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## The impact of unlisted and no-landline respondents on non-coverage bias: The Italian case

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# The impact of unlisted and no-landline respondents on non-coverage bias. The Italian Case

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## Non-technical summary

To survey the general population, survey agencies often use sampling frames of landline numbers. However, these frames may exclude a relevant share of the target population. In 2013, 39% of U.S. households are cell-only households whereas 30% of European households do not own a landline telephone. This alarmingly high level of landline telephone under-coverage poses serious threats to the quality of such frames and the accuracy of the resulting survey data.

There is now a consolidated body of research, mainly carried out in the U.S., that documented the differences in demographic and socio-economic characteristics of respondents included in and excluded from the sampling frames and investigated the impact of the quality of survey data. However, in Europe these topics are still much understudied. The aim of the paper is to assess the effects of under-coverage of sampling frames, i. e., the exclusion of eligible respondents from the list of respondents to interview. We focus on the Italian case, as the under-coverage rate is very high.

Using a unique national survey with key distinctive features (e.g., the availability of information on landline telephone coverage and a sampling frame with full-coverage of the Italian population), we describe the changes in the composition of telephone coverage and investigate differences in demographic and socio-economic characteristics between respondents included in and excluded from the sampling frame (respectively, I and NI respondents) and within the category of excluded respondents (i. e., unlisted respondents (UN) and no-landline telephone respondents (NT)). We also explore whether these differences lead to bias and evaluate the impact of current post-adjustment strategies on the total under-coverage bias as well as on its two components separately. Following a consolidated research approach, in our analysis we focus on survey items on politics, health, media and IT use, safety and leisure consumptions.

A number of findings stand out from our analysis. First, I and NI respondents have marked demographic and socio-economic differences. NT, UN and I respondents seem to be different respondents too; marked differences are found when comparing NT to I and UN respondents. Second, with the exception of only one survey item, under-coverage leads to bias. The comparison between NT, UN and I respondents shows a very complex pattern. Overall, I respondents are different from UN and, especially, NT respondents. However, I and UN respondents do not differ with regard to items on politics. This seems to suggest that the impact of the two components of under-coverage may be topic-specific. Third, current post-adjustment strategies are overall ineffective in removing the bias introduced by the total under-coverage and its two components.

# The impact of unlisted and no-landline respondents on non-coverage bias. The Italian case

Emanuela Sala and Roberto Lillini

## Abstract:

To survey the general population, survey agencies often use sampling frames of landline numbers. However, these frames may exclude a relevant share of the target population. In 2012, 50% of Italian adults are excluded from the sampling frame, as they are unlisted (UN) or do not own a landline telephone (NT). Using a unique national survey with full-coverage of the Italian population, our study describes the changes in the composition of landline telephone coverage over time and investigates differences in demographic and socio-economic characteristics between (i) respondents included in and excluded from the sampling frame and (ii) NT and UN respondents. It also explores whether these differences lead to under-coverage bias and evaluates the impact of current post-adjustment strategies on the total under-coverage bias as well as on its two components separately.

Keywords: Telephone surveys, coverage error, bias in telephone surveys

JEL Classification: C81, C83, D72

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## 1. Introduction

To survey the general population, survey agencies often use sampling frames of landline numbers. However, these frames may exclude a relevant share of the target population. In 2013, 39% of U.S. households are cell-only households (Blumberg and Luke 2013) whereas 30% of European households do not own a landline telephone (EU commission 2013). This alarmingly high level of landline telephone under-coverage poses serious threats to the quality of such frames and the accuracy of the resulting survey data. There is now a consolidated body of research, mainly carried out in the U.S., that documented the differences in demographic and socio-economic characteristics of respondents included in and excluded from the sampling frames and investigated the impact of under-coverage on bias (amongst others, Keeter 2006, Keeter et al. 2007). However, in Europe these topics are still much understudied; the first book on telephone surveys was only published in 2012 (Häder et al., 2012). The aim of the paper is to assess the effects of under-coverage of sampling frames of landline numbers.

Using a unique national survey with key distinctive features (e.g., the availability of information on landline telephone coverage and a sampling frame with full-coverage of the Italian population), our study contributes to expand the current knowledge in this field by disentangling the complex nature of under-coverage (we distinguish between two components of under-coverage, the unlisted and no-landline telephone components) and exploring the role that each component plays in biasing survey estimates on politics, health, media and IT use, safety and leisure consumptions. The Italian case is particularly interesting as non-coverage rate is very high. The main finding is that the current weighting procedures are ineffective in removing the bias; however, they may be effective in reducing its magnitude. We conclude that given the complex nature of under-coverage, a “one size fits all (survey items)” weighting strategy can hardly be considered as an accurate method to correct for under-coverage bias.

## 2. Under-coverage and bias in CATI surveys

Computed assisted telephone interviewing (CATI) surveys are a relatively cheap and quick method of data collection. It is no surprise therefore that CATI surveys have been (and still are) one of the most widely used methods of data collection in the U.S. (Biemer and Peytchev 2012) and Europe (Häder et al., 2012). In the last decades, the effectiveness of CATI surveys in gathering good quality survey data has been challenged by the “threats” posed by two types of non-sampling errors, non-response and frame errors. In this paper we focus on frame errors and, in particular, on under-

coverage error; according to Biemer (2010), this type of error is to be considered as the most serious of frame errors.

Under-coverage occurs when part of the target population is excluded from the sampling frame. When sampling the general population, the sampling frame for CATI surveys is usually constituted of a list of landline telephone numbers that are either randomly generated<sup>1</sup> or randomly drawn from the Directories of Landline Phone Number (DLTN). Random Digit Dialing (RDD) based sampling frames are implemented especially in the U.S. whereas DLTN based sampling frames are more common in Europe (Heckler and Wiese 2012, p. 105). Telephone under-coverage may occur in both cases, although its magnitude varies. When a RDD system is used, the sampling frame excludes *only* individuals with no landline telephone; when sampling from DLTN, the sampling frame excludes *also* individuals whose telephone number is not listed in the DLTN.<sup>2</sup> Under-coverage *per se* does not necessary lead to bias. In case of a sample mean, for example, non-coverage bias is a function of two terms, the magnitude of non-coverage rate and the difference in key survey estimates between the target population that is excluded from or included in the sampling frame (Groves et al. 2009, p. 88).

Currently, the magnitude of non-coverage rate is alarmingly high. On the one hand, 39.4% of American households and 30% of European households do not own a landline telephone (Blumberg and Luke 2013; EU Commission, 2013). In addition, such percentages are constantly increasing over time. On the other, a significant proportion of households worldwide are unlisted households. For example, in Korea, the exclusion rate is 46% (Kim 2012, p. 81) whereas in Germany and Italy exclusion rates are around 40% (Poggio and Callegaro 2012, p. 65; von der Lippe et al. 2011, p. 105). In the Netherlands, the exclusion rate is estimated to vary between 30% and 40% (Cobben et al. 2012, p. 170) whereas in Portugal and Switzerland they are, respectively, 20% and 12% (Joye et al. 2012, p. 91; Vicente and Reis 2012, p. 76).

In the U.S., concern regarding the impact of under-coverage on the quality of survey estimates started to raise around 2007, when the special issue of Public Opinion Quarterly was published. Research carried out in those years has consistently documented the existence of differences in socio-economic and demographic characteristics between the cell-only and landline-only population (Blumberg and Luke 2007; Boyle et al. 2009; Keeter 2006; Keeter et al. 2007; Tucker et al. 2007). For example, Link et al. (2007) found that, compared to landline-only respondents, cell-only

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<sup>1</sup> Due to costs and implementation difficulties, RDD of cellular phones numbers is still not a common practice.

<sup>2</sup> Listed-assisted methods can be considered equivalent to RDD sampling frames (i. e., they include unlisted respondents and exclude no-landline respondents).

respondents were more likely to be men, single, young, employed, etc. However, while evaluating the impact of under-coverage on bias, research findings were quite mixed. For example, when focusing on items on media use or political participation, Keeter (2006), Keeter et al. (2007) and Mokrzycki et al. (2009) found evidence for little or no bias whereas while considering key measures on health, Blumberg and Luke (2007) and Link et al. (2007) found evidence for non-negligible bias. Recent works have shown that the differences in socio-demographic characteristics of cell and landline respondents persist (Blumberg and Luke, 2013; Peytchev et al. 2011) and documented that these marked differences introduce a serious source of under-coverage bias that, in some cases, cannot be removed using current weighting procedures. As Blumberg and Luke (2013, p. 3) put it, “the potential for bias due to under-coverage remains a real threat to surveys conducted only on landline telephones”. There are, however, exceptions. When looking at a set of items on harassment and sexual violence, Peytchev et al. (2011) found that the bias was alleviated when statistical adjustments were performed.

Although the negative effects of under-coverage bias may be potentially more detrimental (e.g., RDD based sampling frames are not often implemented), in Europe research interest in these topics was raised only a few years later, with the publication in 2012 of the first book on telephone surveys in Europe (Häder et al., 2012). Similarly to findings from U.S. studies, research carried out in Germany, Portugal, Spain and Switzerland have shown that mobile-only and landline-only respondents, as well as listed and unlisted respondents, have different socio-economic and demographic characteristics (de Rada 2010; Joye et al. 2012; Vicente and Reis 2009; von der Lippe et al. 2011). For example, in Germany the mobile-only population is younger, male, does not live together with their spouse or partner, is less likely to have a migration background, has a lower household net income and different psychological traits (Schneiderat and Schlinzig, 2012). When evaluating the impact of under-coverage on bias, mixed findings are found. While comparing survey estimates for German listed and unlisted respondents and Portuguese mobile-only and landline-only respondents, von der Lippe et al. (2011) and Vicente and Reis (2009) found little evidence for bias on, respectively, key items on health and Internet use, media consumptions, and politics. However, in Switzerland, Joye et al. (2012) did find evidence for bias in items on politics when comparing respondents with or without a landline phone and listed and unlisted respondents. To our aims, Joye’s work is particularly important. In his work, he investigated whether respondents who have registered their landline telephone number in the DLTN are different from the others. He found that “even if we expect that registration in directories is linked to attitudes such as political opinions or trust in others, this is not really the case, at least not at a significant level. This means that, for telephone surveys, this coverage bias is probably less important here than the

one introduced by not having a landline at one's disposal" (p. 100). Busse and Fuchs (2012) evaluated the impact of two different components of under-coverage (i.e., mobile-only and no telephone) on total coverage error and found that, in Europe, the bias caused by the mobile-only population is more severe than the one caused by the no-phone population.

In Italy, very little is known on issues concerning telephone coverage and bias. In their pioneer work, Callegaro and Poggio (2004) documented the differences in socio-economic and demographic characteristics of respondents with and without landline telephone. They found that respondents without landline phone are more likely to be young, single, renters, farmers, to have no education, and to live in the Southern part of the country. They also found evidence that under-coverage leads to bias. More recent research has provided a general overview of socio-economic and demographic characteristics of respondents with different phone arrangements (Poggio and Callegaro 2012) and documented the magnitude of under-coverage bias in voting preferences and in a set of measures of political participation between listed and unlisted respondents (Fumagalli and Sala 2011). However, these (few) studies have limitations, the most relevant being that they are quite dated (for example, Fumagalli and Sala's study look at the case of the 2006 General Elections) and failed to consider the complexity of under-coverage by focusing only on one of its components. In addition, when investigating the impact of under-coverage on bias, Callegaro and Poggio (2004)'s work considers only a very limited set of survey items (i.e., four items).

Our study sits within this research context. The overall aim of the paper is to investigate the relationship between landline telephone under-coverage and bias. When the sampling frame is the DLTN, under-coverage may be constituted of two components, the NT (No landline Telephone) and UN (Unlisted Numbers) components. Each component identifies a separate subsample of respondents. The NT component identifies respondents who do not own a landline telephone whereas the UN component identifies landline-owning respondents who are unlisted in the DLTN. Following Joye et al. (2012)'s work, one may argue that these subsamples have different characteristics, affect differently the total under-coverage bias and may be dealt with adopting different weighting procedures. This paper describes the changes in the composition of landline telephone coverage over time and investigates differences in demographic and socio-economic characteristics between (i) respondents included in and excluded from the sampling frame (respectively, I and NI respondents) and (ii) NT and UN respondents. It also explores whether these differences lead to under-coverage bias and evaluates the impact of current post-adjustment strategies on the total under-coverage bias as well as on its two components separately. Following a



consolidated research approach, in our analysis we focus on survey items on politics, health, media and IT use, safety and leisure consumptions.

### 3. Telephone surveys in Italy

In Italy, CATI surveys are a very common method of data collection (Poggio and Callegaro 2012). As in other European countries, when sampling the general population, the sampling frame is usually DLTN based (Callegaro and Gasperoni 2008; Poggio and Callegaro 2012). However, the DLTN does not have full coverage of the Italian population, excluding respondents who do not own a landline telephone and those who have not registered with the DLTN. RDD of landline phones is usually not implemented. In addition, no lists of mobile phone numbers are publicly available and RDD of mobile numbers is usually not an option. Post-stratification strategies usually consist of a weighting strategy based on respondents' main socio-demographic characteristics.

### 4. Data

We use data from the 1997-2012 Multipurpose Survey-Aspects of Everyday Living. This is the only Italian survey with full coverage of the Italian population that collects *at the same time* information on telephone use.

The Multipurpose Survey is a face-to-face cross-sectional survey of Italian households run by the Italian National Statistical Institute (ISTAT) since 1993 (in 2004 the survey was not carried out). It collects a wide range of information, including data on household composition, education, training, employment, health, media and IT consumption, political participation and leisure time. It also collects detailed information on landline telephone ownership as well as registration of landline telephone numbers in the DLTN (see Appendix 1 for the question wording).

The Multipurpose Survey is a two-stage clustered sample where primary and secondary sampling units are, respectively, municipalities and households. The sampling frame is addressed-based (ABS), being drawn from regularly updated administrative registers (registration is not on a voluntary base) that list all the households and individuals who live in a municipality. In 2012, the sample consists of 46,464 individuals living in 19,330 households<sup>3</sup>.

### 5. Methods

We use bivariate and multivariate analytical methods. In both cases, our dependent variables are the variables (i) inclusion in the sampling frame and (ii) type of subsample.

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<sup>3</sup> More information are available at <http://siqual.istat.it/SIQual/visualizza.do?id=0058000&refresh=true&language=EN>.

## 5.1. Variables

The first dependent variable, inclusion in the sampling frame, is a dummy that identifies I respondents, i.e., individuals who own a landline phone and the telephone number is listed in the DLTN. The second dependent variable, type of subsample, has three categories that correspond to the three subsamples, I, NT and UN respondents. NT respondents are respondents without a landline telephone whereas UN respondents are respondents who own a landline telephone but their number is unlisted. The number of missing cases on the variables used to create the two dependent variables is very low (in 2012 it is around 2%).

As independent variables, we use a traditional set of socio-economic and demographic variables. Sociological variables include education (no education or primary education, lower secondary, higher secondary, university degree), marital status (single, married, separated or divorced; widowed), household size (1, 2, 3, 4+), and presence of children under 18 (yes, no). Economic variables are employment condition (employed, looking for a new job, looking for 1<sup>st</sup> job, housewife, student, retired, other employment condition) and housing tenure (rent, ownership; other contracts). Demographic variables include sex (male, female) and age (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+). Area of residence (North-West, North-East, Center, South, main Islands) is also included in the analysis.

When evaluating the impact of under-coverage on bias, we focus on 5 domains: politics, health, violence, media and IT consumption and leisure (see Table 5 for the list of items). The choice of these domains is driven by theoretical (see the previous section) as well as practical considerations. In Italy, surveys on these topics, especially pre-election and public opinion polls, are often CATI and the sample is drawn from the DLTN (Poggio and Callegaro 2012).

## 5.2. Methods of analysis

To explore the differences in respondents' socio-economic and demographic characteristics and investigate the impact of under-coverage on bias, we perform a bivariate analysis, adopting a standard analysis of prevalence estimates (amongst others, Link et al. 2007; Peytchev et al. 2011), and then run a set of binomial and multinomial logistic regressions. The bivariate analysis is weighted using the weights provided with the Users' file. To evaluate the effectiveness of current post-adjustment strategies in reducing or removing under-coverage bias we run a set of logistic regression, introducing as control variables those variables that are usually included in the weighting procedure (e.g., sex, age etc). All analyses are limited to individuals who are over 18 and are carried out using Stata Version 12 (StataCorp 2009). To take into account the sampling design

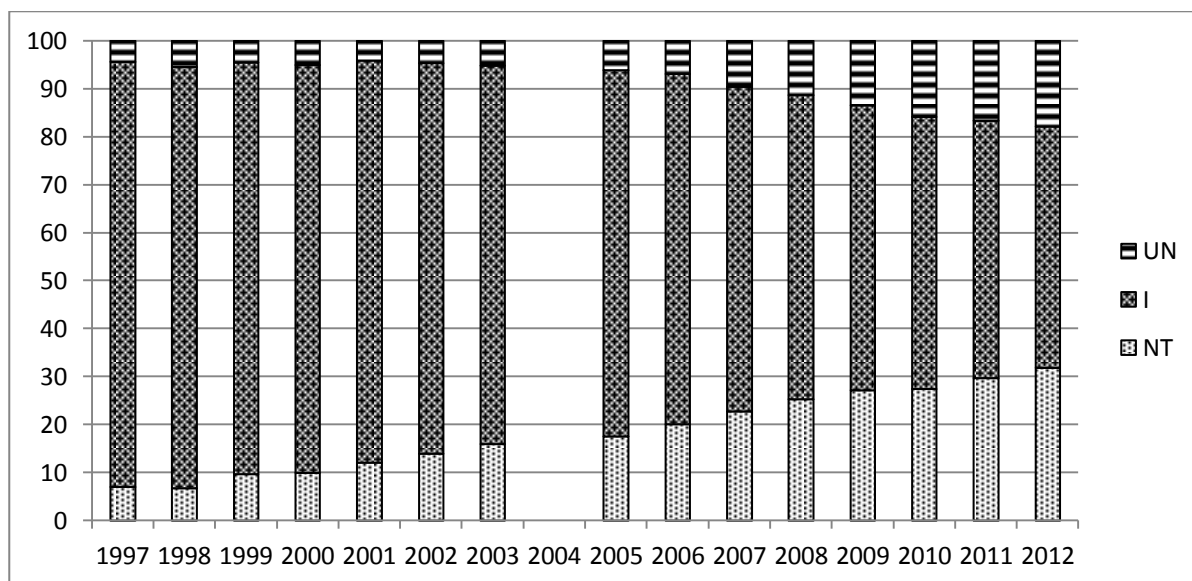
of the Multipurpose Survey, standard errors are adjusted for clustering of respondents within households.

## 6. Results

### 6.1. Changes in landline telephone coverage over time

Graph 1 shows the changes that occurred in landline coverage in Italy between 1997 and 2012. The graph clearly shows the increasing complexity and heterogeneity of landline telephone coverage. First, the percentage of I respondents aged 18 and over has been decreasing from 1997 onwards. In nearly 15 years the percentage of I respondents decreased from 89% to 50%. Second, the category of NI respondents is quite heterogeneous. For example, in 2012 32% of individuals are NT respondents whereas 18% are UN respondents. Interestingly, nearly all individuals own a mobile phone: 97% of NT and UN individuals and 94% of I individuals live in households with at least one mobile phone (weighted data).

Graph 1. Changes in the pattern of landline telephone coverage: individuals over 18 (Italy, 1997-2012)



Note: Multipurpose survey- Aspects of everyday living 2012. Weighted data. Individuals aged 18 and over.

### 6.2. Differences in socio-economic and demographic characteristics

We discuss results from the comparisons of socio-economic and demographic characteristics of (i) I and NI, and (ii) I, NT and UN respondents. When focusing on the first comparison, we find strong differences between I and NI respondents. As shown in Table 1 (columns I and NI), Appendix 2 and Table 3 (column 1), I respondents are more likely to be women, older people, less likely to live in

the South and main Islands, more likely to have no education or tertiary education, be students or retired, be home owners, and have no children under 18. However, results from the bivariate and multivariate analysis are not fully consistent when considering the variables marital status and size of the household. When controlling for sex, age, education etc., we find that singles and households with two or more members are more likely to be included in the sampling frame. Given the magnitude of some of these differences (e. g. age, housing tenure etc.), we further explore their implications. The analysis of Table 1 (columns I and total) and Appendix 2 show that the total sample has socio-economic and demographic characteristics that are different from those of I respondents. For example, the former is younger, more likely to include respondents from the South and the main Islands, respondents who are separated or divorced, single person households, employed, to live in rented accommodations and have children.

The comparison of I, NT and UN respondents shows that, on the all, these respondents are different. The pattern of the differences in socio-economic and demographic characteristics between I and NT respondents mirrors the one between I and NI respondents described above (Table 1, column I and NT; Appendix 2; Table 3, column 2). For example, I respondents are more likely to be women, older people, less likely to live in the Southern part of Italy etc. However, although to a lesser extent, I and UN respondents seem to differ too (Table 1, columns I and UN; Appendix 2; Table 3, column 2). For example, I respondents are more likely to be older, have no education or primary education, and be home-owners. Unsurprisingly, the differences between NT and UN respondents are quite marked, the former being more likely to be male, middle aged (25-44 years old), from the South and the main Islands etc. In brief, although the UN sample is still biased, it seems to be less biased than the NT one. The implication of these findings is that NT are the main driver of the differences between I and NI.

Table 1 Demographic characteristics by type of sampling sample (Italy, 2012)

Demographic Characteristics	NT		UN		NI		I		Total	
	%	95% CI	%	95% CI	%	95%CI	%	95% CI	%	95% CI
<i>Sex</i>										
Male	49.9	49.1-50.6	47.3	46.4-48.2	48.9	48.4-49.5	47.2	46.7-47.7	48.1	47.7-48.5
Female	50.2	49.4-50.9	52.7	51.8-53.6	51.1	50.5-51.6	52.8	52.3-53.3	51.9	51.5-52.3
<i>Age</i>										
18-24	8.9	8.2-9.6	8.8	7.9-9.6	8.9	8.3-9.4	8.1	7.7-8.6	8.5	8.2-8.9
25-34	20.1	19.1-21.0	14.7	13.6-15.9	18.2	17.4-18.9	10.3	9.8-10.8	14.2	13.7-14.6
35-44	27.4	26.4-28.5	22.6	21.2-24.1	25.7	24.8-26.6	13.5	12.9-14.2	19.6	19.0-20.1
45-54	17.2	16.4-18.0	19.2	18.0-20.4	17.9	17.2-18.6	17.9	17.2-18.5	17.9	17.4-18.4
55-64	11.8	11.1-12.5	14.3	13.3-15.4	12.7	12.1-13.3	17.7	17.0-18.4	15.2	14.8-15.7
65-74	7.9	7.3-8.5	11.2	10.1-12.3	9.1	8.5-9.6	16.4	15.7-17.0	12.7	12.3-13.2
75+	6.7	6.2-7.3	9.1	8.2-10.0	7.6	7.1-8.1	16.1	15.4-16.8	11.9	11.5-12.3
<i>Geographic area</i>										
North-West	22.3	20.9-23.7	31.1	28.9-33.3	25.4	24.2-26.6	28.3	27.0-29.6	26.8	26.0-27.7
North-East	15.7	14.6-16.8	19.0	17.3-20.6	16.9	16.0-17.8	22.1	21.0-23.1	19.3	18.6-20.0
Center	18.3	17.1-19.6	22.3	20.5-24.2	19.8	18.7-20.8	20.2	19.2-21.2	19.9	19.2-20.7
South	27.9	26.6-29.2	19.0	17.3-20.7	24.7	23.6-25.8	20.9	19.9-21.9	23.0	22.3-23.7
Main Islands	15.8	14.7-16.9	8.6	7.4-9.8	13.2	12.4-14.0	8.5	7.9-9.2	10.9	10.4-11.4
<i>Education</i>										
No education, primary education	18.9	18.0-19.8	15.2	14.1-16.4	17.6	16.8-18.3	25.5	24.7-26.4	21.5	21.0-22.1
Lower secondary	42.8	41.6-44.0	34.6	33.0-36.3	39.9	38.9-40.9	31.2	30.3-32.0	35.5	34.8-36.1
Higher secondary	28.7	27.6-29.8	34.2	32.7-35.8	30.7	29.8-31.6	29.5	28.6-30.3	30.1	29.4-30.7
University degree (including Ph.D.)	9.7	9.0-10.3	15.9	14.6-17.2	11.9	11.2-12.5	13.9	13.2-14.6	12.9	12.5-13.4
<i>Marital status</i>										
Single	32.2	31.2-33.3	27.7	26.4-29.0	30.6	29.8-31.4	25.9	25.2-26.5	28.2	27.7-28.7
Married	48.2	47.0-49.5	54.5	52.8-56.1	50.5	49.5-51.5	57.7	56.8-58.5	54.1	53.4-54.7
Separated/divorced	11.8	11.0-12.6	9.1	8.2-10.0	10.8	10.2-11.4	4.7	4.3-5.1	7.8	7.4-8.1
Widowed	7.7	7.2-8.3	8.8	7.9-9.6	8.1	7.6-8.6	11.8	11.2-12.3	9.9	9.6-10.3
<i>Number of persons in households</i>										
One	21.0	20.0-22.0	12.8	11.7-13.9	18.1	17.3-18.8	11.9	11.3-12.5	15.1	14.6-15.5
Two	23.4	22.1-24.6	25.1	23.3-26.9	24.0	22.9-25.0	29.5	28.4-30.6	26.7	26.0-27.5
Three	24.7	23.3-26.0	26.2	24.2-28.2	25.2	24.1-26.3	26.4	25.2-27.6	25.6	24.8-26.5
Four or more	31.0	29.4-32.6	35.9	33.6-38.2	32.8	31.4-34.1	32.2	30.9-33.5	32.6	31.7-33.5

Table 2 Demographic characteristics by type of sampling sample (Italy, 2012) (continued)

Demographic Characteristics	NT		UN		NI		I		Total	
	%	95% CI	%	95% CI	%	95%CI	%	95% CI	%	95% CI
<i>Main professional condition</i>										
Employed	50.2	49.1-51.3	49.4	47.8-50.9	49.9	49.0-50.8	39.2	38.4-40.1	44.6	43.9-45.2
Looking for a new job	11.3	10.6-12.0	7.9	7.1-8.7	10.1	9.6-10.6	5.7	5.3-6.1	7.9	7.5-8.2
Looking for the first job	3.4	3.0-3.8	2.2	1.6-2.7	3.0	2.6-3.3	1.9	1.7-2.1	2.5	2.3-2.7
Housewife	15.7	15.0-16.4	14.5	13.6-15.4	15.3	14.7-15.8	15.6	15.1-16.1	15.4	15.1-15.8
Student	3.7	3.3-4.1	5.6	4.9-6.3	4.4	4.0-4.7	6.1	5.7-6.5	5.2	5.0-5.5
Retired	12.5	11.7-13.2	17.6	16.4-18.8	14.3	13.7-14.9	28.7	27.9-29.6	21.5	21.0-22.1
Unfit for employment or other employment conditions	3.2	2.9-3.6	2.8	2.3-3.3	3.1	2.8-3.4	2.7	2.4-3.0	2.9	2.7-3.1
<i>Housing tenure</i>										
Renter	29.3	27.8-30.8	17.8	16.0-19.6	25.2	24.0-26.3	9.2	8.4-10.0	17.0	16.3-17.7
Owner	60.5	58.9-62.1	75.9	73.9-77.8	66.0	64.8-67.2	84.6	83.6-85.5	75.5	74.7-76.3
Other contracts	10.2	9.4-11.1	6.4	5.4-7.4	8.8	8.2-9.5	6.2	5.6-6.8	7.6	7.1-8.0
<i>Children under 18 in the households</i>										
No	68.4	67.2-69.7	70.9	69.1-72.7	69.3	68.3-70.4	81.8	80.9-82.7	75.5	74.8-76.2
Yes	31.6	30.3-32.9	29.1	27.3-30.9	30.70	29.6-31.7	18.2	17.3-19.1	24.5	23.8-25.2

Note: the category "Main Islands" refers to Sardinia and Sicily.

Source: Multipurpose survey- Aspects of everyday living 2012. Weighted data. Individuals aged 18 and over. Standard errors are clustered within households.

Table 3 Results from binomial and multinomial logistic regression (odds ratios and relative risk ratios, Italy 2012)

Socio-economic and demographic characteristics	Column 1	Column 2	
	Logistic regression (ref. category: NI)	Multinomial logistic regression (ref. category: I)	
		NT	UN
<i>Sex (ref. Category: Men)</i>			
Women	1.10 (0.02)**	0.88 (0.02)**	0.97 (0.02)
<i>Age groups (ref. Category: 18-24)</i>			
25-34	1.05 (0.06)	0.93 (0.06)	0.98 (0.08)
35-44	1.42 (0.10)**	0.62 (0.05)**	0.85 (0.08)
45-54	2.51 (0.16)**	0.31 (0.02)**	0.61 (0.05)**
55-64	3.24 (0.26)**	0.22 (0.02)**	0.53 (0.06)**
65-74	5.15 (0.48)**	0.12 (0.01)**	0.43 (0.05)**
75+	7.10 (0.72)**	0.08 (0.01)**	0.36 (0.05)**
<i>Geographic area (ref. Category: Center)</i>			
North-West	1.02 (0.06)	0.88 (0.06)*	1.14 (0.08)
North-East	1.28 (0.07)**	0.72 (0.05)**	0.87 (0.06)
South	0.78 (0.04)**	1.61 (0.10)**	0.87 (0.06)
Main Islands	0.55 (0.04)**	2.36 (0.18)**	1.15 (0.11)
<i>Education (ref. Category: Higher secondary)</i>			
No education, primary education	0.77 (0.04)**	1.85 (0.10)**	0.75 (0.05)**
Lower secondary	0.76 (0.03)**	1.57 (0.06)**	0.99 (0.04)
University degree (including Ph.D.)	1.21 (0.05)**	0.71 (0.04)**	0.99 (0.05)
<i>Marital status (ref. Category: Married)</i>			
Single	1.27 (0.06)**	0.8 (0.05)**	0.79 (0.07)**
Separated/divorced	0.63 (0.04)**	1.62 (0.10)**	1.58 (0.07)**

Table 4 Results from binomial and multinomial logistic regression (odds ratios and relative risk ratios, Italy 2012). Continued.

Socio-economic and demographic characteristics	Column 1	Column 2	
	Logistic regression (ref. category: NI)	Multinomial logistic regression (ref. category: I)	
		NT	UN
Widowed	1.08 (0.06)	0.85 (0.06)*	1.10 (0.09)
<i>Number of persons in households (ref. Category: One)</i>			
Two	2.23 (0.12)**	0.34 (0.02)**	0.76 (0.05)**
Three	3.27 (0.20)**	0.2 (0.01)**	0.66 (0.05)**
Four or more	4.22 (0.29)**	0.14 (0.01)**	0.61 (0.06)**
<i>Main professional condition (ref. Category: Unfit to work)</i>			
Employed	1.12 (0.08)	0.91 (0.08)	0.87 (0.09)
Looking for a new job	1.02 (0.09)	1.01 (0.10)	0.92 (0.11)
Looking for the first job	1.22 (0.13)	0.82 (0.10)	0.81 (0.12)
Housewife	1.05 (0.08)	0.97 (0.08)	0.93 (0.10)
Student	1.77 (0.17)**	0.47 (0.05)**	0.77 (0.10)
Retired	1.25 (0.10)**	0.81 (0.07)*	0.80 (0.08)*
<i>Housing tenure (ref. Category: Renter)</i>			
Owner	2.99 (0.16)**	0.29 (0.02)**	0.45 (0.03)**
Other contracts	2.11 (0.16)**	0.45 (0.04)**	0.50 (0.05)**
<i>Children under 18 in households (ref. Category: No)</i>			
Yes	1.78 (0.09)**	0.48 (0.03)**	0.71 (0.05)**
Constant	0.04 (0.01)	28.25 (4.56)**	2.39 (0.46)**
N	37,529	37,529	

Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$

Source: Multipurpose survey- Aspects of everyday living 2012. Unweighted data. Individuals aged 18 and over. Standard errors are clustered within households.



### 6.3. Impact of under-coverage on coverage error

Following the analytical approach adopted in the previous session, we compare estimates for a set of items. When comparing I and NI respondents we find strong differences in all items but one (Table 5, columns NI and I; Appendix 2). I respondents are more likely to be interested and engaged in politics, have poorer health conditions, and be media and IT users. For example, I respondents are more likely to listen to political debates, and to watch TV, but less likely to report very good health conditions. The magnitude of the differences, that varies between and within domains, is particularly marked for some of the items on politics and health. For example, 41.9% of I respondents and 32.4% of NI respondents get informed about politics every day. Mixed findings are found when looking at the Leisure domain, with I respondents being more likely to have longer holidays and less likely to go on holiday abroad. No differences are found when looking at the Safety domain; however, we cannot exclude *a priori* the existence of different behaviours when additional items are considered. Consistently with results from the previous section, we find that the differences between I and NI respondents lead to bias. When comparing estimates from the total sample and I respondents (Table 5, columns I and total; Appendix 2), we find that the former is less interested in politics, more likely to be in better health conditions, and less likely to be IT and media users. The total sample also differs in relation to leisure consumptions. The magnitude of the bias varies between 1.1 and 5.2%.

The comparison between NT, UN and I respondents shows a complex pattern. NT and I respondents are different in all items but one (Table 5, columns NI and I; Appendix 2). NT respondents are less likely to be engaged in political activities and more likely to be in good health conditions. They are also less likely to be IT and media users, to have long holidays, and more likely to go abroad on holidays. The magnitude of the differences is particularly marked (greater than 10%) for the items: frequency of getting informed about politics, self-reported chronic disease or long standing illness, frequency of Internet use, and holiday length. Interestingly, when comparing UN and I respondents, some of these differences disappear (Table 5, columns I and UN; Appendix 2). The key finding is that UN and I respondents do not differ in any of the items of political engagement. However, significant differences persist, especially while considering items on health (i.e., UN respondents are more likely to have better health conditions). NT and UN respondents seem to be different respondents too, in particular when items on political activities, safety, and leisure are considered (Table 5, columns NT and UN; Appendix 2). There is also some indication that NT respondents may differ from UN respondents on items on health. The comparison between

the three types of respondents and the total sample shows that NT and I subsamples are the main source of bias (Table 5, columns I, UN, NT and total).

Table 5. Impact of non-coverage rate on bias: selected items (Percentages and 95% CI)

Items	Type of sample								Total	
	NT		UN		NI		I		%	95% CI
	%	95% CI	%	95% CI	%	95% CI	%	95% CI		
<i>1. Politics</i>										
Having listened to political debates (yes)	15.0	14.1-15.8	21.4	20.0-22.9	17.3	16.5-18.0	23.0	22.2-.23.9	20.0	19.6-20.8
Frequency of speaking about politics (every day)	8.9	8.1-9.4	11.6	10.6-12.7	9.8	9.2-10.4	12.1	11.5-12.7	11.0	10.5-11.4
Frequency of getting informed about politics (every day)	28.5	27.3-29.6	39.4	37.7-41.1	32.4	31.4-33.2	41.9	41.0-42.9	37.1	36.4-37.8
<i>2. Health</i>										
Self-reported health conditions (very good)	19.1	18.1-20.1	18.0	16.8-19.3	18.7	17.9-19.4	13.3	12.7-14.0	16.0	15.5-16.5
Self-reported chronic disease or long standing illness (no)	79.2	78.3-80.1	72.4	71.0-73.9	76.8	76.0-77.6	66.5	65.7-67.4	71.7	71.1-72.3
Satisfaction for one's health conditions (very satisfied)	19.2	18.3-20.2	19.1	17.7-20.4	19.2	18.4-20.0	15.8	15.1-16.5	17.5	16.9-18.0
<i>3. Safety</i>										
Perception of safety walking alone in the streets at night (very safe)	11.5	10.7-12.4	9.0	8.0-9.9	10.6	10.0-11.2	9.5	9.0-10.1	10.0	9.6-10.5
<i>4. Media and IT use</i>										
Frequency of listening to the radio (every day)	37.4	36.3-38.6	40.3	38.6-42.0	38.5	37.5-39.4	35.9	35.0-36.8	37.2	36.5-37.8
Frequency of watching TV (every day)	80.7	79.7-81.7	80.6	79.2-82.0	80.6	79.8-81.5	85.1	84.1-85.8	82.9	82.3-83.4
Frequency of Internet use (every day)	50.3	48.6-52.1	62.5	60.6-64.5	55.5	54.2-56.9	61.8	60.6-63.1	58.7	57.8-59.6
Frequency of newspaper reading (every day)	14.1	13.3-14.9	18.8	17.4-20.1	15.8	15.1-16.5	20.4	19.6-21.2	18.2	17.6-18.
<i>5. Leisure</i>										
Holiday duration (four days holiday in the last 12 months)	35.8	34.4-37.1	52.7	50.6-54.7	41.8	40.7-43.0	46.5	45.4-47.7	44.2	43.3-45.0
Holiday destination (abroad only)	27.7	25.6-29.9	19.6	17.4-21.8	24.1	22.5-25.6	19.4	18.1-20.7	21.7	20.6-22.7

Source: Multipurpose survey- Aspects of everyday living 2012. Weighted data. Individuals aged 18 and over. Standard errors are clustered within households.

#### 6.4. Evaluating current post-adjustment strategies

Survey statisticians often address non-coverage bias through post survey adjustments (amongst others, Ehlen and Ehlen 2007; Peytchev et al. 2011). Italian survey and polling agencies correct for non-coverage bias using a weighting strategy that is usually based on four variables: sex, age, level of education and geographical area and lies on the assumption that there are no differences between NT and UN respondents.

To evaluate whether this strategy is effective in correcting for the total under-coverage error and its two components, we model prevalence rates of the survey items listed in Table 5 and compare ORs from regressions run without and with control variables (i. e., the same set of variables used to create the weights).<sup>4</sup> We investigate the impact of the weighting procedure on the total under-coverage error (i. e., independent variable is the variable inclusion in the sampling frame) and on its two components separately (i. e., independent variable is the variable type of sample).

When focusing on the total under-coverage error, the analysis of ORs in column 1 suggests that weighting is overall ineffective in removing the under-coverage bias introduced by under-coverage. With three exceptions, the comparison of ORs from regressions run without and with controls shows that the level of significance of the ORs remains unchanged. However, when focusing on the magnitude of the ORs, weighting seems overall to attenuate the size of the bias. For example, for the item “frequency of getting informed about politics”, the magnitude of the ORs is reduced from 1.45 to 1.26 (both significant at the 1% level).

If we look at the two components of under-coverage error, the analysis of ORs in column 2 shows a mixed pattern. For items on politics, media and IT, and leisure, weighing for sex, age, education and area of residence has very little effect, both on terms of magnitude and level of significance. For example, for the item “having listed to political debates”, the introduction of control variables has no effects; NT are less likely than I respondents to have listed to a political debate (OR=0.61 and 0.66 in the regressions without and with controls, both significant at the 1% level) whereas UN and I respondents do not differ with regard to this item (OR=0.97 and 0.92 in the regressions without and with controls). For items on health, weighting may have an effect in reducing the magnitude of the under-coverage bias; however, weighting may be effective in removing only one source of non-coverage bias. For example, for the items self-reported health conditions and self-reported chronic

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<sup>4</sup> As a further check, we also run the models with interaction terms (i. e., the full model). Results from these regressions are analogous to those that include main effects only, shown in Table 6.

disease, weighting removes the NT or UN component (but not both) of bias. For items on safety, there is indication that weighting for sex, age, education and area of residence may reduce the NT component as well as accentuate the UN component of bias.

To conclude, the current weighting strategy is overall ineffective in removing the under-coverage bias, although in some cases it may be effective in attenuating its magnitude; the impact of weighting on the different components of under-coverage error may vary in relation to the different survey domains.

Table 6 Results from binomial logistic regression (OR, standard errors in parenthesis)

Items	Column 1		Column 2				N
	OR		OR				
	(ref. category: NI)		(ref. category: I)				
	No controls	Yes controls	No controls		Yes controls		
		NT	UN	NT	UN		
<i>1. Politics</i>							
Having listened to political debates (yes)	1.38 (0.04)**	1.33 (0.04)**	0.61 (0.02)**	0.97 (0.04)	0.66 (0.03)**	0.92 (0.04)	37270
Frequency of speaking about politics (every day)	1.21 (0.05)**	1.1 (0.05)*	0.73 (0.03)**	1.03 (0.06)	0.84 (0.04)**	1.02 (0.06)	37347
Frequency of getting informed about politics (every day)	1.45 (0.04)**	1.26 (0.04)**	0.58 (0.02)**	0.95 (0.03)	0.71 (0.02)**	0.94 (0.04)	37478
<i>2. Health</i>							
Self-reported health conditions (very good)	0.67 (0.02)**	0.90 (0.03)**	1.49 (0.06)**	1.48 (0.07)**	1.08 (0.04)	1.19 (0.06)**	37994
Self-reported chronic disease or long standing illness (no)	1.64 (0.04)**	1.11 (0.03)**	0.55 (0.02)**	0.75 (0.03)**	0.83 (0.03)**	1.03 (0.04)	36744
Satisfaction for one's health conditions (very satisfied)	0.79 (0.03)**	0.98 (0.03)	1.26 (0.05)**	1.27 (0.06)**	1.02 (0.04)	1.02 (0.05)	37349
<i>3. Safety</i>							
Perception of safety walking alone in the streets at night (very safe)	0.92 (0.04)	0.99 (0.04)	1.19 (0.05)**	0.88 (0.05)*	1.11 (0.05)*	0.83 (0.05)**	37395
<i>4. Media and IT use</i>							
Frequency of listening to the radio (every day)	0.88 (0.02)**	1.07 (0.03)*	1.10 (0.03)**	1.20 (0.04)**	0.91 (0.03)**	0.98 (0.04)	37523
Frequency of watching TV (every day)	1.37 (0.05)**	1.27 (0.04)**	0.73 (0.03)**	0.72 (0.03)**	0.78 (0.03)**	0.81 (0.04)**	37523
Frequency of Internet use (every day)	1.24 (0.04)**	1.21 (0.04)**	0.66 (0.02)**	1.1 (0.05)*	0.67 (0.03)**	1.12 (0.05)*	18627
Frequency of newspaper reading (every day)	1.38 (0.04)**	1.21 (0.04)**	0.64 (0.02)**	0.90 (0.04)*	0.80 (0.03)	0.88 (0.04)*	37502
<i>5. Leisure</i>							
Four days holiday in the last 12 months (yes)	1.15 (0.03)**	1.25 (0.04)**	0.69 (0.02)**	1.35 (0.06)**	0.67 (0.02)**	1.09 (0.05)	37935

Table 7 Results from binomial logistic regression (OR, standard errors in parenthesis) (continued)

Items	Column 1		Column 2				N
	OR		OR				
	(ref. category: NI)		(ref. category: I)				
	No controls	Yes controls	No controls		Yes controls		
		NT	UN	NT	UN		
Holiday destination (abroad only)	0.79 (0.04)**	0.83 (0.04)**	1.44 (0.08)**	1.06 (0.07)	1.36 (0.08)**	1.02 (0.07)	15429

Note: \* p<0.05; \*\* p<0.01.

Source: Multipurpose survey- Aspects of everyday living 2012. Unweighted data. Individuals aged 18 and over. Controls include sex, age groups, education, area of residence. Standard errors are clustered within households. N refers to the sample size of the regressions with the control variables.

## 7. Conclusion

In many countries, the sampling frame used to sample the general population is based on a list of landline telephone numbers that can be randomly generated or drawn from the DLTN. When a non-negligible share of households are without a landline telephone, issues concerning the accuracy of the sampling frame and the quality of survey estimates (under-coverage bias) arise. In 2012, 50% of Italians are included in the sampling frame (i. e., the DLTN), the remaining are excluded as they do not own a landline telephone (32%) or their landline telephone number is unlisted in the DLTN (18%). This work explores the implications on survey estimates of the total under-coverage and its two components, NT and UN. Analysing the two components of under-coverage separately is key, especially when post-adjustment strategies are based on the assumption that there are no differences between NT and UN respondents.

A number of findings stand out from our analysis. First, I and NI respondents have marked demographic and socio-economic differences; I respondents differ from the total sample in a number of ways, being, for example, older and more likely to live in the Northern part of Italy. This is consistent with results from other studies discussed in the first part of the paper. NT, UN and I respondents seem to be different respondents too; marked differences are found when comparing NT to I and UN respondents. However, the differences between I and UN respondents are less relevant. Second, with the exception of only one survey item, under-coverage leads to under-coverage bias. This is not surprisingly given the high level of non-coverage rates associated to the strong differences between I and NI respondents. The bias seems to be particularly severe for items on politics and health. Note that pre-election and public opinion polls are normally carried out on samples drawn from the DLTN. The comparison between NT, UN and I respondents shows a very complex pattern. Overall, I respondents are different from UN and, especially, NT respondents. However, I and UN respondents do not differ with regard to items on politics. This seems to suggest that the impact of the two components of under-coverage may be topic-specific. NT and UN respondents are also very likely to differ on the items we considered. Third, current post-adjustment strategies are overall ineffective in removing the bias introduced by the total under-coverage and its two components; they may only alleviate its impact. However, for some survey topics, we found evidence that weighting for sex, age, education and area of residence has a different effect on the NT and UN components, removing or strengthening only one of the two sources of bias. This seems to suggest that a single weighing strategy that “fits all” components of under-coverage (as well as all survey items) may be an inappropriate strategy to tackle the under-coverage problem.



Overall, the results from our study are in line with findings from similar research carried out in Europe and the U.S. In sum, there is increasing evidence that suggests that current post-adjustment procedures are unable to correct for under-coverage error. Our results are also consistent with Joye et al. (2012)'s study when the authors conclude that UN and I respondents are not statistically different on a set of items on politics. However, our research shows that this does not hold for other survey topics, such as health, safety, media and IT use, and leisure consumption. Although further studies are needed to reinforce our conclusions, the implications of this research are important: innovative strategies to remove the under-coverage bias that take into account the complex composition of under-coverage need to be urgently developed. For items on politics, for example, under-coverage bias is only introduced by the NT component of under-coverage. To remove this source of bias, one could develop a sampling frame based on RDD of mobile phones only (nearly everyone in Italy owns at least one mobile phone). To our knowledge this is a research field that is completely unexplored in Italy and feasibility studies to drive its implementation are therefore urgently needed. For other items, a more sophisticated dual frame based on RDD of landline and mobile phone could be developed (Heckel and Wiese, 2012). Last, but not least, Italian pollsters and survey agencies may take advantage of the good quality addressed based sampling frames that exist in Italy on which, for example, the Multipurpose survey is based (Brick et al 2011; Link and Lai, 2011). This, of course, may have some disadvantages, in terms of time and costs. However, it could be a venue that is worth exploring.

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Appendix 1 Question wording

English	Italian
<p>Does the household own a telephone?</p> <p>NO (1)</p> <p>YES (2)</p> <p><i>(If YES)</i></p>	<p>L'abitazione dispone di telefono?</p> <p>NO (1)</p> <p>SÌ (2)</p> <p><i>(Se SÌ)</i></p>
<p>Is the telephone number of the main dwelling listed in the Directory of Telephone Numbers of the Municipality in which you live?</p> <p>NO (1)</p> <p>YES (2)</p>	<p>Il numero telefonico dell'abitazione principale è riportato nell'elenco telefonico del Comune in cui vive?</p> <p>NO (1)</p> <p>SÌ (2)</p>

Appendix 2 Demographic and socio-economic differences by type of sample. An overview

Demographic and socio-economic characteristics	I compared to				NT compared to
	NI	Total	NT	UN	UN
<i>Sex</i>					
Male	-1.7	-0.9 (n.s.)	-2.7	-0.1 (n.s.)	2.6
Female	1.7	0.9 (n.s.)	2.6	0.1 (n.s.)	-2.5
<i>Age</i>					
18-24	-0.8 (n.s.)	-0.4 (n.s.)	-0.8 (n.s.)	-0.7 (n.s.)	0.1 (n.s.)
25-34	-7.9	-3.9	-9.8	-4.4	5.4
35-44	-12.2	-6.1	-13.9	-9.1	4.8
45-54	0 (n.s.)	0 (n.s.)	0.7 (n.s.)	-1.3 (n.s.)	-2 (n.s.)
55-64	5	2.5	5.9	3.4	-2.5
65-74	7.3	3.7	8.5	5.2	-3.3
75+	8.5	4.2	9.4	7	-2.4
<i>Geographic area</i>					
North-West	2.9	1.5 (n.s.)	6	-2.8 (n.s.)	-8.8
North-East	5.2	2.8	6.4	3.1	-3.3
Center	0.4 (n.s.)	0.3 (n.s.)	1.9 (n.s.)	-2.1 (n.s.)	-4
South	-3.8	-2.1	-7	1.9 (n.s.)	8.9
Main Islands	-4.7	-2.4	-7.3	-0.1 (n.s.)	7.2
<i>Education</i>					
No education, primary education	7.9	4	6.6	10.3	3.7
Lower secondary	-8.7	-4.3	-11.6	-3.4	8.2
Higher secondary	-1.2 (n.s.)	-0.6 (n.s.)	0.8 (n.s.)	-4.7	-5.5
University degree (including Ph.D.)	2	1 (n.s.)	4.2	-2 (n.s.)	-6.2
<i>Marital status</i>					
Single	-4.7	-2.3	-6.3	-1.8 (n.s.)	4.5
Married	7.2	3.6	9.5	3.2	-6.3
Separated/divorced	-6.1	-3.1	-7.1	-4.4	2.7
Widowed	3.7	1.9	4.1	3	-1.1 (n.s.)
<i>Number of persons in households</i>					
One	-6.2	-3.2	-9.1	-0.9 (n.s.)	8.2
Two	5.5	2.8	6.1	4.4	-1.7 (n.s.)
Three	1.2 (n.s.)	0.8 (n.s.)	1.7 (n.s.)	0.2 (n.s.)	-1.5 (n.s.)
Four or more	-0.6 (n.s.)	-0.4 (n.s.)	1.2 (n.s.)	-3.7	-4.9
<i>Main professional condition</i>					
Employed	-10.7	-5.4	-11	-10.2	0.8 (n.s.)
Looking for a new job	-4.4	-2.2	-5.6	-2.2	3.4
Looking for the first job	-1.1	-0.6	-1.5	-0.3 (n.s.)	1.2
Housewife	0.3 (n.s.)	0.2 (n.s.)	-0.1 (n.s.)	1.1 (n.s.)	1.2 (n.s.)
Student	1.7	0.9	2.4	0.5 (n.s.)	-1.9
Retired	14.4	7.2	16.2	11.1	-5.1
Unfit for employment or other employment conditions	-0.4 (n.s.)	-0.2 (n.s.)	-0.5 (n.s.)	-0.1 (n.s.)	0.4 (n.s.)
<i>Housing tenure</i>					
Renter	-16	-7.8	-20.1	-8.6	11.5
Owner	18.6	9.1	24.1	8.7	-15.4
Other contracts	-2.6	-1.4	-4	-0.2 (n.s.)	3.8
<i>Children under 18 in the households</i>					
No	12.5	6.3	13.4	10.9	-2.5 (n.s.)
Yes	-12.5	-6.3	-13.4	-10.9	2.5 (n.s.)

Note: Numbers in the table are from Table 1. n. s. differences not statistically significant at 0.5 level.

### Appendix 3 The impact of under-coverage on bias. An overview

Items	I compared to			NT compared to	
	NI	Total	NT	UN	UN
<i>1. Politics</i>					
Having listened to political debates (yes)	5.7	3	8	1.6 (n.s.)	-6.4
Frequency of speaking about politics (every day)	2.3	1.1	3.2	0.5 (n.s.)	-2.7
Frequency of getting informed about politics (every day)	9.5	4.8	13.4	2.5 (n.s.)	-10.9
<i>2. Health</i>					
Self-reported health conditions (very good)	-5.4	-2.7	-5.8	-4.7	1.1 (n.s.)
Self-reported chronic disease or long standing illness (no)	-10.3	-5.2	-12.7	-5.9	6.8
Satisfaction for one's health conditions (very satisfied)	-3.4	-1.7	-3.4	-3.3	0.1 (n.s.)
<i>3. Safety</i>					
Perception of safety walking alone in the streets at night (very safe)	-1.1 (n.s.)	-0.5 (n. s.)	-2	0.5 (n.s.)	2.5
<i>4. Media and IT use</i>					
Frequency of listening to the radio (every day)	-2.6	-1.3 (n.s.)	-1.5 (n.s.)	-4.4	-2.9
Frequency of watching TV (every day)	4.5	2.2	4.4	4.5	0.1 (n.s.)
Frequency of Internet use (every day)	6.3	3.1	11.5	-0.7 (n.s.)	-12.2
Frequency of newspaper reading (every day)	4.6	2.2	6.3	1.6 (n.s.)	-4.7
<i>5. Leisure</i>					
Four days holiday in the last 12 months (yes)	4.7	2.3	10.7	-6.2	-16.9
Holiday destination (abroad only)	-4.7	-2.3 (n.s.)	-8.3	-0.2 (n.s.)	8.1

Note: Numbers in the table are form Table 5. For example, 5.7 in the first row is the difference between 23 and 17.3 in Table 5. n. s. differences not statistically significant at 0.5 level.