidentiality of the collected data. On the other side, the presence of the interviewer may lead to "social desirability" phenomena, when talking about own economic situation (Bagozzi, 1994, Pitrone, 2009).[4]

The comparison between the composition of the theoretical sample (i.e. the initially selected one) and the composition of the final sample in WEBIT is a first way to assess the presence of non-sampling errors. If this is the case, the socio-demographic distributions in the two samples would be very similar. Instead, the interviewed households have more often 3 or 4 household members, with children, they live more often in the North and the heads of household are more often aged between 35 and 64 years old and men. They also have in general better economic conditions than others (table 1).

We evaluate the WEBIT survey using three different approaches. First, coverage errors are analyzed using the SHIW-I survey, which was conducted during the same fieldwork period on a sample representative of the entire population (section 4.1). The bias due to non-response (section 4.2) is evaluated using the information available for non-respondents (coming from population registers and tax data) and the information

[4] For instance, a respondent belonging to a very wealthy household might prefer to report a lower income in order to conform with the interviewer or for fear of a leak of information. In principle, the opposite may happen as well, with the respondent trying to impress the interviewer by reporting a better economic situation than the real one.

available in the SHIW-I survey (which allows us to estimate the eligibility condition of households in the WEBIT sample). Finally, we study measurement errors by comparison between the distributions of answers from similar respondents in SHIW-I, using tax records and using some tests done in the WEBIT survey (section 4.3).

**4.1 Coverage errors**

The population of interest in the WEBIT survey is the entire Italian population. The bias of the Horvitz-Thompson estimator ($\bar{y}_I$), computed on a probabilistic sample drawn from the population with access to the Internet, is:

$$[2] \qquad B_{COV} = E(\bar{y}_I) - \bar{Y} = \frac{N_{NI}}{N}(\bar{Y}_I - \bar{Y}_{NI})$$

The extent of this bias is due to two elements:

a) the proportion of households with no access to the Internet;
b) the difference between the averages of Y in the two sub-populations.

We can estimate the first factor using the SHIW-I survey, which is conducted on the entire population. According to this survey, the share of households with Internet access (using a personal computer or a tablet or smartphone) is about 70 percent. This result is consistent with what is found in the annual Istat survey on the use of ICT instruments by individuals and firms (Istat, 2016).[5] Internet diffusion in Italy is slightly below the European average (figure 1). In the most recent years, however, the percentage of households using Internet has been rapidly increasing (it was 47 per cent in 2008, according to the Istat survey). The use of the Internet is not uniform across the different socio-demographic groups of the population (table 2). Age is one of the most relevant factors, as older people are more difficult to reach with this instrument. Furthermore, the access to the Internet is more common among households headed by individuals with higher educational qualifications, belonging to higher income and wealth classes, living in the North or the Centre of Italy and in bigger cities.[6] Among all of these groups, the only one which might be difficult to cover with a web survey is composed by households whose reference person has no educational qualification: only 6 per cent of these households have access to the Internet. These households, however, represent less than 4 per cent of the entire population (Banca d'Italia 2015).
The magnitude of the component of bias (the difference in mean values) can be estimated in both surveys. For the web survey, the information from the tax records is available on the entire initial sample of 10.030 households. It is necessary, however, to impute the eligibility condition as this information is not available. The imputation is performed in two steps. First, we estimate a logistic model of the probability of having access to the

[5] In 2016 about 70 per cent of households had access to the Internet from home, according to the ICT survey conducted by Istat. This share increases to 72 per cent if individuals accessing the Internet from other places are included. The main reason why households do not have access to the Internet (57 per cent) is that none of the members can use the instrument. The second reason (24 per cent) is that the household does not find it useful or interesting. Economic reasons matter in less than 10 per cent of the cases.
[6] Similar results are found at the European level: about 96 per cent of individuals between 16 and 24 years old regularly use the Internet, while the same is true only for 57 per cent of the individuals aged between 55 and 74. Furthermore, almost all the individuals with high educational qualifications regularly use the Internet, against about 60 per cent of those with low educational level. European statistics are available on the Eurostat website *statistics explained*.

Internet on the SHIW-I data, using a set of observables (table 3).[7] Second, we use these estimates to impute the availability of a web connection for all the households in the WEBIT sample. The imputation is not done if this information is directly available from other sources (such as via telephone calls).[8] Using the information on income from the tax records, the average net household income is about 18.300 euro for the households estimated to be not eligible for the web survey ($\overline{Y}_{NI}$), while it amounts to about 31.800 for the eligible households ($\overline{Y}_{I}$). Even when looking at the entire household income distribution, eligible households seem to have better economic condition than the others (figure 2).
Using equation [2], we find that the use of the web survey to estimate household income (without exploiting the information available in the tax records) leads to an over-estimation of about 15 per cent of the average income (4.000 euro on an average income of about 27.700 euro). Similar results can be obtained using the SHIW-I survey. Looking at the household net income (which is slightly different than the one reported in the tax records), the bias due to coverage errors is about 15 per cent of the average income. As far as household net wealth is concerned, the bias is still positive and it amounts to about 10 per cent of the average.

### 4.2 Non-response errors

Web surveys generally have lower participation rates than similar surveys conducted with traditional modes (e.g. CAPI or telephone interviews).
A study on more than 40 experimental surveys shows that the average participation rates in web surveys are 11 percentage points lower than the ones obtained with alternative survey modes (Manfreda et al., 2008). Jäckle et al. (2015) find similar results even when analyzing panel surveys, where there should be no eligibility issues and that are usually characterized by a higher propensity to participate.

Low participation rates do not necessarily imply a low quality of the collected data (Groves e Peytcheva, 2008).

If we assume that each household has an unknown propensity to answer $p_k = E(r_k)$, where $r_k$ is a dummy variable taking value 1 if household k participated and taking value 0 otherwise, an estimator of the mean of a variable of interest on the population with access to the Internet ($\overline{Y}_I$) is the sample mean computed using the information available for the respondents only $\bar{y}_{I,r} = \frac{1}{n_r}\sum_{k=1}^{N} r_k Y_k$, where $n_r$ is the size of the respondents

[7] We use the following regressors: gender, age classes, nationality of the head of household, dummy variables on the presence of a young person in the household (i.e. a household member aged less than 40) and on the presence of a spouse/partner, number of household members, household income classes, ownership of dwellings other than the household main residence (used as a proxy of household wealth), geographical area and size of the municipality of residence.
[8] Overall, the estimated percentage of eligible households is about 70 per cent in the WEBIT sample. However, the eligibility estimation process was subject to a number of approximations. First, the data sources used were different: in one case we used the information collected in the survey, in the other case the data came from the civic registers (for the demographic information) and from the tax records for the income information. More specifically, the ownership of properties other than the household main residence was estimated using the information on the property taxes paid. The definition of head of household is different as well: in the SHIW-I survey it is the household member who earned the highest income, while in the web survey it was the reference person resulting from the population register.

sample. Bethlehem (1988, 2002) proved that this estimator is biased (even in absence of measurement errors) and that the bias can be written as:

$$[3] \qquad B_{NR} = E(\bar{y}_{I,r}) - \bar{Y}_I \approx \frac{Cov(p, Y)}{\bar{p}} \qquad Cov(p, Y) = \frac{1}{N}\sum_{k=1}^{N}(p_k - \bar{p})(y_k - \bar{y})$$

Equation (3) shows that when measuring the bias of an estimator it is necessary to refer to a specific variable of interest (Y): the same survey can produce biased results for some variables and accurate ones for others. The bias also is due to the extent of the non-response (1-$\bar{p}$) and on its association with the variable of interest.

As expected, the WEBIT survey had a low response rate. Even after excluding the households with no access to the Internet, the response rate is about 12 per cent (this figure is about 37 per cent in the non-panel component of the Survey on Household Income and Wealth, Banca d'Italia 2015). The response rate in the web survey is likely to be underestimated, since there is no information on the share of households which are not eligible due to inaccuracies in the population registers information or due to other reasons (the address does not exist, the household moved to another place, all the household members died). On the basis of the Survey on Household Income and Wealth conducted in 2014, this share amounts to about 5 per cent of the total selected sample. Even taking into account this component, the response rate of the web survey would increase only to about 13 per cent.

The second component of the bias is related to the correlation between the probability to participate and the variable of interest. The probability to answer of each individual is unknown and it is usually estimated as a function of some observables, under the assumption that these observables carry the entire amount of information needed (*missing at random* assumption, MAR). Tables 4 and 5 show the estimated parameters of two logistic models:

$$logit(r_k) = \alpha + \beta X_k$$

In the first specification $r_k = 1$ if the respondent completed the survey, in the second specification $r_k = 1$ if the respondent participated to the survey (even if he or she did not complete it). $X_k$ is a set of regressors which include demographics (such as gender, age classes, nationality, marital status of the reference person, presence of a young member in the household, number of household members, geographical area and size of the municipality) and economic variables (household income classes and ownership of properties other than the household main residence).

Participation to the WEBIT survey is higher in the North and for smaller households. The probability to complete the survey is higher if the reference person had Italian citizenship and if he or she is married. Furthermore, even when accounting for the other observable characteristics, the probability to participate is higher for households with higher income. The extent of the bias depends not only on the association of the variable of interest with the propensity to answer, but also on its association with the socio-demographic characteristics (used to estimate the propensity to answer). If we are interested in estimating the mean income, table 6 shows how it is connected with socio-demographic factors such age, gender, geographical area of residence, citizenship and the presence of a young member in the household, all factors that have a positive impact on the probability to participate. Figure 3 shows the association between the estimated probabilities to participate for the WEBIT survey and the household income retrieved from the tax records. The mean (and median) probability to participate is about 7 per cent in the lowest income class, while it increases to 18 per cent in the highest income class. The

linear correlation coefficient between the two variables is about 43 per cent. Using equation [3], the bias of the estimator of the mean net household income due to non-response is about 4.500 euro, 17 per cent of the mean income.

An interesting result is that this evidence goes in an opposite direction than what is usually found in face-to-face surveys. In these surveys wealthy households are the most difficult to interview. For instance, Cannari and D'Alessio (1992) analyze the panel component of the Banca d'Italia's Survey on Household Income and Wealth (SHIW) and show that high-income households have a lower propensity to participate to subsequent waves of the surveys than others. Similarly, D'Alessio and Faiella (2002), exploiting a sample of individuals which had been selected among the clients of an important commercial bank (and for which administrative information was available), find a negative correlation between wealth and the propensity to participate to a survey. A possible explanation of this result is that the survey mode has an impact on survey participation for this class of households. First, wealthy households have usually higher educational levels than others and, therefore, they might face less difficulty in participating to a web survey (which requires a minimum of IT competencies). Additionally, wealthy households usually have little time to devote to a *face to face* interview.[9] In this regard, the web mode might be the most suited solution for their needs, by allowing the respondent to fill in the questionnaire whenever he/she has free time and even over several days.

Web surveys are affected by a form of non-response that is not present in CAPI surveys, i.e. breakoffs before the completion of the questionnaire. This issue isn't extremely severe in the WEBIT survey: less than 4 per cent of the respondents quitted the survey before completing it. Breakoffs mainly occurred in the income section of the questionnaire (figure 4) and this contributed to bias the final estimates.

An interesting result is that non-response errors go in the same direction as coverage errors, thus inflating the final bias. The total bias of the estimator of the mean household income is about 8.500 euro (4.500 due to non-response and 4.000 due to coverage issues), about 31 per cent of the mean. This result is due to the fact that the wealthier segments of the population are more likely both to have access to the Internet and to participate in the survey. There are, however, other non-observable factors that seem to contribute to this result. Table 7 reports the results of a bivariate model of the joint probability of being eligible and participating to the survey, as a function of observable demographic variables (gender, age, marital status, citizenship of the head of household, number of household members, presence of a young member, geographical area and municipality size) and of economic variables (household income classes and ownership of properties other than the household main residence). The error terms of the two models have significant positive correlation, even when accounting for the above mentioned factors. This means that the groups of households that have access to the Internet, such as the ones with higher educational levels, are also more likely to participate to the survey (Roberts, 2007). If these unobservable variables are correlated with the variables of interest, there is no way to correct the bias using ex-post methods (since these variables are not observable).

[9]Kennickell (2009) shows that the major issues in reaching the ultra-wealthy households in the SCF (Survey of Consumer Finance) are first to contact them and then to find the time for the interview. Once these problems are solved, these households do not show lower propensity to participate than other households.

### 4.3 Measurement errors

Measurement error occurs when there is a difference between the value of a characteristic provided by the respondent and the true (but unknown) value of that characteristic. In surveys on household income and wealth, measurement error is probably one of the most damaging sources of error (see for instance Neri, Ranalli, 2011 and D'Alessio, Neri 2015).

The bias due to measurement error can be written as:

$$[3] \quad B_{MIS} = E(\bar{y}_r) - \bar{Y}_{I,R}$$

where $\bar{\mathbf{Y}}_{\mathbf{I,R}}$ is the (unknown) value for the mean of y in the population with an Internet connection.

The best approach for estimating the effect of data collection on this bias would require a random assignment of the method among respondents. Unfortunately we were not able to make such an experiment. Nevertheless, we compare two surveys based on two independent samples that are randomly extracted from the population registers in the same primary sampling units (municipalities). Moreover, the fieldworks were conducted as much as possible in parallel. Therefore, the main reasons that can explain the differences in the results coming from the two surveys are essentially due to a different non-response behavior or to the data collection method.

In order to disentangle the mode effect from other confounding factors, we first select in the SHIW-I survey the sample of households who reported to have Internet access. Second, we calibrate the sampling weights for the WEBIT survey so that they are aligned as much as possible to those of the SHIW-I survey (see the appendix B for details). Third, as far as the comparison of income values is concerned, the robustness of the results is also tested by conducting analyses on homogeneous subgroups of the population identified through *propensity score matching* (Rubin, 1974). Finally, we study the presence of measurement error in the WEBIT survey comparing the information provided by each respondent with the one contained in the tax records.

#### *4.3.1 Measuring income from employment and pensions*

Both surveys collect information about the main sources of income in the household (such as income from employment, from self-employment and from pension).

We find that the data collection method is associated with a different reporting behavior.

The use of the CAPI methodology seems to bring out a greater number of income earners from work or pension (Figures 5 and 6) compared to the web survey. About 38 percent of the families interviewed in SHIW-I and whose reference person is retired, claims to have at least two recipients of pension income. This percentage drops to 18 percent in the WEBIT survey. A similar result is obtained for employment income. In the SHIW-I survey, 38 percent of households (whose reference person is employed) report at least two recipients against a percentage of 28 percent in the CAWI survey. One possible explanation is that the presence of the interviewer helps and encourages the respondent (who generally provides the answers for all the other members of the family) to remember all the sources of income earned. In the CAWI survey, without the interviewer's insistence, the respondent probably tends to declare only the most important sources of income.

When considering per-capita values of employment and retirement incomes, the CAWI methodology produces results that are systematically higher than those collected in the SHIW-I survey (Figures 7 and 9). On the other hand, the CAPI technique produces higher values (Figure 8) for self-employment income. This result must however be interpreted with caution since these incomes have a high variability. That said, the result may also depend on the fact that the respondents to the SHIW-I survey are already familiar with the survey, together with the fact that interviewers are trained to reassure the respondent on the confidentiality of the data provided.

As a robustness check, statistical matching techniques are used to reduce the effect of nonresponse as much as possible. Tables 8 and 9 show the results obtained by using sub-samples of the SHIW-I respondents who have socio-demographic characteristics (age, gender, geographical area and educational qualification, employment, family type and residence tenure status) very similar to those of the WEBIT survey. The average value of employment income declared in WEBIT is significantly higher than that of the SHIW-I survey, while for the self-employment income the opposite situation is observed. Finally, CAPI is confirmed to be the most effective method for collecting information about the number of earners.

A further evaluation of the WEBIT survey is done integrating the survey data with tax data files (BDR). This operation is possible only for the reference person (the only member of the household who has to provide his/her personal id in order to participate to the survey).
As to the number of income recipients, the two sources are not completely aligned. The percentages of individuals who turn out to have an income in the BDR but who have not stated it in the web survey are around 11 percent for employment and pension incomes and 35 percent for self-employment income (Table 10). These differences may depend not only on measurement errors, but also on the different definitions adopted in the two sources (especially in the case of self-employed) and on the existence of some categories such as atypical jobs that are not easily identifiable in the web survey (and that are classified as self-employed in consistency with the tax definition). On the other hand, the share of income recipients present in the survey but not in the BDR is almost 2 percent for pension income, 5 percent for employment income and almost 48 percent for income from self-employment.

Since the tax records contain gross incomes, while the survey asks for net incomes, we transform gross incomes into net incomes by dividing the total amount of tax paid proportionally to the value of incomes. Considering also the margin of error due to this approximation, the values of the two sources are in line with regards to income from employment and retirement income (Table 10). The differences vary around 5 percent for employee income and 2 percent for retirement income. On the other hand, significant differences are confirmed for income from independent work, which are likely to be significantly affected by the different definitions adopted in the two sources. This result must however be interpreted with caution due to the low number of observations.
In terms of variability of income estimates, the estimates based on the CAWI survey show higher coefficients of variation than those relating to the CAPI survey for all types of income when non-weighted estimates are considered. The result is not univocal when we introduce weights: in this case the variability of CAWI estimates is lower for income from self-employment (Table 11).

### *4.3.2 Qualitative assessments of the household's economic conditions*

Further comparisons concern the qualitative self-assessment of the households economic condition.

Figure 10 shows the distribution of future income expectations. The question reads as follows: "Thinking of all sources of income (from work or pension, rents, capital rents, etc.), in 2016 their total amount will be higher, equal or lower than the one in 2015? ". In the SHIW-I survey, 81% of respondents use the "neutral" category, stating that their income will remain substantially unchanged. In the WEBIT survey, this percentage drops to 64.5%. Moreover, using the web mode, a greater number of families declare to expect a worsening of their economic situation (almost 18% compared to 8.4% of CAPI): this may suggest that respondents feel more free to give a truthful answer when they don't have to give it in front of a stranger. It should be noted, however, that web data report a higher nonresponse: the item "Don't know/No answer" is 10% compared to 3.5% in CAPI because of the interviewer's insistence.

Similar results emerge for questions on household savings or household indebtedness: "Considering all expenses and all sources of income, did your family spend less (saving), everything (without saving) or more of your annual income (getting into debt)? ". In the CAPI interview, households use more frequently the neutral response option (63.6% declare that expenses are equal to income, compared to 46.9% of CAWI). On the contrary, compiling the online questionnaire, families seem to "open up" more, declaring more frequently that they have spent more than the annual income (14.0% against 6.5%) or that they managed to put savings aside (39.1% against 30%) (Figure 11).

Similarly, comparing current expenditures to those of the previous year, a very high percentage of CAPI respondents state that there were no changes (82% compared to 38.5%), while with CAWI many more households declare an increase in expenses (48.3% against 15.2%) (Figure 12). The CAWI technique is confirmed to produce a higher frequency of "Don't know"/"No answer" (7.7% compared to 1.0%).

Even information on economic (and not-economic) assistance received by relatives appears to be more effectively measured using web mode: in the CAPI survey, households who received some form of assistance in the last 3 years are less than half of those resulting from the web survey (6.5 % against 17%, Fig. 13). Mode differences also emerge for financial debts: only 23% of CAPI interviewees declare it, while this percentage rises to almost 48% using the CAWI method (Figure 14).

In conclusion, a significant difference between the two modes is that web respondents tend to give less "neutral" answers and to report more difficult economic situations. This could result from a situation where respondents are able to answer more privately and freely, as the absence of the interviewer reduces the misreporting phenomena related to social desirability bias. In fact, the presence of an interviewer, though ensuring a lower non-response, seems to favor the increase in the choice of the neutral answer categories.

### *4.3.3 The effect of the presence of "Don't know" / "No answer" options*

The choice of whether or not offering respondents "Don't know" / "No answer" options is widely discussed in literature. "Forcing" respondents to give an answer has the advantage

of pushing respondents to make an effort to recover in their memory the information necessary to respond. Even if an inaccurate answer is provided, it will be more informative than any ex-post imputation model. The disadvantage is that some respondents may feel "authorized" to provide totally invented answers.

On the contrary, giving the possibility to say "Don't know" could help to obtain more sincere answers. However, the downside is that this answer option could be an easy shortcut for both the interviewer and the interviewee to reduce their burden. Most studies available in literature seem to agree that it is not advisable to include these options (for a review of these studies see Krosnick and Presser 2010).

The effect of the presence of "Don't know" / "No answer" options is tested using two qualitative questions, relating to household income and the value of the main residence.

Regarding the question on income, in the version of the questionnaire without the "no answer" options, almost 70 percent of households report that the income remained substantially the same as in the previous year. This percentage drops to 62.3 percent whit the "Don't know" option (Figure 15). Note that in this second version, there are 4.5 percent of respondents who state they do not know how their income has changed, while the "Higher" and "Lower" categories show similar frequencies in the two questionnaires. We can conclude that when there is no possibility of giving a "Don't know" answer, respondents tend to choose the "neutral" option (declaring for instance that the income has not changed).

Even more significant differences arise for the question on the expectation about the value of the main residence. The percentage of households who expect this this value to remain unchanged is equal to 75.4 percent when the "Don't know" option is not given, compared to 55.1% of the other version with a 16% of "Don't knows" (Figure 16).

Our results show that the "no answer" options should be included, at least in those questions where they represent plausible answers, as in the cases described above (it is not always easy or immediate to compare one's income with that of the previous year or estimate the future value of a house). For these types of questions, when excluding this response option, the "neutral" response categories need particular attention, since they are likely be overestimated.

## 5. Measures used to increase participation

Several studies have shown that incentives in web surveys have a positive effect on participation and that this effect increases for monetary and prepaid incentives (for a review see Göritz 2006 and 2010). Similar results are found for surveys using a different collection method (see for example the review by Singer and Ye, 2013). However, monetary and prepaid incentives are not very frequent in practice. One possible reason is that the participation rates that normally characterize web surveys are so low that the benefits that can be obtained from their increase are generally considered lower than the costs (Tourangeau et al., 2013).

The incentive used for the WEBIT survey (a lottery for 5 Ipads) produced only modest effects: overall, the increase in the probability of participation is about 0.5 percentage points, while the reduction in the probability of breakoff is about one percentage point (Figure 17). Both values are not significantly different from zero. However, the incentive

is more effective for some subgroups of the population. For example, significant effects were found for families living in the North West, in the Islands and for those living in small municipalities. Furthermore, the incentive is more effective for segments of the population potentially more interested in technological tools (such as males) or who probably thought of the incentive as a gift for a relative outside the family (such as singles aged over 65 or families without children, Figure 18).

Another strategy adopted to boost participation is the use of recalls. About one third of the sample was contacted by telephone and about 11% through e-mails. Furthermore, a second letter was sent to about 1,000 families chosen randomly among non-respondents.

The telephone calls were made by Istat personnel during office hours. This organizational constraint has obviously diminished the effectiveness of the strategy since the recalls were made during the day when older people are more available at home.

Telephone recalls reached 65.3% of households, but only slightly more than half of these (53.2%) were willing to answer. The results 'Free / No one answers', 'Rejected' and 'No internet' show the highest percentages (respectively 34, 23 and 17 percent). The main effect of telephone reminders was to induce people to register at the survey site (about 9% of those contacted by telephone). The stimulus to register was not followed, however, by an equally strong impulse to fill out the questionnaire: only 4.7% of the solicited, in fact, sent the questionnaire only partially completed. The reminders by e-mail reached about one third (32.1%). The invitation to complete the questionnaire was accepted by around 15% of the solicited.

Thanks to the joint action of all forms of reminders, the trend of filling out web questionnaires has increased over time (Figure 19) with a growth rate that has suffered a natural slowdown about a month and half after the opening of the survey. A slight boost to the compilation is recorded around the date of arrival of the reminder letter (end of May 2016).

## Conclusions

The paper discusses the advantages and disadvantages of web surveys on household income and wealth. The analysis focuses on the most problematic aspects of the method, that is coverage, non-response and measurement errors and takes advantage of an ad-hoc experimental survey realized by Banca d'Italia and Istat.

Coverage does not seem to represent a major, even for Italy where Internet diffusion is lower than in other European countries. Currently, the web instrument does not allow to reach about 30% of Italian households (around 7.7 millions); the likelihood of using Internet increases with the level of education and income. However, to date there are no groups of the population (defined on the basis of socio-demographic characteristics) totally unreachable. In fact, the presence of a member of the family who knows how to use the Internet is sufficient in order to participate in the survey. The use of web survey requires the availability of auxiliary information (such as tax data or socio-demographics) in order to correct ex-post for the bias introduced by the mentioned under-coverage issues.

The main problem with this instrument is the difficulty of obtaining satisfactory response rates. Since participation is associated to the economic condition of the households, nonresponse may introduce significant bias in the results. The use of a lottery as incentive

was only marginally helpful and exclusively for certain sub-groups of the population. The telephone recall activity also made a modest contribution, probably because it was carried out only during office hours.

A positive aspect, however, is that, contrary to what happens in the presence of an interviewer, the web tool seems suitable to interview the economically more well-off families. A first reason could be because of their level of education, which is generally higher than average, and the fact that they also possess the computer skills necessary to participate in a web survey. Moreover, the possibility of being able to fill in the questionnaire at the desired moments, without any pressure and even over several days, can convince those who cannot allocate around one hour of their time to an interviewer. The downside is of course represented by the need to have auxiliary information, such as tax information, to offset the tendency of the sample to over-represent the economically more well-off families.

As to measurement errors, the use of the web seems to help collecting more accurate information for some types of questions. We find that the per-capita values of the employment and pension income reported in the web survey are systematically higher than those of the CAPI survey. Moreover, they are close to those contained in tax records. A possible explanation is that the web allows respondents to retrieve the information requested by looking at their documents (such as tax declarations or bank statements) or by involving other members of the family. These results are also made robust by the fact that the CAPI survey is conducted on panel families, typically characterized by greater confidence towards the interviewers and therefore by a high propensity to give truthful answers.

Moreover, the web seems to boost individuals to respond more freely to qualitative questions even if they relate sensitive topics. For example, respondents to the WEBIT survey systematically tend to use less neutral response options to questions about their economic conditions, signaling more frequently difficult situations.

On the other hand, the web seems less suitable for collecting information on sources of income that are perceived by respondents as sensitive, such as those for self-employment. This result should be interpreted with caution since it is based on few observations. Nevertheless, it could be due to the interviewers' ability to reassure about the confidentiality of the answers and to the familiarity with the CAPI survey (that was conducted among panel households). Furthermore, the physical presence of the interviewer at the interviewee's home may make it more difficult to hide their standard of living and therefore declare income that is too far from what is actually earned. Furthermore, it should also be noted that in the WEBIT survey, unlike the SHIW-I survey, respondents received a personal invitation letter (with their first and last name) and this may have created some concerns about the confidentiality of their answers (despite the assurances provided).

Another limitation of the web technique is that it under-estimates the number of declared recipients compared to the CAPI survey. This result could depend on the fact that, in the absence of an interviewer who prompts respondents reminding them to declare each (albeit minimal) source of income, they tend to report only the main ones, in order to reduce their response burden.

In general, therefore, even if the use of the interviewers implies higher costs and the possibility of introducing errors, their contribution in convincing the selected families to participate in the survey, in persuading, clarifying and motivating the respondents during

the interview, results at the moment difficult to replace. It is instead imaginable to develop mixed data collection techniques that make it possible to exploit the strengths of both methods. For example, in the case of the survey on household income and wealth that is carried out every two years by the Banca d'Italia, the web tool could be used in the intervening years to carry out qualitative surveys on families that have already participated in the main survey. These families generally have a greater propensity to collaborate and, moreover, the availability of auxiliary information present in the main survey would allow to keep under control the phenomena of under-coverage and non-response.

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## Appendix A – Tables and figures

**Table 1:** Composition of the theoretical and the empirical sample for web survey (Percentages, unweighted statistics)

| | | *Sample* | |
|---|---|---|---|
| | | *Theoretical* | *Empirical* |
| *Gender** | Female | 35.99 | 27.90 |
| | Male | 64.01 | 72.10 |
| *Age** | 34 and under | 7.11 | 6.97 |
| | 35-44 | 15.84 | 17.14 |
| | 45-54 | 20.52 | 22.93 |
| | 55-64 | 17.98 | 21.87 |
| | Over 64 | 38.55 | 31.09 |
| *Young person in the household*** | | 51.44 | 60.28 |
| *Number of household members* | 1 | 33.38 | 27.30 |
| | 2 | 26.33 | 24.70 |
| | 3 | 19.22 | 24.35 |
| | 4 | 14.99 | 18.91 |
| | 5 and more | 6.08 | 4.73 |
| *Children in the household* | | 44.92 | 52.48 |
| *Married** | | 47.84 | 56.97 |
| *Quintiles of household (fiscal) income* | Not in BDR*** | 11.34 | 5.44 |
| | 1º quintile | 17.74 | 8.04 |
| | 2º quintile | 17.75 | 10.99 |
| | 3º quintile | 17.72 | 16.90 |
| | 4º quintile | 17.74 | 24.82 |
| | 5º quintile | 17.73 | 33.81 |
| *Other real estates* | | 35.62 | 45.15 |
| *Geographical area* | North | 42.42 | 51.89 |
| | Centre | 21.59 | 21.87 |
| | South and Islands | 35.99 | 26.24 |
| *Town size (inhabitants)* | up to 20.000 | 10.77 | 10.99 |
| | from 20.000 to 40.000 | 16.55 | 15.84 |
| | from 40.000 to 500.000 | 63.71 | 62.65 |
| | over 500000 | 8.97 | 10.52 |
| *Citizenship** | Italian | 92.46 | 99.17 |
| *Total* | | 100.00 | 100.00 |

(*) Individual characteristics refer to the head of household as recorded in the Register Office. (**) Family with at least one component less than 40 years old. (***) Tax data files (BDR).

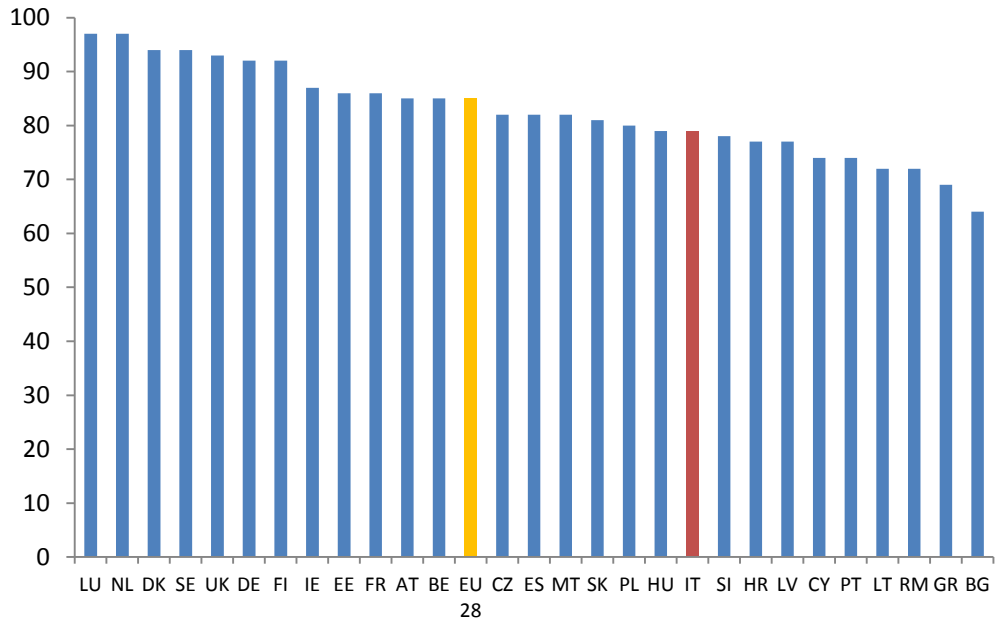


**Figure 1:** Share of households with internet access in 2016 (percentages). Source: Eurostat, Community survey on ICT usage in households and by individuals (households with at least one member aged between 16 and 74).

**Table 2:** Internet diffusion in the Italian population
(Percentages)

| *Characteristics** | | *Households with internet access* | *Households without internet access* |
|---|---|---|---|
| *Gender* | Male | 73.3 | 26.7 |
| | Female | 60.9 | 39.1 |
| *Age* | 34 and under | 94.2 | 5.8 |
| | da 35 a 44 | 90.5 | 9.6 |
| | da 45 a 54 | 91.0 | 9.0 |
| | da 55 a 64 | 78.0 | 22.0 |
| | over 64 | 34.4 | 65.7 |
| *Work status* | Employee | 91.1 | 8.9 |
| | Self-employed | 92.7 | 7.3 |
| | not employed | 40.9 | 59.1 |
| *Educational qualification* | None | 5.7 | 94.3 |
| | Primary school certificate | 18.0 | 82.0 |
| | Secondary school certificate | 74.8 | 25.2 |
| | Upper Secondary school diploma | 88.0 | 12.0 |
| | University degree | 95.7 | 4.3 |
| *Quintiles of household income* | 1º quintile | 40.6 | 59.4 |
| | 2º quintile | 58.5 | 41.6 |
| | 3º quintile | 71.2 | 28.8 |
| | 4º quintile | 85.8 | 14.2 |
| | 5º quintile | 93.8 | 6.3 |
| *Quintiles of household net wealth* | 1º quintile | 61.7 | 38.3 |
| | 2º quintile | 66.9 | 33.2 |
| | 3º quintile | 63.1 | 36.9 |
| | 4º quintile | 77.8 | 22.2 |
| | 5º quintile | 77.5 | 22.5 |
| *Geographical area* | North | 75.2 | 24.8 |
| | Centre | 70.6 | 29.4 |
| | South and Islands | 60.1 | 39.9 |
| *Town size (inhabitants)* | up to 20.000 | 63.0 | 37.0 |
| | da 20000 a 40000 | 71.3 | 28.7 |
| | da 40000 a 500000 | 73.5 | 26.5 |
| | over 500000 | 79.9 | 20.1 |
| *Total* | | 69.4 | 30.6 |

Source: Authors' elaborations on data from the Banca d'Italia, SHIW-I. (*) Individual characteristics refer to the head of household, i.e. the member with the highest income.

**Table 3:** Probability of having access to the Internet (logistic model)

| *Characteristics** | | *Parameter* | *P-value* |
|---|---|---|---|
| *Intercept* | | 0.694 | 0.3562 |
| *Gender** | Male | 0.141 | 0.3923 |
| | Female | -- | -- |
| *Age** | 34 and under | 1.881 | <.0001 |
| | 35-44 | 2.021 | <.0001 |
| | 45-54 | 2.503 | <.0001 |
| | 55-64 | 1.492 | <.0001 |
| | Over 64 | -- | -- |
| *Young person in the household* | | 1.790 | <.0001 |
| *Number of household members* | 1 | 0.656 | 0.2515 |
| | 2 | 0.559 | 0.2273 |
| | 3 | 0.089 | 0.8216 |
| | 4 | 0.323 | 0.4399 |
| | 5 and more | -- | -- |
| *Children in the household* | | 0.315 | 0.3305 |
| *Married* | | 0.000 | 0.9989 |
| *Quintiles of household (fiscal) income* | 1º quintile | -3.489 | <.0001 |
| | 2º quintile | -2.530 | <.0001 |
| | 3º quintile | -1.946 | <.0001 |
| | 4º quintile | -1.203 | <.0001 |
| | 5º quintile | -- | -- |
| *Other real estates*** | | 0.421 | 0.0167 |
| *Geographical area* | North | 0.398 | 0.0170 |
| | Centre | 0.178 | 0.3518 |
| | South and Islands | -- | -- |
| *Town size (inhabitants)* | up to 20.000 | -1.175 | 0.0004 |
| | from 20.000 to 40.000 | -0.867 | 0.0048 |
| | from 40.000 to 500.000 | -0.803 | 0.0030 |
| | over 500000 | -- | -- |
| *Citizenship** | *Italian* | 0.301 | 0.3653 |

Source: Authors' elaborations on data from the Banca d'Italia, SHIW-I. (*) Individual characteristics refer to the head of household, i.e. the member with the highest income. Pseudo $R^2$=0,35. (**) Ownership of dwellings other than the household main residence.

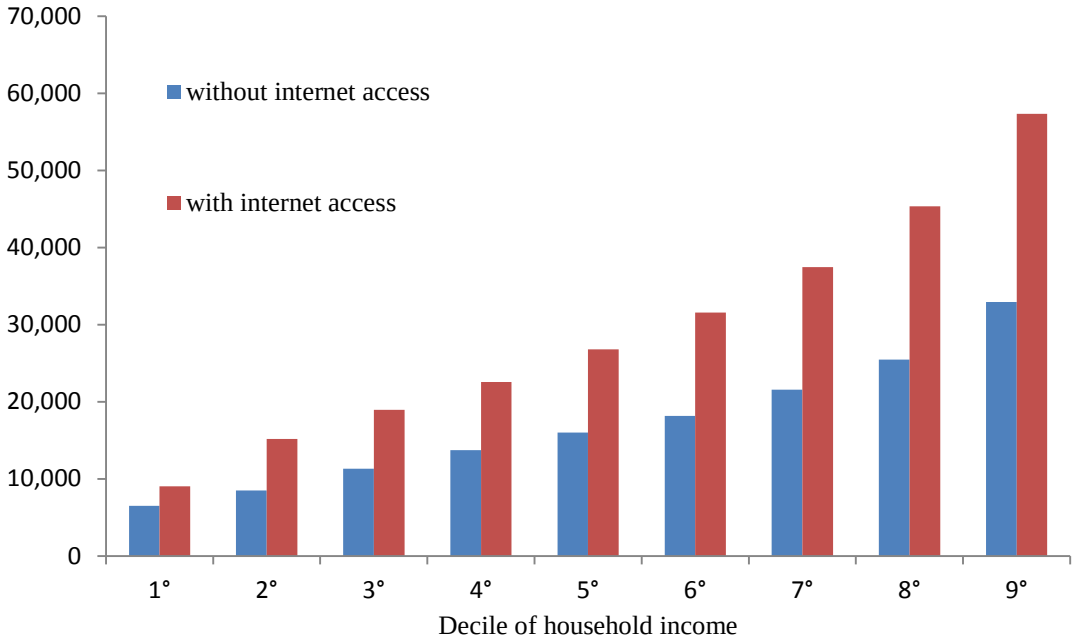


**Figure 2:** Deciles of household net income by internet access (euro)

**Table 4:** Probability of completing the web survey (logistic model)

| Characteristics* | | Parameter | Pr > ChiSq |
|---|---|---|---|
| *Intercept* | | -4.621 | <.0001 |
| *Gender** | Male | 0.023 | 0.8177 |
| | Female | -- | -- |
| *Age** | 34 and under | -0.074 | 0.7123 |
| | 35-44 | -0.163 | 0.2252 |
| | 45-54 | -0.265 | 0.0187 |
| | 55-64 | -0.142 | 0.2001 |
| | Over 64 | -- | -- |
| *Young person in the household* | | -0.033 | 0.8171 |
| *Number of household members* | 1 | 1.075 | 0.0003 |
| | 2 | 0.528 | 0.0255 |
| | 3 | 0.459 | 0.0129 |
| | 4 | 0.368 | 0.0497 |
| | 5 and more | -- | -- |
| *Children in the household* | | 0.153 | 0.3885 |
| *Married* | | 0.351 | 0.0073 |
| *Quintiles of household (fiscal) income* | 1º quintile | -0.698 | <.0001 |
| | 2º quintile | -0.611 | <.0001 |
| | 3º quintile | -0.443 | 0.0002 |
| | 4º quintile | -0.186 | 0.0682 |
| | 5º quintile | -- | -- |
| *Other real estates* | | -0.054 | 0.5088 |
| *Geographical area* | North | 0.390 | <.0001 |
| | Centre | 0.205 | 0.0591 |
| | South and Islands | -- | -- |
| *Town size (inhabitants)* | up to 20.000 | -0.014 | 0.934 |
| | from 20.000 to 40.000 | -0.098 | 0.5111 |
| | from 40.000 to 500.000 | -0.043 | 0.7335 |
| | over 500000 | -- | -- |
| *Citizenship** | Italian | 2.177 | <.0001 |

(*) Individual characteristics refer to the head of household defined as the person who is most knowledgeable on household's financial matters. Breakoffs are considered as non-responses. The model is estimated on eligible households.

**Table 5:** Probability of participating* in the web survey (logistic model)

| *Characteristics*** | | *Parameter* | *Pr > ChiSq* |
|---|---|---|---|
| *Intercept* | | -3.447 | <.0001 |
| *Gender*** | Male | -0.071 | 0.4365 |
| | Female | -- | -- |
| *Age*** | 34 and under | 0.250 | 0.1883 |
| | 35-44 | 0.003 | 0.9791 |
| | 45-54 | 0.030 | 0.7713 |
| | 55-64 | 0.027 | 0.7941 |
| | Over 64 | -- | -- |
| *Young person in the household* | | -0.099 | 0.456 |
| *Number of household members* | 1 | 0.738 | 0.0061 |
| | 2 | 0.470 | 0.0283 |
| | 3 | 0.523 | 0.002 |
| | 4 | 0.369 | 0.0321 |
| | 5 and more | -- | -- |
| *Children in the household* | | -0.009 | 0.9539 |
| *Married* | | 0.253 | 0.0299 |
| *Quintiles of household (fiscal) income* | 1º quintile | -0.737 | <.0001 |
| | 2º quintile | -0.791 | <.0001 |
| | 3º quintile | -0.534 | <.0001 |
| | 4º quintile | -0.308 | 0.0009 |
| | 5º quintile | -- | -- |
| *Other real estates* | | 0.032 | 0.6704 |
| *Geographical area* | North | 0.322 | 0.0002 |
| | Centre | 0.143 | 0.1537 |
| | South and Islands | -- | -- |
| *Town size (inhabitants)* | up to 20.000 | -0.226 | 0.1505 |
| | from 20.000 to 40.000 | -0.284 | 0.0436 |
| | from 40.000 to 500.000 | -0.081 | 0.4877 |
| | over 500000 | -- | -- |
| *Citizenship*** | Italian | 1.614 | <.0001 |

(*) Breakoffs are considered as participations. (**) Individual characteristics refer to the head of household defined as the person who is most knowledgeable on household's financial matters. The model is estimated on eligible households.

**Table 6:** Households net income and socio-demographic characteristics (dependent variable: logarithm of net income)

| *Characteristics** | | *Parameter* | *Pr > ChiSq* |
|---|---|---|---|
| *Intercept* | | 10.26 | <.0001 |
| *Gender** | Female | -0.134 | <.0001 |
| | Male | -- | . |
| *Age** | 34 and under | -0.588 | <.0001 |
| | 35-44 | -0.365 | <.0001 |
| | 45-54 | -0.235 | <.0001 |
| | 55-64 | -0.044 | 0.1694 |
| | Over 64 | -- | -- |
| *Young person in the household* | | -0.167 | <.0001 |
| *Number of household members* | 1 | -0.612 | <.0001 |
| | 2 | -0.294 | <.0001 |
| | 3 | -0.025 | 0.56 |
| | 4 | 0.038 | 0.39 |
| | 5 and more | -- | -- |
| *No children* | | 0.066 | 0.14 |
| *Not Married* | | -0.146 | <.0001 |
| *Geographical area* | North | 0.390 | <.0001 |
| | Centre | 0.300 | <.0001 |
| | South and Islands | -- | -- |
| *Town size (inhabitants)* | up to 20.000 | 0.075 | 0.12 |
| | from 20.000 to 40.000 | 0.060 | 0.16 |
| | from 40.000 to 500.000 | 0.052 | 0.15 |
| | over 500000 | -- | -- |
| *Citizenship** | Italian | 0.762 | <.0001 |

(*) Individual characteristics refer to the head of household as recorded in the Register Office. Model estimated on individuals present in the tax data files (obs.=8,823). Pseudo $R^2$=0,21.

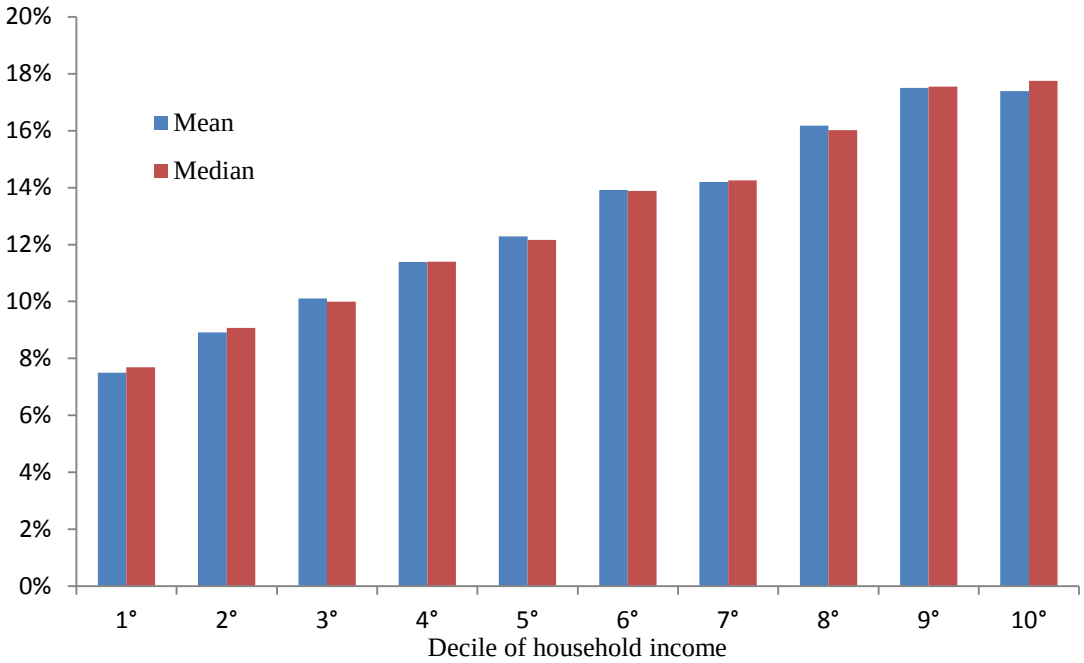


**Figure 3:** Estimate survey participation probability by households' income decile

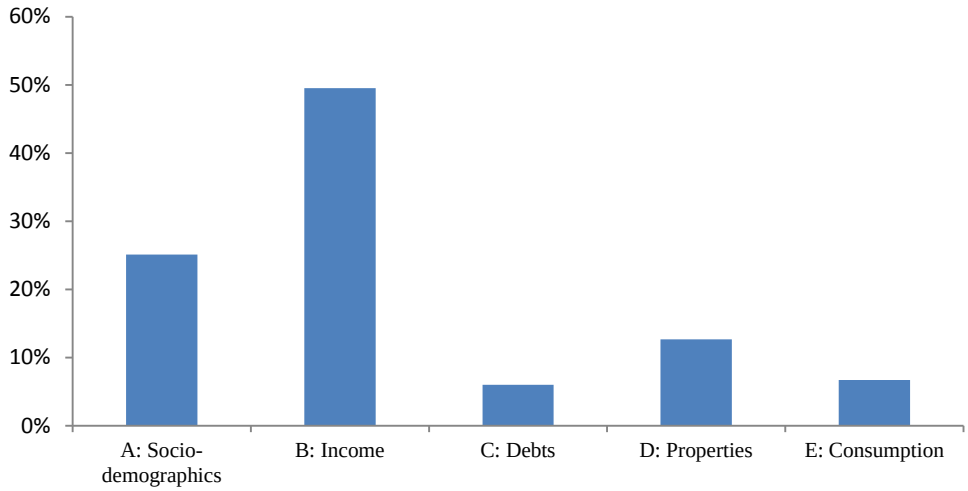


**Figure 4:** Distribution of breakoffs by questionnaire sections

**Table 7:** Joint probability of participating* and being eligible to the web survey (bivariate probit model)

| | | *Eligibility* | | *Participation* | |
|---|---|---|---|---|---|
| *Characteristics*** | | *Parameter* | *Pr > ChiSq* | *Parameter* | *Pr > ChiSq* |
| *Intercept* | | -0.521 | 0.000 | -2.353 | 0.000 |
| *Gender*** | Male | 0.133 | 0.001 | 0.051 | 0.321 |
| | Female | -- | -- | -- | -- |
| *Age*** | 34 and under | 0.033 | 0.672 | -0.070 | 0.437 |
| | 35-44 | 0.288 | 0.000 | -0.107 | 0.262 |
| | 45-54 | -0.287 | 0.000 | -0.112 | 0.254 |
| | 55-64 | -1.130 | 0.000 | -0.228 | 0.043 |
| | Over 64 | -- | -- | -- | -- |
| *Young person in the household* | | 0.966 | 0.000 | 0.145 | 0.058 |
| *Number of household members* | 1 | -0.051 | 0.363 | -0.241 | 0.001 |
| | 2 | -0.354 | 0.000 | -0.314 | 0.011 |
| | 3 | -0.361 | 0.001 | -0.384 | 0.004 |
| | 4 | -0.464 | 0.000 | -0.563 | 0.000 |
| | 5 and more | -- | -- | -- | -- |
| *Children in the household* | | 0.210 | 0.001 | 0.097 | 0.277 |
| *Married* | | -0.027 | 0.617 | 0.142 | 0.033 |
| *Quintiles of household (fiscal) income* | 1º quintile | -1.645 | 0.000 | -0.628 | 0.000 |
| | 2º quintile | -1.175 | 0.000 | -0.511 | 0.000 |
| | 3º quintile | -0.906 | 0.000 | -0.355 | 0.000 |
| | 4º quintile | -0.504 | 0.000 | -0.160 | 0.004 |
| | 5º quintile | -- | -- | -- | -- |
| *Other real estates* | | 0.254 | 0.000 | 0.021 | 0.629 |
| *Geographical area* | North | 0.279 | 0.000 | 0.228 | 0.000 |
| | Centre | 0.169 | 0.000 | 0.120 | 0.028 |
| | South and Islands | -- | -- | -- | -- |
| *Town size (inhabitants)* | up to 20.000 | -0.619 | 0.000 | -0.098 | 0.260 |
| | from 20.000 to 40.000 | -0.393 | 0.000 | -0.109 | 0.165 |
| | from 40.000 to 500.000 | -0.383 | 0.000 | -0.081 | 0.226 |
| | over 500000 | -- | -- | -- | -- |
| *Citizenship*** | Italian | 0.254 | 0.000 | 0.924 | 0.000 |
| Rho 0.68 (0.0001) | | | | | |

(*) Breakoffs are considered as participations to the survey. (**) Individual characteristics refer to the head of household defined as the person who is most knowledgeable on household's financial matters.

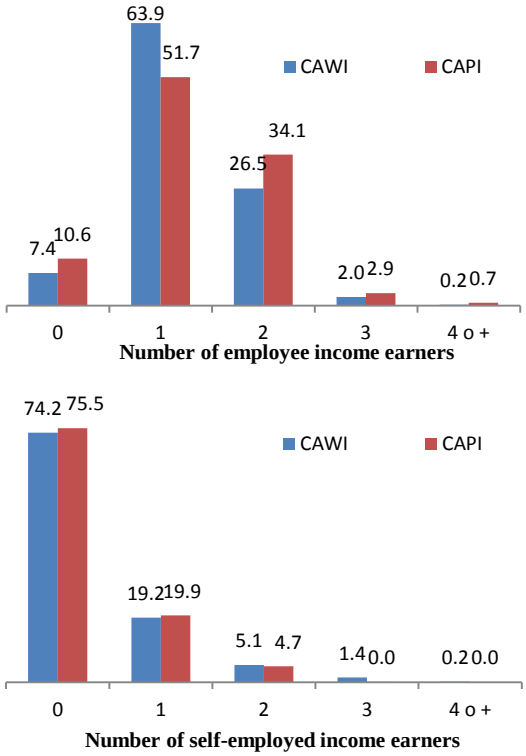


**Figure 5:** Distribution of income earners (households with working reference person)

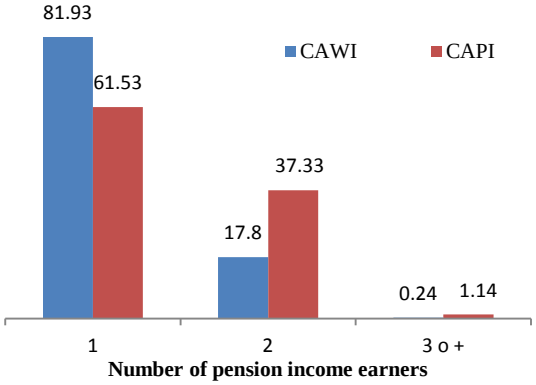


**Figure 6:** Distribution of pension income earners (households with retired reference person)

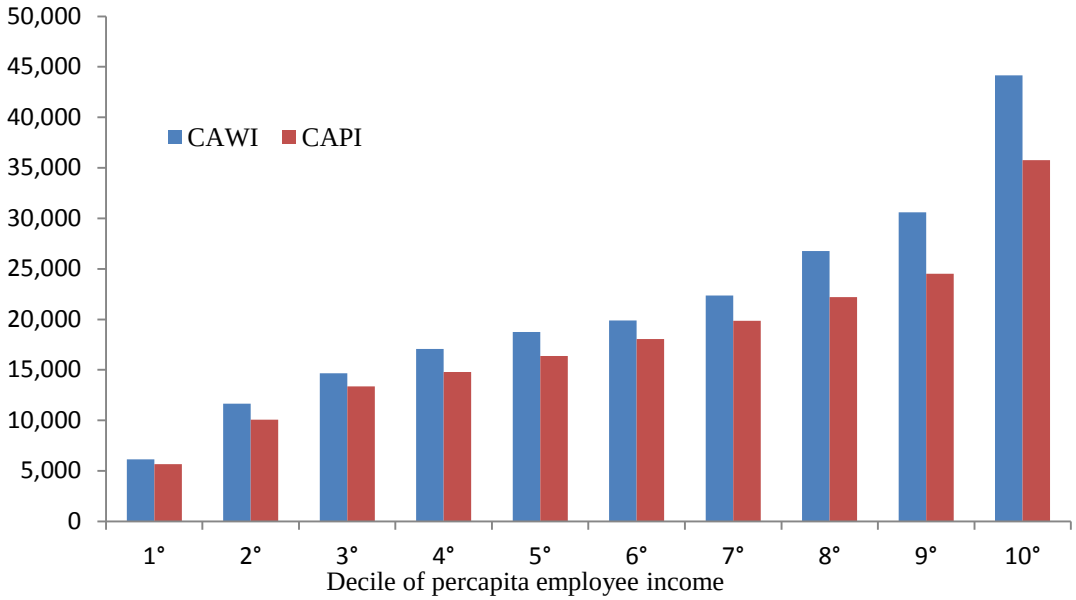


**Figure 7:** Mean employee income by income deciles (euro); Households with employed reference person. Deciles are calculated on the distribution of the households' per capita employee income. Per capita income is calculated for each household as the ratio between the household employee income and the number of earners.

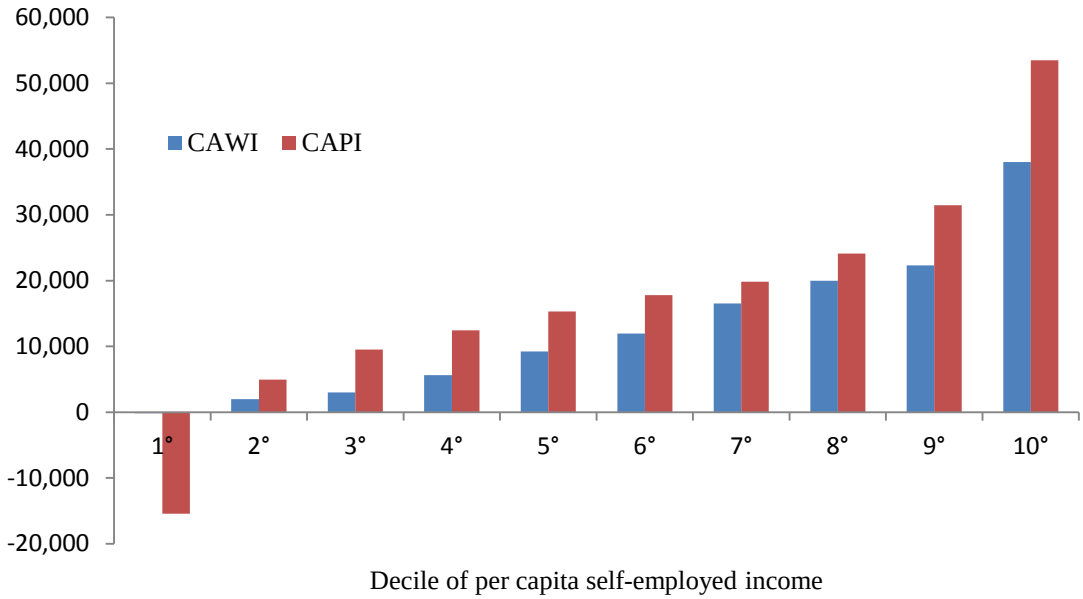


**Figure 8:** Mean self-employed income by income deciles (euro) Households with self-employed reference person. Deciles are calculated on the distribution of the households' per capita self-employed income. Per capita income is calculated for each household as the ratio between the household self-employed income and the number of earners

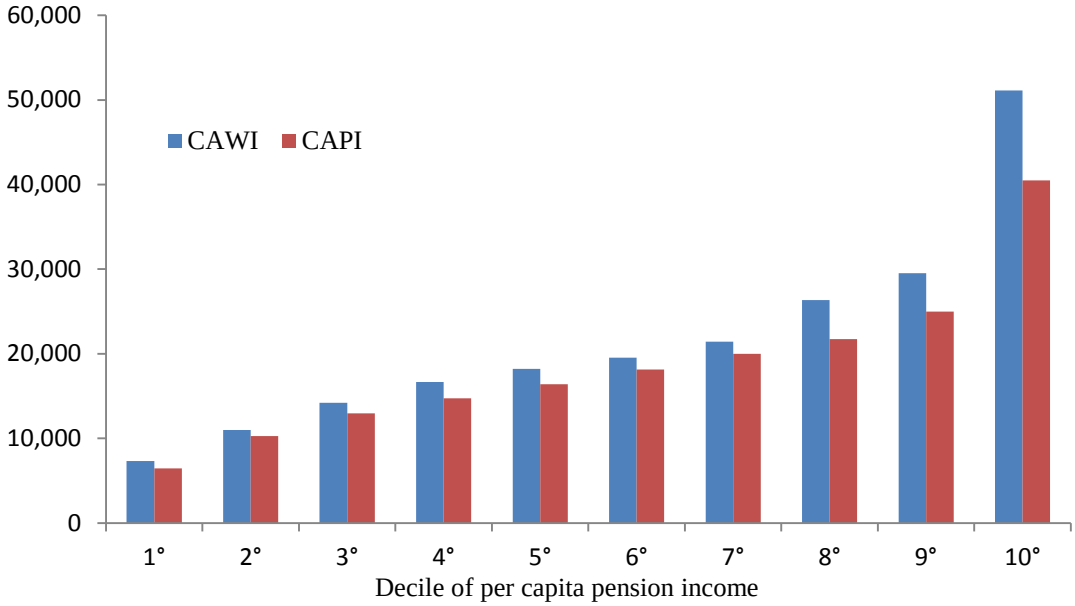


**Figure 9** Mean pension income by income decile (euro) Households with retired reference person. Deciles are calculated on the distribution of the households' per capita pension income. Per capita income is calculated for each household as the ratio between the household pension income and the number of earners

**Table 8:** Balancing of CAWI and CAPI samples selected with propensity score matching (example concerning the analysis of the number of income earners)

| | *Mean values* | | *P-value* |
|---|---|---|---|
| *Characteristics** | *CAWI* | *CAPI* | *diff.* |
| *Female* | 0.282 | 0.268 | 0.525 |
| *35-44* | 0.178 | 0.174 | 0.818 |
| *45-54* | 0.230 | 0.231 | 0.957 |
| *55-64* | 0.234 | 0.244 | 0.618 |
| *Over 64* | 0.293 | 0.288 | 0.827 |
| *University degree* | 0.284 | 0.276 | 0.719 |
| *Employed* | 0.354 | 0.344 | 0.688 |
| *Centre* | 0.217 | 0.215 | 0.911 |
| *South and Islands* | 0.263 | 0.267 | 0.854 |
| *Single under 65* | 0.181 | 0.188 | 0.739 |
| *Couple without children* | 0.206 | 0.211 | 0.820 |
| *Couple with children* | 0.390 | 0.389 | 0.961 |
| *Single parent with children* | 0.069 | 0.072 | 0.774 |
| *Other household type* | 0.064 | 0.060 | 0.731 |
| *Renter* | 0.128 | 0.128 | 0.996 |

* Individual characteristics refer to reference person defined as…

**Table 9:** Comparison of employment and pension income in SHIW-I and WEBIT surveys (number of income earners; mean values in euro Matching method: radius, caliper 0.03)

| | *Observations* | | *Mean values* | | *P-value* |
|---|---|---|---|---|---|
| | *CAPI* | *CAWI* | *CAPI* | *CAWI* | *diff.* |
| *Income from payroll employment* | | | | | |
| *Average number of earners per household* | 1,272 | 843 | 0.988 | 0.998 | 0.74 |
| *Mean value for earner* | 907 | 562 | 18.600 | 19.614 | 0.06 |
| *Income from self-employment* | | | | | |
| *Average number of earners per household* | 1,347 | 843 | 0.232 | 0.287 | 0.02 |
| *Mean value for earner* | 251 | 184 | 18.650 | 10.704 | 0.00 |
| *Pension income* | | | | | |
| *Average number of earners per household* | 1,347 | 845 | 0.437 | 0.331 | 0.00 |
| *Mean value for earner* | 503 | 314 | 17.255 | 17.249 | 0.90 |

**Table 10:** Comparison between CAWI e BDR
(income earners; mean values in euro)

| | *Obs.* | *CAWI* | *BDR* |
|---|---|---|---|
| *Income from payroll employment* | 441 | | |
| *Share of earners not in BDR* | | 5.4 | - |
| *Share of earners not in CAWI* | | - | 11.3 |
| *Mean* | | 24,907 | 26,326 |
| *Median* | | 21,937 | 23,135 |
| *Income from self-employment* | 99 | | |
| *Share of earners not in BDR* | | 47.9 | - |
| *Share of earners not in CAWI* | | - | 35.1 |
| *Mean* | | 25,754 | 23,635 |
| *Median* | | 19,500 | 14,419 |
| *Pension income* | 261 | | |
| *Share of earners not in BDR* | | 1.9 | - |
| *Share of earners not in CAWI* | | - | 11.5 |
| *Mean* | | 21,014 | 21,635 |
| *Median* | | 19,123 | 19,416 |

Mean and median values are calculated on the individuals present in both sources (CAWI and BDR).

**Table 11:** Comparison of employment and pension income variability in SHIW-I and WEBIT
(Coefficient of variation; inter-decile ratios)

| | Weighted estimates | | Unweighted estimates | |
|---|---|---|---|---|
| | *CAWI* | *CAPI* | *CAWI* | *CAPI* |
| *Income from payroll employment* | | | | |
| *Coefficient of variation* | 69.0 | 60.1 | 65.7 | 58.2 |
| *P95/P5* | 7.1 | 8.2 | 9.3 | 7.4 |
| *Income from self-employment* | | | | |
| *Coefficient of variation* | 122.0 | 141.5 | 159.6 | 120.0 |
| *P90/P10*[*] | 135.0 | 22.7 | 178.0 | 16.7 |
| *Pension income* | | | | |
| *Coefficient of variation* | 56.2 | 49.0 | 59.1 | 53.9 |
| *P95/P5* | 6.8 | 7.1 | 7.2 | 6.1 |

[*]With respect to this income source P5 is equal to zero.

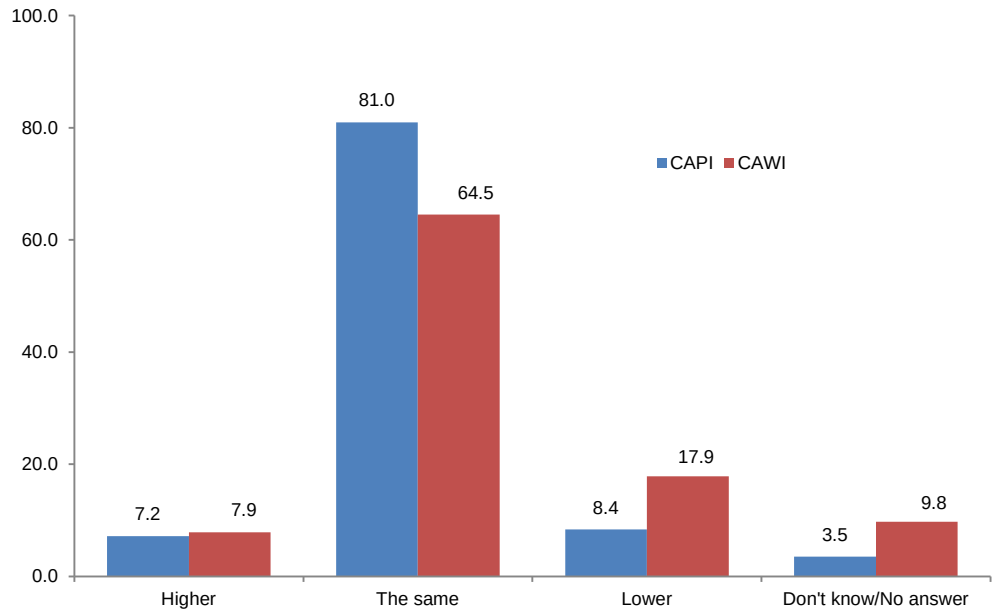


**Figure 10** Considering the total income of your household in 2016, would you expect that compared to that of 2015 it will be …(percentages)

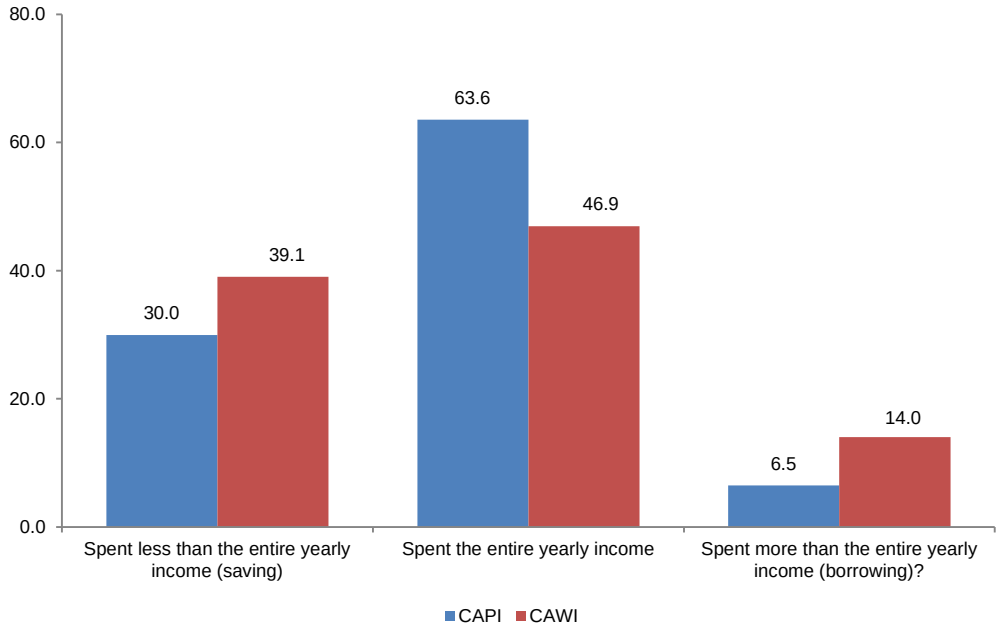


**Figure 11** Considering all of the sources of income for your household in 2015, could you tell me if in 2015 your household spent less (saving), all (with no savings) or more that entire yearly income (borrowing)? (percentages)

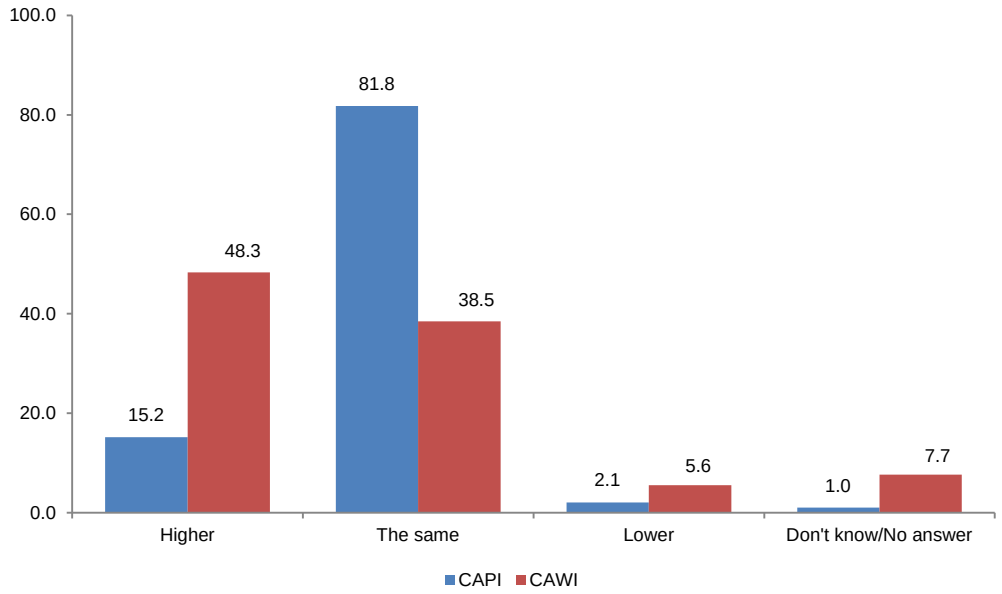


**Figure 12** The average spending supported by your family for all consumption in 2015 was higher, lower or about the same than what you spent in 2014? (percentages)

*(Percentages)*

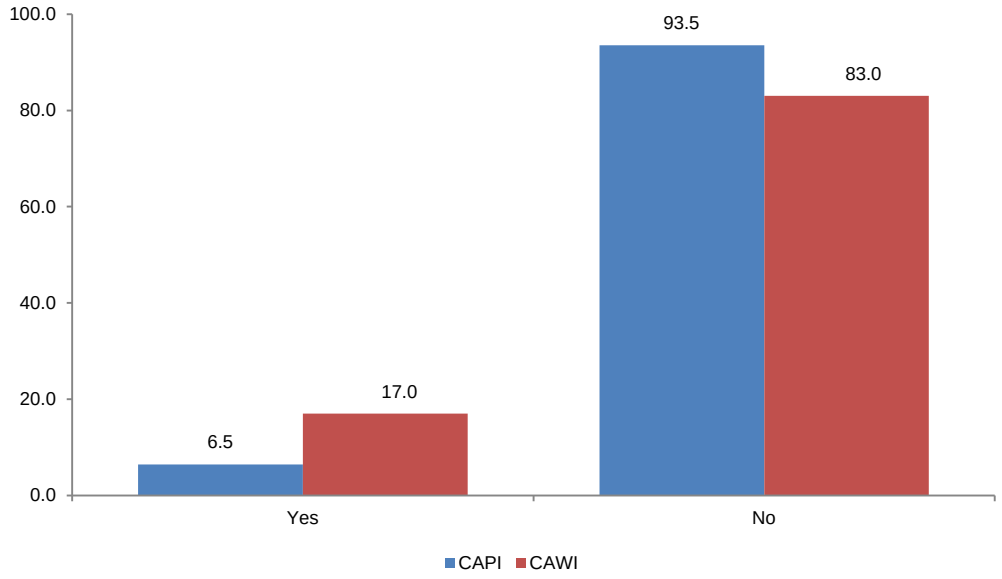


**Figure 13** During the last 3 years did your household receive any (economic or non-economic) assistance by relatives or friends not living with the household? (percentages)

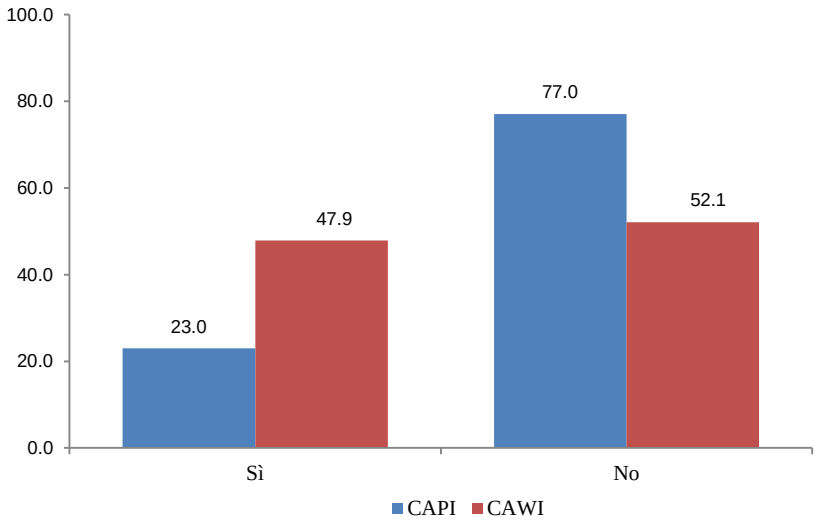


**Figure 14** At the end of 2015 did your household have debts with banks or financial companies? (percentages)

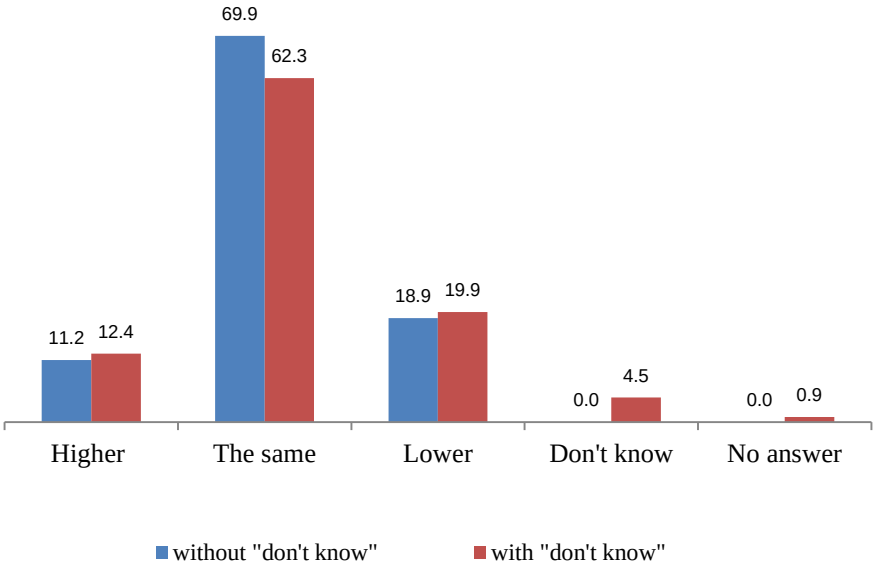


**Figure 15** Considering the total income of your household in 2015, would you say that it was higher, lower or about the same as the yearly income of your household in 2014? (percentages)

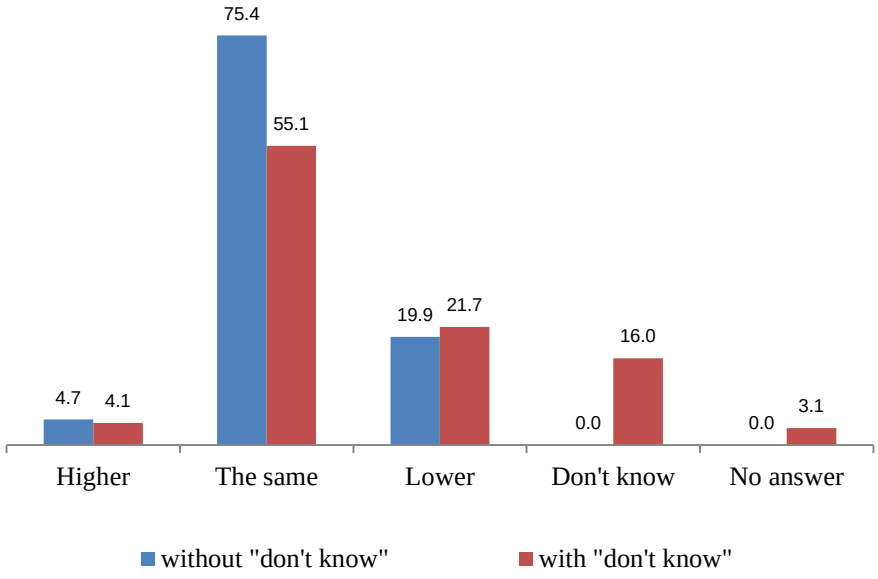


**Figure 16** In your opinion, at the end of 2016 the value of your main residence will be:…...? (percentages)

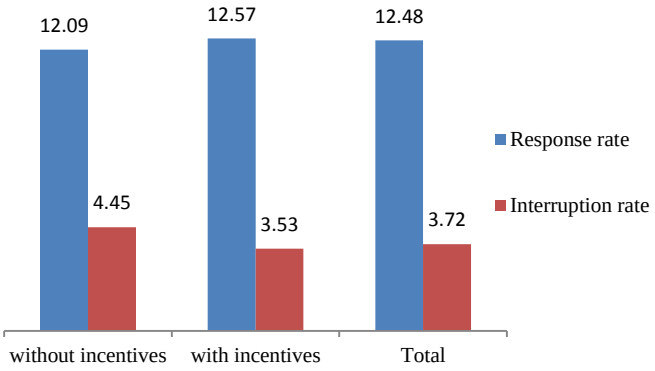


**Figure 17** Response and breakoff rates (percentages)

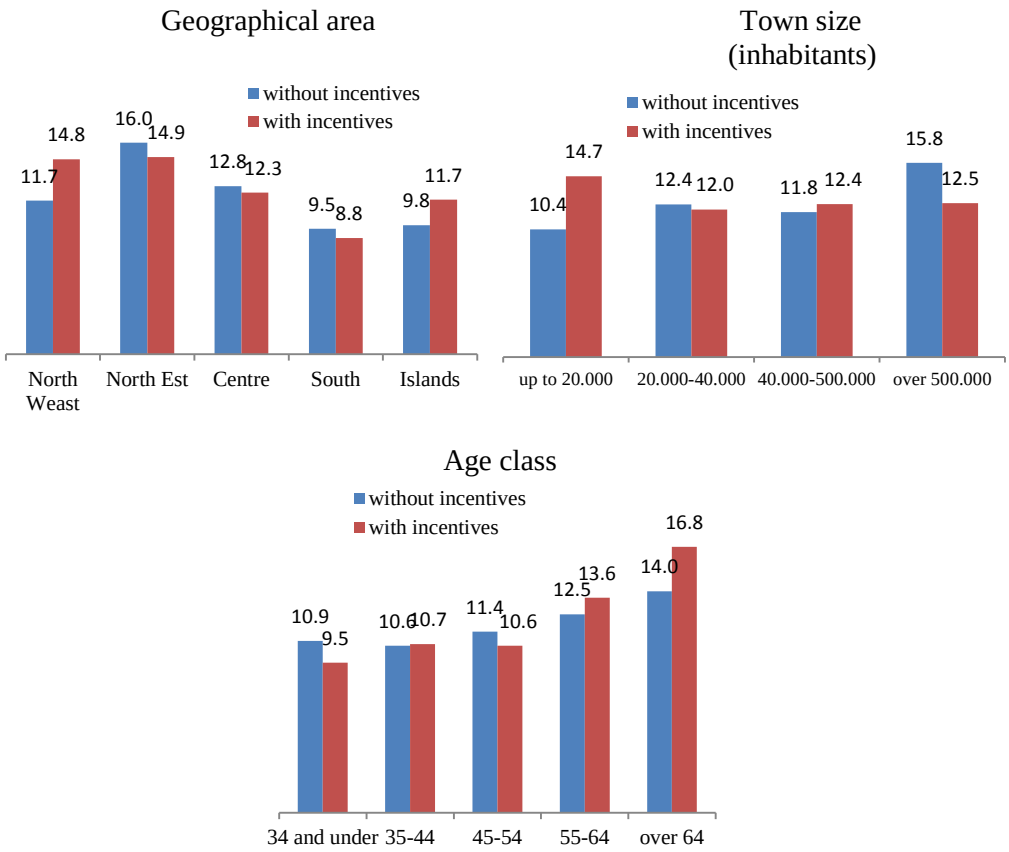


**Figure 18** Response rates by… (percentages)

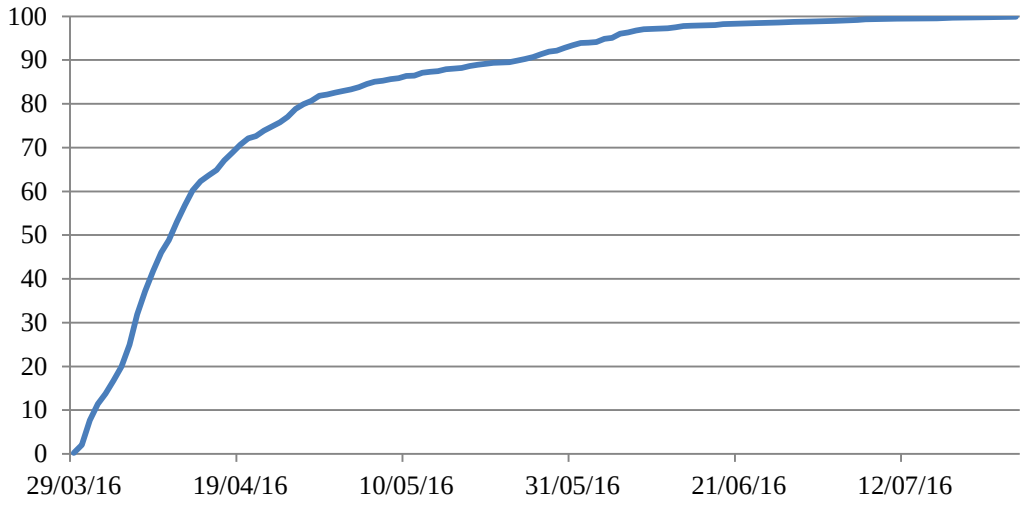


**Figure 19** Trend in web survey completion rate

## Appendix B – Sampling weights

The final weight of each sampling unit is the result of the following steps:

a) an initial weight is computed as the inverse of selection probability (design weight $w^{(0)}$);

b) this weight is then adjusted for unit nonresponse ($w^{(1)}$) by multiplying $w^{(0)}$ by the inverse of response rate in the municipality;

c) Last, $w^{(1)}$ is calibrated to account for additional information coming from external surveys (the final weight is $w^{(2)}$).

In accordance with the sampling design each person in the household is given an initial weight, being the inverse of his/her probability of inclusion in the sample (*design weight*). This weight is constant at the municipality level and is computed as follows:

$$(1) \qquad w_{hi}^{(0)} = \frac{1}{m_h}\frac{P_h}{P_{hi}}\frac{P_{hi}}{n'_{hi}} = \frac{1}{m_h}\frac{P_h}{n'_{hi}}$$

where $P_h$ and $m_h$ are respectively the resident population and the number of sample municipalities in the $h^{th}$ stratum, and $P_{hi}$ and $n'_{hi}$ are respectively the population and the number of persons to be interviewed in the municipality *j* of stratum *h*. [10]

The design weight is further adjusted for unit nonresponse. The correction consists in inflating the weights by the ratio between the size of the theoretical sample and the size of the actual sample (*Weighting Class Adjustment*):

$$(2) \qquad w_{hi}^{(1)} = w_{hi}^{(0)}\frac{n'_{hi}}{n_{hi}}$$

where $n_{hi}$ is the number of respondents in municipality *i* and stratum *h*. This correction assumes that the response probability is the same for all households belonging to the same municipality.

As a robustness check, the adjustment for the non-response was also carried out on the basis of the model described in paragraph 4.2. The adjustment factor in this case is represented by the estimated probability of response for each family (which therefore varies within each municipality):

$$(2a) \qquad w_j^{(1')} = w_j^{(0)}\alpha_j$$

where $\alpha_j$ represents the inverse of the estimated response probability for the family *j*.

[10] In the case of municipalities that are always included in the theoretical sample (*self-representing municipality*), the probability of a household being extracted in a selected municipality is approximately equal to $n_{hi}/P_{hi}$. Municipalities that are not self-representing are selected with a probability proportional to size (PPS); the probability of selection of the municipality *j* in the $h^{th}$ stratum is therefore equal to $m_hP_{hi}/P_h$. A household's probability of being included in the sample can therefore be written as: $m_hn_{hi}/P_h$.

This approach is based on the assumption that the estimation of the model must be done on eligible families (i.e. those who have access to the web). As described in paragraph 4.2, this information is not available in our case, where the sample has been selected from the registry lists that do not contain data about households' web access. To avoid this drawback, it was therefore necessary to estimate for each sample unit its eligibility using a model estimated using the CAPI survey data (SHIW-I).

Finally, the weights are calibrated at households' level using external information available from the SHIW-I survey.[11] The correction is carried out by imposing to the final sample the alignment to the web population characteristics with regard to gender, age group (under 34, 35-44, 45-54, 55-65, over 65), geographical area (North, Centre, South and Islands), size of the municipality of residence (under 20,000, 20,000-40,000, 40,000-500,000, over 500,000 inhabitants) and educational qualification (up to secondary school certificate, upper secondary school diploma, university degree or more) [12]. The final weight is then obtained as follows:

$$(3) \qquad w_c^{(2)} = w_c^{(1')} \beta_c$$

where $\beta_c$ is the adjustment factor for cell *c*.

The characteristics of the web population are estimated using the SHIW-I survey, selecting families where the respondent has internet access via PC or other instrument. The socio-demographic characteristics are naturally related to the reference person (the person in charge of the family economy) who answers the questionnaire for the family.

The purpose of this adjustment is to align the composition of the two samples (WEBIT and SHIW-I) so that the differences in the results do not depend on observable socio-economic characteristics.

[11] This procedure improves the accuracy of estimators and further limits the distortions related to the unit non-response when the variables used for the calibration are correlated with the variables being investigated.

[12] The technique used allows to simultaneously align the sample weights to the distribution of some characteristics known from external sources considering only the marginal probabilities. This technique is known as *Iterative Proportional Fitting* (o *Raking*). For further details see G. Kalton and I. Flores Cervantes, *Weighting Methods*, in *Journal of Official Statistics*, Vol.19, No.2, 2003, pp. 81-97.