Survey Research Methods (2021)
Vol. 15, No. 2, pp. 115-133
doi:10.18148/srm/2021.v15i2.7457
European Survey Research Association

Establishing a Baseline: Bringing Innovation to the Evaluation of Cross-National Probability-Based Online Panels

Gianmaria Bottoni
City, University of London
United Kingdom

Rory Fitzgerald
City, University of London
United Kingdom

A number of countries in Europe and beyond have established online or mixed mode panels with a web component based upon probability samples of the general population. This paper evaluates data from the Cross-National Online Survey (CRONOS), a cross-national online panel of ESS respondents in three countries. By comparing the CRONOS data, both with external benchmarks, and with the face-to-face data from the ESS, we assess data quality in terms of representativeness and differences in attitudinal and behavioural characteristics without confounding the findings with other changes such as mode effects. Our findings suggest that the CRONOS sample is not extremely divergent from the target population or to the ESS. However, there are sometimes cross-national differences suggesting cross-national comparability might be different when compared to using similar estimates from a face-to-face survey.

Keywords: Representativeness, Online panel, European Social Survey, Nonresponse, Propensity to join a web survey.

1 Introduction

The so-called volunteer access panels offered by many commercial research companies are affected by self-selection bias (Yeager et al., 2011). However, coverage error is also a key limitation for probability-based web panels since many people do not have internet access (Manfreda & Vehovar, 2008). In Europe, there are several probability-based online panels that try to address this by including the offline population via different approaches (Blom et al., 2016). In the Netherlands, the LISS panel used face-to-face fieldwork to recruit the panel. Meanwhile the ELIPSS panel implemented a strategy which aimed to maximise measurement equivalence by providing each panel member (whether offline or online) with a tablet and internet connection. In the German Internet Panel (GIP) instead all eligible household members were invited to join the panel at the recruitment stage. The GESIS panel differs from the LISS and ELIPSS panels since it employs a mixed-mode approach to its regular data collection (online and mailed paper questionnaires). In the same way, the NatCen Panel employs a sequential mixed-mode approach (online and telephone).

Several studies have analysed the representativeness of these panels. It was found that the LISS panel suffers from underrepresentation of certain groups (Van der Laan, 2009). In particular, older, single people and first generation immigrant households are underrepresented compared to the Labour Force Survey (LFS) whilst voters as well as people with internet access are over-represented (Scherpenzeel & Bethlehem, 2010).

Blom, Gathmann, and Krieger (2015) assessed the representativeness of the GIP panel and found that it underrepresents the older population compared to the German Census. In addition, using auxiliary commercial street-level data, the authors used logistic regression and found that three characteristics were significant predictors of participation: the level of education (GIP over-represented those living in areas with a high proportion of university graduates), purchasing power (people living in prosperous areas were more likely to participate) and immigration (areas with higher proportions of immigrants were under-represented). Regarding the GESIS panel, Bosnjak et al. (2018) measured the deviation of the sample composition from the German Microcensus (GMC). Using the Duncan Index, they found that the dissimilarities in terms of sample composition between the GESIS Panel and the GMC are similar to those found between other general population surveys as the German General Social Survey ALLBUS and the German part of the European Social Survey (ESS).

The ESS has used the gold standard of face-to-face as its sole mode of data collection for the survey questionnaire since it was established in 2001 (Jowell, Roberts, Fitzgerald, & Eva, 2007). In the face of declining response rates (De Heer & De Leeuw, 2002) and increased costs, the ESS experimented with mixed mode data collection. However, this

Contact information: Gianmaria Bottoni, DG13, Rhind Building City—University of London, Northampton Square, London EC1V 0HB, United Kingdom (Email: gianmaria.bottoni@city.ac.uk)

was rejected due to concerns about non-equivalence between data collection modes on certain topics, for example subjective wellbeing (Villar & Fitzgerald, 2017).

In order to deal with the limitations outlined above, the CROss-National Online Survey[1] (CRONOS) panel was tested by the ESS with a view to it complementing the face-to-face ESS rather than replacing it (Villar et al., 2018). Reflecting on existing research on the representativeness of probability-based panels (Blom et al., 2015; Bosnjak et al., 2018; Scherpenzeel & Bethlehem, 2010; Van der Laan, 2009), our paper aims to assess the dissimilarities in terms of sample composition between the CRONOS achieved sample compared to population data and the ESS itself. The biggest difference between CRONOS and the other panels which have already been evaluated is its cross-national composition. Our research therefore tries to fill this gap in the literature by evaluating the representativeness of a cross-national probability-based web panel. In particular, in addition to the typical analytical approach of comparing the achieved panel sample to population data, we use data from the parent survey to examine differences between the full face-to-face survey sample and the sub sample of panel respondents. Comparing the sub-sample who entered the panel to all those who answered the parent survey provides a unique opportunity to compare the changes in sample composition and changes to answers to attitudinal survey items without the confounding effects of different modes.

In order to assess the sample representativeness of CRONOS we compare its sample composition to population data on several demographic characteristics. The paper then moves on to test whether specific demographic variables predict the propensity to join the CRONOS panel, comparing the CRONOS achieved sample with ESS Round 8 sample splitting the ESS sample in two sub-groups: those who decided to participate in the panel and those who did not. Finally, we compare attitudinal and behavioural characteristics evaluating differences between the CRONOS and ESS samples.

2 Sample representativeness and approaches to assess it

The representativeness[2] cannot be the property of a sample as a whole. We can only claim representativeness for variables whose distributions are known for the population. These variables represent only a limited set of items (generally, age, gender, education) and even then comparisons are difficult because of different target population definitions, varying data formats and differing reference times (e.g. see Ortmanns & Schneider, 2016, for issues when comparing education distribution)

There are four main approaches for evaluating representativeness. The first is the response rate since surveys with very high response rates are traditionally considered to be representative (Stoop, Billiet, Koch, & Fitzgerald, 2010). However, several scholars have shown that low response rates do not necessarily result in biased samples (Groves & Peytcheva, 2008; Koch, Halbherr, Stoop, & Kappelhof, 2014). B. Schouten, Cobben, and Bethlehem (2009) suggest that increased efforts to raise response rates could even be counter-productive leading to lower representativeness.

A second method uses sample-based representativeness indicators comparing respondents to the gross sample (B. Schouten et al., 2012; B. Schouten et al., 2009; J. Schouten & Cobben, 2007). However, this approach requires the availability of auxiliary data (generally taken from the sampling frame) for respondents and non-respondents. Such data are however only available for some surveys in some countries and so this technique is of limited value in a cross-national context.

The third approach employs the so called "internal criteria for representativeness" (Kohler, 2007). This method uses some internal criteria with the objective of measuring unit nonresponse bias for specific subgroups of a sample. This approach compares some known parameters of the subpopulation to the observed values in the sample of those parameters that are used as benchmarks. The comparison between the subpopulation and sample parameters provides an estimation of how much those parameters differ from the expectation of pure random fluctuation (Kohler, 2007). The main limitation regards the fact that the absence of nonresponse bias does not necessarily reflect an absence of the bias in the entire sample as the method is based on comparisons of specific subgroups of the sample.

The fourth method involves making comparisons between sample distributions in the achieved sample of a survey with external benchmark sources (Bosnjak et al., 2018; Koch et al., 2014; Ortmanns & Schneider, 2016). This approach has several advantages: simple statistical implementation, relatively high availability of comparable demographic variables, and the fact that sampling error is also reflected in the benchmark comparison (Ortmanns & Schneider, 2016). In this paper, we follow this fourth approach and consider representativeness as being when the distribution of key variables in the sample are equivalent to the distribution in the target population. The approach is based on the assumption that the benchmark variables themselves were measured without error. Generally, the comparison is made with official sources (census or register) and other high quality official surveys that are assumed to be the "gold standard" with regard to

[1] The CRONOS panel work was funded under the 'Synergies for Europe's Research Infrastructures in the Social Sciences (SERISS)' funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 654221. The CRONOS initiative was also supported by ESS ERIC Work Programmes (2015-2017) and (2017-2019).

[2] For a discussion of the vague meaning of the term representativeness see Kruskal and Mosteller (1979, 1980).

the data quality. However, data coming from surveys always contain a certain amount of error (Koch et al., 2014). For example, Schneider (2009) shows that the distributions of the education variable coming from EU-LFS and EU-SILC are quite divergent for the years 2002 to 2007 in most European countries, whilst Ortmanns and Schneider (2016) found high inconsistency between the Eurobarometer and the EU-LFS.

3 CROss-National Online Survey (CRONOS) panel

The CRONOS panel was an attempt to set up an academically driven cross-national probability-based online panel. CRONOS was set up in Estonia, Great Britain and Slovenia and was centrally organised and led by ESS ERIC Headquarters at City, University of London in collaboration with several ESS National Coordinators and SERISS project partners[3].

The panel employed a 'piggybacking' recruitment approach that presents several advantages: maximising the investments of the main 'parent' face-to-face survey, reducing panel recruitment costs compared to bespoke efforts, avoiding the need to source a new sampling frame, as well as drawing on trained interviewers. Obviously, this approach also has shortcomings. One of the most relevant is that the CRONOS sample is a function of the sampling procedures of the parent ESS survey, reflecting and/or magnifying the divergence and differences between the sample of the parent survey and the target population. In other words, if a bias is present in the parent survey, this bias is automatically transmitted to the survey employing the piggybacking approach. Another limitation stems from the interviewer training since in a directly recruited panel interviewer training is focused on motivating the people to join the panel and conversion strategies. However, with a piggybacking approach the recruitment process to the panel is just a part of a much larger number of tasks that interviewers need to carry out right after the mainstage survey that sometimes, like in the ESS, is a very long interview, increasing further the burden for respondents. Finally, a survey employing a piggybacking approach has little room to modify or adjust the features of the parent survey, therefore the quality and selection of the parent study is an important issue.

CRONOS was recruited on the back of the ESS (Round 8). All ESS respondents aged 18 and over were invited to join the panel[4].

CRONOS aimed to be representative of the general (residential) population regardless of whether or not people had internet access. In Europe, there is still a non-negligible number of households without internet access. This aspect would represent a trivial problem if the online population had the same characteristics as the offline population. However, several studies have shown that the offline population tends to be older, less educated, more rural and have lower incomes compared to the online population (Couper, 2000; Ragnedda & Muschert, 2013; Rookey, Hanway, & Dillman, 2008). In addition to demographic variables, Robinson, Neustadtl and Kestnbaum (2002) and Robinson and Martin (2005) found that internet users tend to show more tolerant attitudes than non-internet users. Dever, Rafferty, and Valliant (2008) found that internet users have characteristics that mean they are more likely to be in good health and to exercise regularly, whilst Schnell, Noack, and Torregroza (2017) showed that subjective health reports are clearly worse for non-internet users. Zhang, Callegaro, Thomas, and DiSogra (2009) showed that the online population reports higher levels of political participation. In addition, several studies have pointed out that including the offline population increases the accuracy of survey estimates (Blom et al., 2017; Eckman, 2016; Revilla, Cornilleau, Cousteaux, Legleye, & de Pedraza, 2016; Van der Laan, 2009).

In order to address this issue internet-enabled tablets were offered to ESS respondents who had no internet access. This approach aimed to minimise coverage error and avoid mode effects (Vannieuwenhuyze, Loosveldt, & Molenberghs, 2010; Villar & Fitzgerald, 2017). During ESS Round 8 fieldwork, in Estonia 46 respondents were eligible for tablets and accepted to join the panel, 52 in Slovenia and 84 in Great Britain[5]. Regarding CRONOS Wave 1 tablet respondents, there were 35 tablet respondents in Estonia (4.8% of total wave 1 respondents), 38 in Slovenia (7.2%), and 47 in Great Britain (6.9%). CRONOS respondents were provided with an unconditional incentive (Blom et al., 2015; Millar & Dillman, 2011; Singer, Hoewyk, Gebler, & McGonagle, 1999).

CRONOS comprised six bimonthly waves plus a welcome

[3]The partners are NSD—Norwegian Centre for Research Data (Norway), University of Ljubljana (Slovenia), Tilburg University and CentERdata (the Netherlands), Munich Centre for the Economics of Ageing (Germany), Universitat Pompeu Fabra (Spain) and National Coordinator (NC) teams in Slovenia (University of Ljubljana), UK (NatCen Social Research) and Estonia (University of Tartu).

[4]Those aged 15-17 were not invited to avoid issues related to parental consent for participation in an online survey. Respondents in Northern Ireland were excluded as the fieldwork is conducted by a different fieldwork agency to the rest of the UK.

[5]The only information ESS has for each CRONOS country is how many respondents took a tablet and how many overall were eligible to be invited to take part in the panel (and how many actually did). There is no explicit data on how many respondents were offered a tablet (because of having no internet access) and then still refused to take part. We know that the overall number using a tablet was very low and unlikely to reverse any bias from having low numbers of off-liners overall. In all cases when respondents requested tablets the survey agency attempted to deliver them and set the respondent up. So, the key explanation for having such a low number of tablets handed out was a reluctance of off-liners to take them (and not practical issues of delivery).

survey with the latter designed to bridge the gap between the ESS face-to-face interview and the first main wave. The data collection for the welcome survey started in December 2016 and the first wave was launched in February 2017. The data collection process ended in February 2018[6].

4 Data and method

4.1 Objective of the study

Our paper aims to assess the representativeness of CRONOS[7] wave 1 achieved sample compared to population data and to assess the degree to which specific demographic variables predict the propensity of a respondent to the ESS Round 8 to participate in the CRONOS panel.

The CRONOS wave 1 achieved sample is 1944 respondents (Estonia 730, Slovenia, 529, Great Britain 685). The participation rate, computed as a proportion of all people invited, ranged from 78% in Estonia to 56% in Great Britain (fig.1). As the individuals invited to join the online panel were only those who also participated in the main ESS interview, the cumulative response rate computed as a proportion of the ESS gross sample[8] (see also ESS response rate fig.1) ranges from 25% in Estonia to 15% in Great Britain (fig.1). Finally, the participation rate computed as a proportion of ESS Round 8 actual respondents aged 18 years and older ranged from 42% in Slovenia to 37% in Great Britain (fig.1).

The data sources used as benchmarks to compare the CRONOS achieved sample to the population refer to data from National Statistical Institutes, data from Eurostat and data from the EU Labour Force Survey (EU-LFS) (see table 1 for data sources). To assess whether specific demographic variables predict the propensity to join CRONOS panel we used the ESS Round 8 dataset (European Social Survey, 2016) including a variable indicating CRONOS participation.

4.2 Method

The data about the CRONOS respondents described in this paper come directly from their answers to the main ESS face-to-face questionnaire. This allows comparisons between the characteristics of the respondents that participated in the web panel with those who did not whilst avoiding confounding the findings with mode effects.

In order to assess the CRONOS sample representativeness and discrepancies between CRONOS and population data we computed the average absolute error that takes into account the number of categories of the variable of interest. The average absolute error is computed similarly to the Duncan Index (Bosnjak et al., 2018) but instead of dividing the sum of the differences by 2, the differences are divided by the total number of categories. This makes possible to compare variables with a different number of categories. In addition, in order to precisely pinpoint the discrepancy, we also report the cross-tabulations of the variables analysed.

In a second step we tested whether specific demographic variables measured in the ESS face-to-face predict the propensity to join the CRONOS panel by performing a multiple logistic regression model. The outcome variable for the logistic regression is participation in CRONOS wave 1 (1=Yes, 0=No). We computed the predictive margins and marginal effects using the AME (average marginal effects) method. The average marginal effect is the average of predicted changes in fitted values for a discrete change in X (if the predictor is a dichotomous or a polytomous variable) for each observation on the X variable.

Finally, in order to test attitudinal and behavioural characteristics between the two sub-samples—those who participated in the web panel and those who did not—we specified another multiple predictor logistic regression model. In these models, we compare two sub-groups: ESS respondents who participated in CRONOS wave 1 versus those who refused to participate.

5 Results

5.1 Dissimilarities between the CRONOS sample and other benchmark data

In this section, we evaluate the extent to which the CRONOS web panel is affected by sample composition bias. In particular, we focus on those variables that several studies have shown to be affected by larger bias, namely age and education (Couper, 2000; Ragnedda & Muschert, 2013; Rookey et al., 2008) but also look at others. Our comparison is limited by the availability of the data in the target population and whether the variables were measured in the same way. In Table 1, we report the variables and categories used in this analysis[9].

[6]CRONOS data are available at https://www.europeansocialsurvey.org/data/download_cronos.html

[7]CROss-National Online Survey panel [CRONOS wave 1] (2018). NSD - Norwegian Centre for Research Data, Norway—Data Archive and distributor of CRONOS data for ESS ERIC

[8]The ESS gross sample slightly differs from the one reported in the ESS official documentation (ESS Round 8: European Social Survey (2017): ESS-8 2016 Documentation Report) since it has been recomputed accordingly to CRONOS sample characteristics. Precisely, slightly discrepancies result from:

- Age eligibility (15-17 years old were excluded).
- Northern Ireland was excluded in the UK CRONOS sample.

[9]Data for CRONOS were weighted by the design weight to correct for differences in selection probabilities. The design weights only impact the GB data since Estonia and Slovenia used equal probability selection methods for the mainstage ESS.

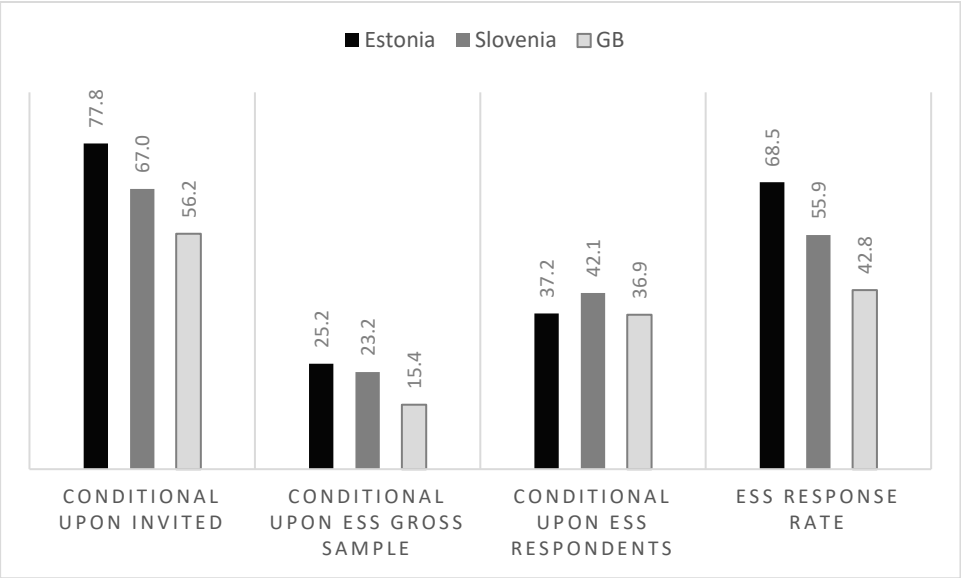

Figure 1. Cronos and ESS participation rates

In order to measure the discrepancies in comparison with population distributions and to identify the variables with the largest mismatch whilst at the same time accounting for the different number of categories within each variable, we computed the average absolute error.

The overall average absolute error computed across the 8 variables is 3.7 in comparison to population estimates. Computing the average absolute error per country, the largest discrepancy is shown in Estonia, followed by Slovenia and is lowest in Great Britain (table 2).

The variables that, on average, show the largest mismatch are Household size (the biggest discrepancy is in Slovenia) followed by Citizenship (with highest discrepancy registered in Estonia), Marital Status (biggest mismatch in GB) and finally Gender (table 2).

In order to pinpoint the source of the mismatches, in Table 3 we report the distributions of the benchmark variables for CRONOS and the population.

Looking at the distributions, CRONOS tends to underrepresent individuals with only primary education in Estonia and Slovenia (but not in GB) and over-represents individuals with secondary education in Slovenia.

In terms of age, the CRONOS distributions appear to match the ones in the population up to 74 years of age. However, starting from 75+ the bias becomes a serious issue in comparison to the population (as represented by the EU-LFS). This might be accounted for by several factors. For example, the older population might be less willing to make a one year long commitment to be part of a panel or they may feel less confident or not have access to the web (see next section). CRONOS tends to over-represent the female population in each country and in Estonia also citizens (which in that context may be a problem due to the status of the Russian speaking minority). Regarding household size, CRONOS underrepresents single adult households in Estonia and especially in Slovenia and over-represents married individuals, particularly in Great Britain.

In summary, the scores reported in Table 2 show that the discrepancies between CRONOS sample and the benchmarks are in line with other studies, suggesting no unexpected concerns with regard to self-selection bias in CRONOS (Bosnjak et al., 2018; Koch et al., 2014). However, as the analyses of the other online panels showed (Blom et al., 2015), the CRONOS panel appears to systematically underrepresent the older population, those with lower education, single adult households, and to over-represent females, citizens and married people.

Table 1
Variables compared

Variable	Categories	Comparison	Target population
Gender	Female Male	National statistics offices	18+
Age	18–24 25–34 34–54 55–64 65–74 75+	National statistics offices	18+
Education	Primary Secondary Tertiary	EU-LFS	18–74
Marital Status	Married Not Married	Eurostat, Office for National Statistics (just for GB*)	20+
Employment relation	Self-employed Not self-employed	EU-LFS	25-54
Work status	In paid work Not in paid work	EU-LFS	25–54
Citizenship	Citizen Not citizen	Eurostat	20+
Household size	Single person Household Household with at least 2 individuals	EU-LFS	25–54

* Data for GB were not available on the Eurostat website so we turned to UK Office for National Statistics. Data were available only for England and Wales; however, this was the most adequate benchmark for this variable that was available for GB

5.2 Propensity to join the CRONOS panel

In this section we compare the ESS sub-population who participated in CRONOS with the ESS sub-population who did not participate. This enables us to identify the characteristics of those who agreed to join the CRONOS panel and to assess whether specific demographic variables predict the propensity to join the web panel.

The data about CRONOS respondents described in this paper comes directly from their answers to the main ESS face-to-face questionnaire.This allows comparisons without confounding mode effects between the ESS sub-sample comprising respondents participating in CRONOS with the ESS sub-sample comprising respondents not participating in the panel. The outcome variable is CRONOS participation which we define as ESS respondents who participated in CRONOS wave 1 (assigned the value 1; the others assigned the value 0). The predictors of CRONOS participation were gender, age, education, whether voted in the last general election, being in paid work, economic situation, frequency of internet use, and country.

We performed a multiple predictor logistic regression model with main effects specified (table 4) and then inserted several interaction terms between country and other predictors to assess if recruitment patterns varied across countries[10].

Gender is a significant predictor of CRONOS participation at the 5% level. Females are on average 3 percentage points more likely than males to join the web panel (see table 4 predictive margins and/or average marginal effect). Perhaps surprisingly, age is not a significant predictor of CRONOS participation. In the same way, economic condition is not a significant factor of the propensity to take part in the web panel. Instead, education and whether voted in the last election are clear predictors of participation. Highly educated people are 10 percentage points more likely to join CRONOS compared to those with just primary education, and those with a secondary education are 5 percentage points more likely than those with primary education. CRONOS respondents also claim higher levels of electoral participation

[10] As in the previous analysis, data were weighted by the design weight to correct for differences in selection probabilities.

Table 2
Average absolute error

	CRONOS/POP			
	Estonia	GB	Slovenia	Mean scores
Gender	3.9	4.1	5.2	4.4
Age	2.8	3.4	3.1	3.1
Education	4.1	1.5	5.1	3.6
Employment relation	3.5	2.3	1.3	2.4
Work status	2.2	1.8	2.9	2.3
Citizenship	8.9	0.8	4.0	4.6
Household size	5.6	1.9	6.6	4.7
Marital status	3.0	7.5	3.4	4.6
Average	4.3	2.9	4.0	3.7

Table 3
Benchmark variables distributions

	Estonia		GB		Slovenia	
	CRONOS	EU-LFS	CRONOS	EU-LFS	CRONOS	EU-LFS
Education						
Primary	8.5	14.8	20.3	21.1	8.8	15.2
Secondary	52.9	50.2	42.5	40.2	65.4	57.8
Tertiary	38.6	35.1	37.2	38.8	25.7	26.9
Employment relation						
Self-employed	13.6	10.1	12.4	14.7	10.3	11.6
Work status						
In paid work	84.8	82.6	80.9	82.9	80.6	83.5
Household size						
Single adult households	12.1	17.7	13.7	11.9	5.9	12.5

	Estonia		GB		Slovenia	
	CRONOS	POP	CRONOS	POP	CRONOS	POP
Age distribution						
18–24	10.1	8.8	10.2	11.2	8.1	8.4
25–34	20.4	18.0	13.6	17.2	19.7	16.1
35–54	37.3	33.1	36.5	34.0	41.0	35.9
55–64	16.6	16.2	17.0	14.7	18.0	17.2
65–74	11.1	12.1	18.0	12.6	9.8	11.8
75+	4.5	11.8	4.7	10.3	3.4	10.5
Gender						
Female	58.2	54.3	55.3	51.2	56	50.8
Citizenship						
Citizens	91.1	82.2	91.3	90.8	98.5	94.5
Marital status						
Married	42.9	39.9	61.7	54	51.2	47.8

Table 4
Logistic regression model for demographic variables

	B	SE	Predictive margins[a]	SE	Average marginal effect[a]	SE
Male			38	0.01		
Female	0.13*	0.06	41	0.00	3	0.01
65+			39	0.02		
18–34	−0.03	0.12	39	0.01	−1	0.03
35–64	0.06	0.11	41	0.01	1	0.02
Primary			34	0.01		
Secondary	0.24*	0.10	39	0.01	5	0.02
Tertiary	0.44*	0.11	44	0.01	10	0.02
Did not vote			33	0.01		
Voted	0.42*	0.08	42	0.00	9	0.02
Not paid work			43	0.01		
Paid Work	−0.23*	0.08	38	0.01	−5	0.02
Difficult/Very difficult			37	0.02		
Living comfortably or coping	0.17	0.10	40	0.01	4	0.02
Internet Use – Never			13	0.01		
Occasionally/Most days	1.26*	0.13	35	0.02	21	0.02
Every day	1.91*	0.13	50	0.01	37	0.02
Estonia			39	0.01		
GB	−0.10	0.08	37	0.01	−2	0.02
Slovenia	0.33*	0.08	46	0.01	7	0.02
Constant	−2.63	0.15				

[a] predictive margins and AMEs reported as rounded percentages
* $p < .05$

compared to those who did not join the panel. The predicted probabilities of joining the panel are 33% for panellists who did not vote and 42% for those who voted. Therefore, voters were 9 points more likely to join the panel than those who did not vote. Those who are in paid work show lower probabilities of taking part in the panel (5 percentage points less for people in paid work than those not). However, the strongest predictor of participation is internet use. The predicted probabilities are 50% for individuals using the internet every day, 34.8% for those using internet occasionally and just 13.4% for panellists never using the internet. In other words, daily internet users are 37 points more likely to join the panel than those who never use it. Finally, regarding participation in CRONOS across the three countries, there were no statistically significant differences between Great Britain and Estonia. However, in Slovenia ESS respondents tended to participate more often in the follow up web panel compared to the other countries.

We also tested for several interaction effects. First, we tested the interaction between age and internet use, and then tested the interactions between country and gender, age, education, voting, main activity, economic condition as well as internet use. The interactions between predictors and country were useful to more carefully test cross-country differences and assess if the recruitment patterns differed across the countries. All the interaction terms except age and internet use, age and country, and internet use and country were not statistically significant. In order to facilitate the interpretation of the interaction coefficients, we report the graphs for the significant interactions (figure 2, 3, and 4). The interaction models' relevant statistics (i.e. coefficients and predicted probabilities) are shown in the appendix (table A1).

Regarding the interaction models' results, the general interaction term for age and internet use is significant at the 5% level (likelihood-ratio test: $\chi^2 = -10.361$, df = 4, $p = 0.035$); however just the contrasts between 35–64 and 65+ groups are significantly different from zero at the 5% level (see table A1).

In figure 2, we can see that those aged 35-64 tend to participate more in the web survey compared to those aged 65+ when their level of internet use is "never". Whilst both age groups have the same predicted probabilities for participation in CRONOS when using the internet "occasionally".

However, when panellists use the internet every day then

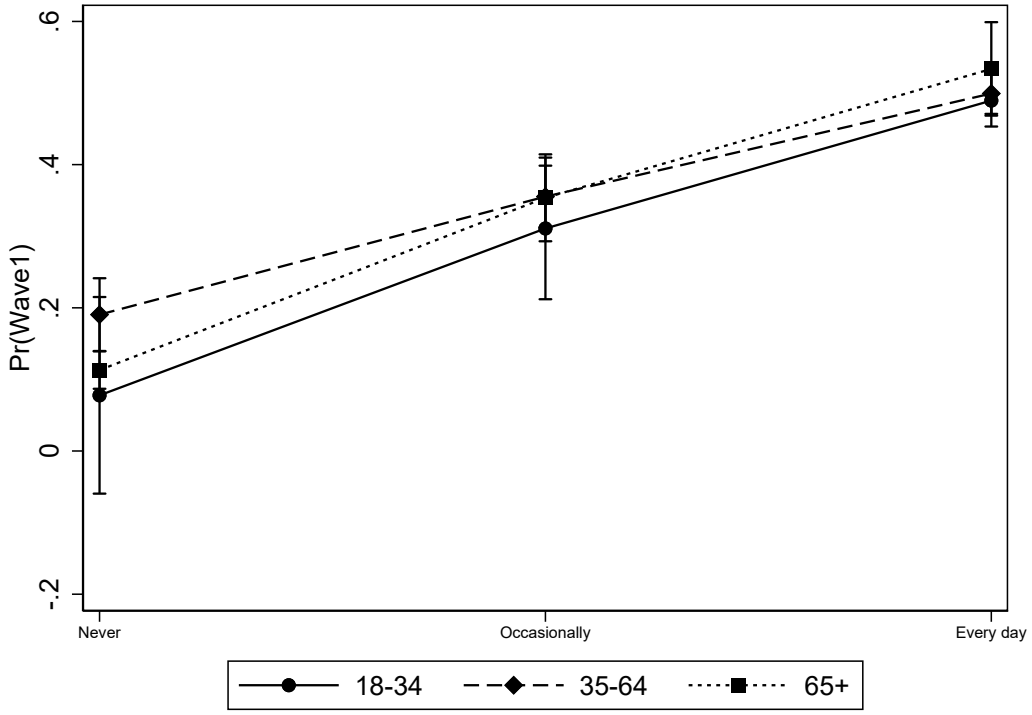

Figure 2. Age and Internet use interaction

the oldest age group shows the highest level of participation in CRONOS. The predicted probabilities of participating for those who never use the internet were 19% for the 35-64 year olds and 11% for those aged 65+ in the category "Never"; 35% for both the age groups in the category "Occasionally"; finally, for those who say they use the internet every day the predicted probabilities are 50% for 35-64 year olds and 53% for 65+ year olds (see also the table A1). This suggests that older people would tend to participate more (or just as often) in the panel but the different level of familiarity with the internet or less access to it prevents them from doing so. Indeed, when they show high levels of internet use their participation increases relatively more compared to the other age groups. In addition, among those who never use the internet, the 35-64 group is much more likely than the 65+ group to join. This may suggest the hypothesis that offering tablets may be an effective way to get younger non-internet users to participate but it may be less effective for the oldest whose lower familiarity with the Internet and technology in general may be a larger impediment.

Also, the interaction between age and country shows statistical significance (Wald test for the general interaction term $p < .05$; likelihood-ratio test: $\chi^2 = -10.638$, df = 4, $p = 0.031$).

The younger population in Great Britain show less propensity to join the panel compared to their peers in Estonia and Slovenia (table A1).

Figure 3 shows something interesting. In Great Britain as the age increases the predicted probabilities of taking part in the survey increase as well. Exactly the opposite happens instead in Estonia where progressively the probabilities decrease as age increases. In Slovenia the probabilities drop for the oldest age group after an increment in the probabilities is registered in those aged 35-64. Therefore, age has a positive association with participation in Great Britain and a negative association in the other countries.

Finally, we tested the interaction between Country and internet use (Wald test for the general interaction term $p < 0.01$; likelihood-ratio test: $\chi^2 = -19.288$, df = 4, $p = 0.001$).

The propensity to join the panel increases as use of the internet increases in each country. However, in Great Britain a relative drop in the probabilities is shown for those people using the internet every day (figure 4). This indicates that the effect of internet use on the propensity to join the web panel is smaller in Great Britain compared to the other two countries (see also the predictive margins in table A1). In terms of marginal effects, a surge of 22 and 19 percentage points in Estonia and Slovenia respectively is recorded in terms of participation in CRONOS between respondents who use the internet "Occasionally" and those who use it "Every day". However, in Great Britain the increase is just 6.5 percentage points. The smaller impact of internet use may be the result

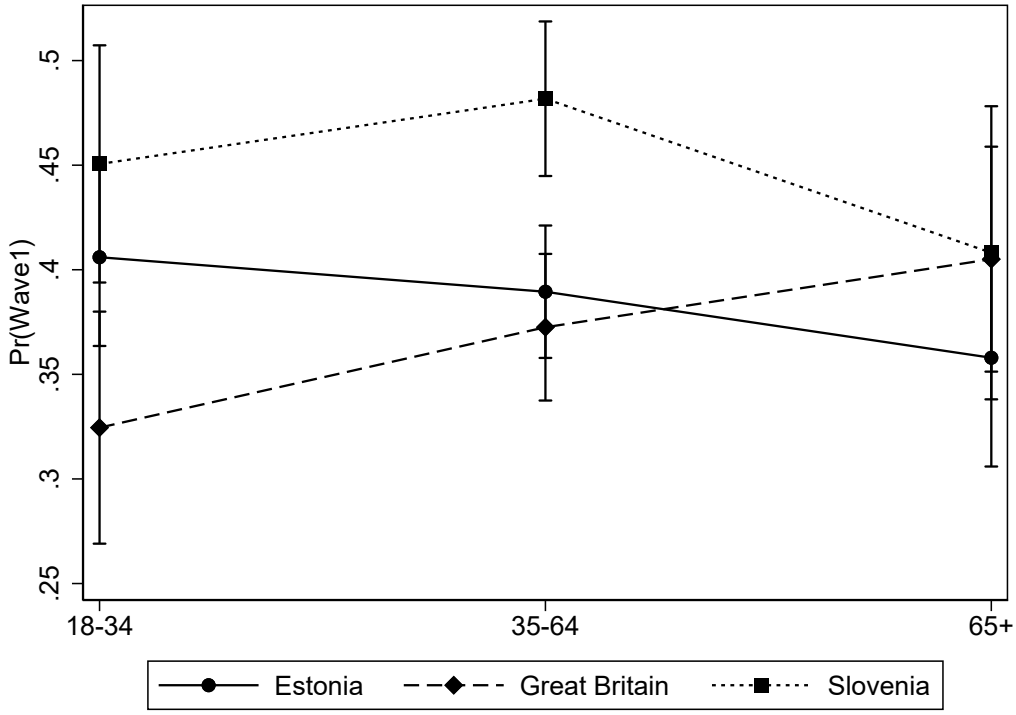

Figure 3. Age and Country interaction

of the association between age, survey participation and internet use (in Great Britain younger people are less likely to join the panel compared to Estonia and Slovenia). Also the lower internet penetration rate in Slovenia and Estonia may have played a role in the recruitment patterns (in 2018, 95% of households have access to internet in UK, 90% in Estonia and 87% in Slovenia. Source Eurostat, online data code: isoc_ci_in_h).

As Couper (2000) noted, even though the demographic characteristics of web survey respondents match those of the target population, the fundamental question is whether they are also similar on the substantive variables of interest concerning attitudes and behaviours.

Little attention has been paid to this aspect and less research evidence is available since the question can only generally be answered by running parallel surveys.

However, the ESS follow up survey CRONOS provides the opportunity to investigate discrepancies in substantive variables without mode-effects influencing the results because it is possible to identify which respondents participated in the panel and those that did not and compare their answers to attitudinal and behavioural variables in the face-to-face data.This is a rare opportunity to compare characteristics of a web panel sample with another high quality survey sample on those variables that are rarely available in official surveys or where comparability is hampered by differences in data format.

We specified another logistic regression model, this time selecting several attitudinal and behavioural items as the independent variables. The outcome variable is CRONOS participation. The predictors refer to political participation[11] subjective health, interpersonal trust, trust in parliament, concern about climate change, attitude toward gays and lesbians, life satisfaction, attitudes toward immigration, social relationships, and type of domicile. We controlled the relationships by country, gender, age, income condition, and

[11]Political participation is an additive index resulting from the sum of eight dichotomous items. The items were:

- Contacted politician or government last 12 months
- Worked in political party or action group last 12 months
- Worked in another organisation or association last 12 months
- Worn or displayed campaign badge/sticker last 12 months
- Signed petition last 12 months
- Taken part in lawful public demonstration last 12 months
- Boycotted certain products last 12 months
- Posted or shared anything about politics online last 12 months.

The index has been then dichotomised identifying people that have never done any of the above actions in the last 12 months and people that have done one or more.

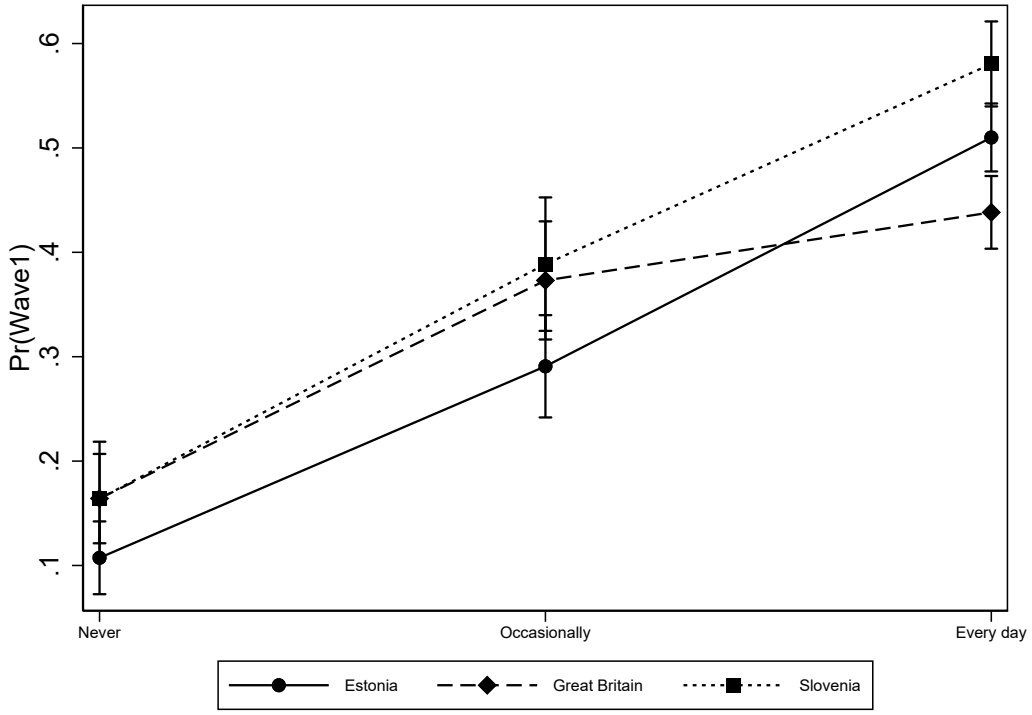

Figure 4. Internet use and Country interaction Attitudinal and behavioural variables

years of education since several studies showed that some relationships disappear after controlling for demographic variables (Piekarski et al., 2008; Valliant & Lee, 2005).

CRONOS respondents are characterised by higher levels of social and institutional trust than those not taking part in the first wave of the panel—the marginal effect on predicted probabilities of going from low to high social trust is 4.2 percentage points and 3.8 percentage points for institutional trust—(Table 5). At the same time, CRONOS participants seem slightly more worried about climate change with a marginal effect of 3.6 percentage points higher (the predicted probabilities of joining the panel are 37.1% for those people not worried by climate change and 40.7% for those that are worried). They also report higher levels of political participation—respondents that have done at least one of a set of political activities in the last 12 months are more likely to participate in CRONOS by 13.5 percentage points compared to those who have done none (the predicted probabilities are respectively 46.8% and 33.3%). CRONOS panellists also tend to have better self-reported health conditions. The positive effect of being in good health on the predicted probabilities is 7.6 percentage points higher than for those in poor health. Finally, there are also statistically significant differences with regard to life satisfaction and attitudes toward gays and lesbians. Being highly satisfied with one's life and more tolerant toward the LGBT community slightly increase the probabilities of participating in CRONOS by 4.6 and 4.8 percentage points respectively. However, no significant differences are found for attitudes towards immigration, density of social relationships or levels of urbanisation in terms of self-reported location.

Once again, we tested for possible interaction effects. As in the previous analysis, the interactions help to identify potential differences in the recruitment patterns between countries. Therefore, the presence of an interaction between country and other variables indicates differences amongst the countries whilst the absence of interaction implies that all the countries behaved in the same way with reference to the variables of interest.

For this reason, all the possible interactions between the predictors and the country variables were tested. However, only two interactions showed statistically significant coefficients; that is the interactions between country with political participation and country with climate change.

The interaction term between political participation and country is statistically significant at the 5% level (likelihood-ratio test: $\chi^2 = 6.039$, df = 2, $p = 0.049$) (see figure 5 and table A2 in the appendix).

As it is shown in figure 5, in Slovenia the effect of higher political participation exerts a relatively weaker effect on increasing the probabilities of participating in the survey compared to Estonia and Great Britain. Indeed, the marginal ef-

Table 5
Logistic regression model for attitudinal and behavioural variables

	B	SE	Pred. margins[a]	SE	Avg marg. effect[a]	SE
Participation: no political action			33	0.01		
At least 1 action	0.60*	0.07	47	0.01	14	0.01
Health: fair/bad			35	0.01		
Health: good	0.35*	0.07	42	0.01	8	0.02
Interpersonal trust: low			38	0.01		
Interpersonal trust: high	0.19*	0.07	42	0.01	4	0.01
Trust in country's parliament: low			39	0.00		
Trust in country's parliament: high	0.17*	0.07	42	0.01	4	0.02
Climate change: not worried			37	0.01		
Climate change: worried	0.16*	0.07	41	0.00	4	0.02
Gays and lesbians free to live life as they wish: not agree			36	0.01		
Gays and lesbians free to live life as they wish: agree	0.22*	0.07	41	0.00	5	0.02
Life satisfaction: low			36	0.01		
Life satisfaction: high	0.21*	0.09	41	0.00	5	0.02
Immigrants make country a worse place to live			39	0.01		
Immigrants make country a better place to live	0.10	0.07	41	0.01	2	0.02
Socially meet with friends: less than once a week			39	0.01		
Socially meet with friends: once a week or more	0.09	0.07	41	0.01	2	0.01
Domicile - Country village			39	0.01		
Town/small city	0.13	0.08	41	0.01	3	0.02
City	0.01	0.08	39	0.01	0	0.02
Male			38	0.01		
Female	0.18*	0.06	42	0.01	4	0.01
Income: Difficult/Very difficult			37	0.02		
Income: Living comfortably or coping	0.15	0.10	40	0.00	3	0.02
65+			34	0.01		
18–34	0.28*	0.10	40	0.01	6	0.02
35–64	0.33*	0.08	42	0.01	7	0.02
Primary			31	0.01		
Secondary	0.42*	0.09	40	0.01	9	0.02
Tertiary	0.60*	0.10	44	0.01	13	0.02
Estonia			42	0.01		
GB	−0.33*	0.08	34	0.01	−7	0.02
Slovenia	0.14	0.08	45	0.01	3	0.02
Constant	−2.44	0.14				

[a] predictive margins and AMEs reported as rounded percentages
* $p < .05$

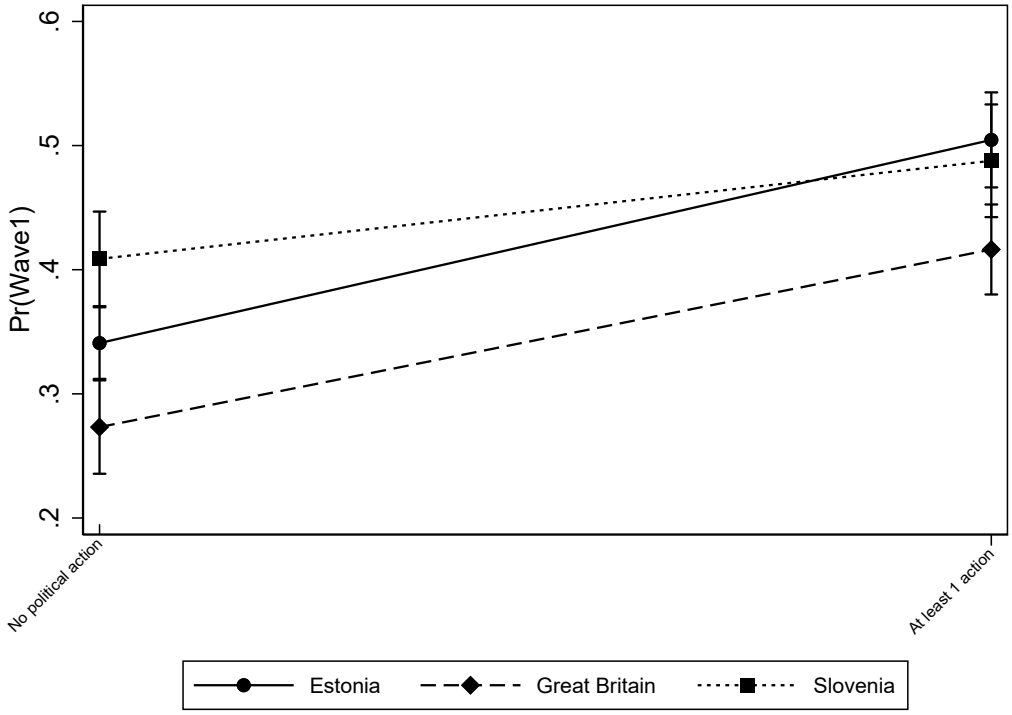

Figure 5. Country and political participation interaction

fect of political participation on taking part in CRONOS is 8 percentage points in Slovenia compared to 14 and 16 percentage points in Great Britain and Estonia. In other words, we can say that in those two countries the level of political participation is a relatively stronger factor than in Slovenia in determining the probabilities to join the panel. Also, the overall interaction between country and climate change is statistically significant at the 5% level (likelihood-ratio test: $chi^2 = 7.135$, df = 2, $p = 0.028$) (table A2).

Figure 6 shows that, compared to Estonia, the propensity to join the panel in Great Britain and Slovenia is essentially a flat line indicating no effect of the climate change variable. In terms of marginal effects, being worried about climate change results in a change of -2.5 percentages points in Slovenia, 0.07 percentage points in Great Britain but almost 8 percentage points in Estonia (see also table A2). In other words, this indicates that climate change opinions are a strong predictor in Estonia whilst they have basically no effect in the other two countries.

6 Discussion and Conclusion

Our research used external benchmark data to assess the CRONOS socio-demographic sample composition in comparison with the target population. In addition, we were also able to investigate the differences in several attitudinal and behavioural variables. Such variables are rarely available for comparison since there are no population estimates available and this has never been done before for a cross-national recruitment to a probability sample panel.

The average absolute error showed discrepancies in line with other similar research (Bosnjak et al., 2018; Koch et al., 2014). The distributions highlighted that the larger discrepancies are in regard to the people with primary education and single adult households, who are underrepresented in Estonia and Slovenia. CRONOS instead over-represents the female population in all countries with cross-national differences in terms of over representing citizens (in Estonia) and married individuals (in Great Britain).

However, a consistent bias, which has been regularly found in every country, is related to the population aged 75 and older. Amongst those under 75 years the CRONOS distributions are fairly close to the population scores. However, starting from 75+ the bias becomes a serious issue as people in that age group are strongly underrepresented and with those that do remain probably being a very untypical sub sample not representative of their population. For example, 48% of those in the CRONOS sub sample aged 65+ claim that they use internet every day compared to 14.2% in the ESS sub sample that did not participate in the web panel.

Our research highlights that online surveys based on probability samples are currently likely to be an unsuitable method to survey the older population in Europe and there-

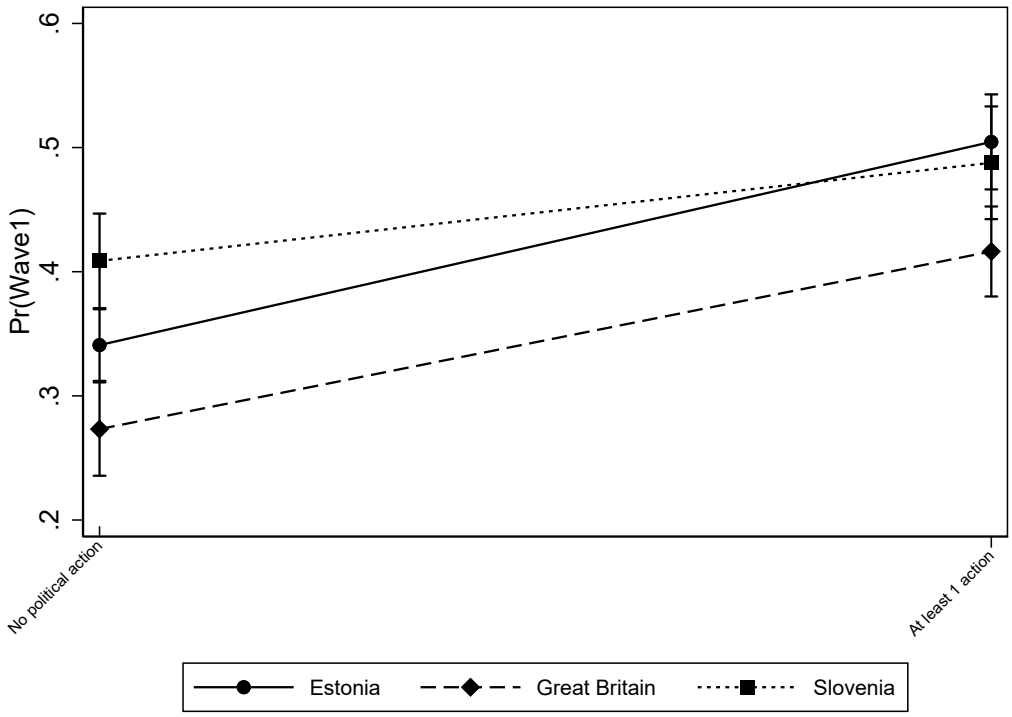

Figure 6. Country and climate change interaction

fore the general population. This is an important result and underlines why three out of four of the national online panels presented in the introduction set an upper age limit (GESIS Panel = 70; GIP and ELIPSS = 75) or include other modes (the NatCen panel—telephone, the GESIS panel—postal).

The regression analysis focused on the propensity to join CRONOS suggests that age is not a driver of CRONOS participation. However, we found that there is an interaction effect between age and internet use. Other significant differences were found for gender, education, whether voted in the last general election, being in paid work and in particular internet use. However, no differences for the economic condition were found.

In summary, in terms of sample composition bias, CRONOS seems to underrepresent the older population and least educated whilst over-representing voters and in particular individuals using the internet most frequently.

We should also consider that the ESS respondents are in a way different from the population and that at the same time the CRONOS sample reflects not only its own recruitment process but also the original ESS recruitment process. Therefore, we need to take into account that the CRONOS achieved sample is also a function of the main ESS fieldwork response process, reflecting and/or magnifying ESS divergence from the population.

There were interesting differences between countries in terms of representativeness as shown by the average absolute error. The country's internet penetration rate likely played a role (also considering that internet use is the strongest driver of CRONOS participation). Indeed, the participation rate for the British sample was the lowest compared to the other two countries. However, its sample showed the lowest discrepancies compared to population distributions overall. Therefore, it appears that a low internet penetration rate in a country would, unsurprisingly be likely to lower the quality of online panels compared to countries where the internet penetration rate is higher.

Our paper also compared the CRONOS and ESS samples on several attitudinal and behavioural characteristics providing a rare insight beyond demographic variables. The literature on the offline population suggested several specific properties of this group. They tend to be older, more rural, less educated, less wealthy, less tolerant, less healthy and to have lower levels of political participation (Couper, 2000; Dever et al., 2008; Ragnedda & Muschert, 2013; Robinson & Martin, 2005; Robinson, Neustadtl, & Kestnbaum, 2002; Rookey et al., 2008; Zhang et al., 2009). Based on this previous finding we specified a logistic regression model in order to investigate discrepancies between CRONOS panellists and non-panellists on those characteristics. Our study supported the findings referring to political participation, social and institutional trust, health, life satisfaction, openness to-

ward LGBT community and concern for climate change. It is therefore clear that a web panel established in this way could not currently simply be used instead of a face-to-face survey unless it is possible to correct for such differences later (for example by using weighting). However, the model did not find significant differences concerning tolerance toward immigrants, density of social relationships and self-reported levels of urbanisation.

Our study also highlighted some important cross-national differences in particular regarding age, internet use and political participation. We showed that the probabilities to join the web panel increase in Great Britain as age increases. Exactly the opposite happens in Estonia and Slovenia where the probabilities to take part drop as age increases. This shows that age exerts a different effect in the different countries. Regarding internet use, we showed that the effect of internet use is relatively less strong in Great Britain compared to Estonia and Slovenia where instead internet use plays a crucial role in determining the probabilities to join the panel. Finally, political participation has been shown to be a relatively less important predictor in Slovenia than in Great Britain and Estonia. All these cross-national differences have an impact on recruitment strategies and for future cross-national web panel experiments they suggest that targeted recruitment strategies/targeted approaches to fieldwork could be considered and/or evaluated (e.g. increasing the efforts for respondents who use the web less often or include off-liners via other modes). In addition, even if generally the design of the parent survey is not guided by the follow up survey, it could be carefully considered to oversample those groups with a known, higher non-response rate in the follow up survey.

Some practical implications concerning setting up a cross-national web panel can also be drawn from our analyses. Age and internet use suggest that web surveys remain an unsuitable way to survey those aged over 75, particularly in those countries with a low internet penetration rate. Logistic regressions underline that the key driver for participation is internet use. Taking into account that internet penetration rates are very likely to increase in the future – and ICT literacy along with it – web surveys and web panels should become gradually less affected by sample composition bias and non-response error in future. At the same time, we should be aware that as internet penetration rates increase the discrepancy between the online and offline population might increase as well. Indeed, the offline group may represent an increasingly isolated and differentiated niche group. Should the digital divide start to increase again in future (e.g. due to privacy concerns or generational changes) this issue might change once again.

In terms of future research, it will be important to examine whether the CRONOS representativeness was improved by providing tablets to offline respondents. The analysis of the LISS panel (Van der Laan, 2009) showed that providing internet-enabled devices improved the representativeness.

One limitation of this study is that some of our benchmarks (e.g. the LFS) cannot be considered free from errors themselves (Ortmanns & Schneider, 2016). Another limitation is that the sample size in each country is relatively small, not allowing for more complex country specific analyses.

In conclusion, our findings suggest that the characteristics of the CRONOS panellists were not extremely divergent from the ones in the target population or from its parent survey—with important exceptions like those in the oldest age groups and regarding education, political participation and internet use. It is fairly clear that a web panel such as the one presented in this study cannot be used to replace, at least for now, face-to-face surveys and that such an approach would need to be completed by other modes of data collection. Also, it should be remembered that, as already flagged, the CRONOS achieved sample is the result of a double selection process, magnifying and/or reflecting the differences of the parent survey with the target population. In addition, there are cross-national differences (also in terms of data quality) that require further exploration in the future as they suggest cross-national comparability might be diminished in a cross-national setting using web surveys compared to a single mode face-to-face survey.

References

Blom, A. G., Bosnjak, M., Cornilleau, A., Cousteaux, A.-S., Das, M., Douhou, S., & Krieger, U. (2016). A comparison of four probability-based online and mixed-mode panels in europe. *Social Science Computer Review*, *34*(1), 8–25.

Blom, A. G., Gathmann, C., & Krieger, U. (2015). Setting up an online panel representative of the general population: The german internet panel. *Field Methods*, *27*(4), 391–408.

Blom, A. G., Herzing, J. M. E., Cornesse, C., Sakshaug, J. W., Krieger, U., & Bossert, D. (2017). Does the recruitment of offline households increase the sample representativeness of probability-based online panels? evidence from the german internet panel. *Social Science Computer Review*, *35*(4), 498–520.

Bosnjak, M., Dannwolf, T., Enderle, T., Schaurer, I., Struminskaya, B., Tanner, A., & Weyandt, K. W. (2018). Establishing an open probability-based mixed-mode panel of the general population in germany: The gesis panel. *Social Science Computer Review*, *36*(1), 103–115.

Couper, M. P. (2000). Web surveys: A review of issues and approaches. *The Public Opinion Quarterly*, *64*(4), 464–494.

De Heer, W., & De Leeuw, E. (2002). Trends in households survey nonresponse: A longitudinal and international comparison. In R. Groves, D. Dillman, E. Eltinge, &

R. Little (Eds.), *Survey nonresponse* (pp. 41–54). New York: Wiley.

Dever, J. A., Rafferty, A., & Valliant, R. (2008). Internet surveys: Can statistical adjustments eliminate coverage bias? *Survey Research Methods*, *2*(2), 47–60.

Eckman, S. (2016). Does the inclusion of non-internet households in a web panel reduce coverage bias? *Social Science Computer Review*, *34*(1), 41–58.

European Social Survey. (2016). ESS round 8: European social survey round 8 data. Data file edition 1.0. NSD - Norwegian Centre for Research Data, Norway – Data Archive and distributor of ESS data for ESS ERIC.

Groves, R. M., & Peytcheva, E. (2008). The impact of nonresponse rates on nonresponse bias: A meta-analysis. *Public Opinion Quarterly*, *72*(2), 167–189.

Jowell, R., Roberts, C., Fitzgerald, R., & Eva, G. (Eds.). (2007). *Measuring attitudes crossnationally: Lessons from the european social survey*. Sage.

Koch, A., Halbherr, V., Stoop, I., & Kappelhof, J. (2014). Assessing ess sample quality by using external and internal criteria. Mannheim: European Social Survey, GESIS. Retrieved from https : / / www . europeansocialsurvey . org / docs / round5 / methods / ESS5_sample_composition_

Kohler, U. (2007). Surveys from inside: An assessment of unit nonresponse bias with internal criteria. *Survey Research Methods*, *1*(2), 55–67.

Kruskal, W., & Mosteller, F. (1979). Representative sampling, ii: Scientific literature, excluding statistics. *International Statistical Review/Revue Internationale de Statistique*, 111–127.

Kruskal, W., & Mosteller, F. (1980). Representative sampling, iv: The history of the concept in statistics, 1895-1939. *International Statistical Review/Revue Internationale de Statistique*, 169–195.

Manfreda, K., & Vehovar, V. (2008). Internet surveys. In E. Leeuw, J. Hox, & D. Dillman (Eds.), *International handbook of survey methodology*. Taylor & Francis.

Millar, M. M., & Dillman, D. A. (2011). Improving response to web and mixed-mode surveys. *Public Opinion Quarterly*, *75*(2), 249–269.

Ortmanns, V., & Schneider, S. L. (2016). Can we assess representativeness of cross-national surveys using the education variable? *Survey Research Methods*, *10*(3), 189–210.

Piekarski, L., Galin, M., Baim, J., Frankel, M., Augemberg, K., & Prince, S. (2008). Internet access panels and public opinion and attitude estimates. In *63rd annual conference of the american association for public opinion research*, New Orleans, LA.

Ragnedda, M., & Muschert, G. (Eds.). (2013). *The digital divide: The internet and social inequality in international perspective*. Routledge.

Revilla, M., Cornilleau, A., Cousteaux, A.-S., Legleye, S., & de Pedraza, P. (2016). What is the gain in a probability-based online panel of providing internet access to sampling units who previously had no access? *Social Science Computer Review*, *34*(4), 479–496.

Robinson, J. P., & Martin, S. (2005). It and social change, 2000-2004: Behavioral and attitudinal evidence from the general social survey. *Webuse & Society*, *1*(8), 1–33.

Robinson, J. P., Neustadtl, A., & Kestnbaum, M. (2002). The online 'diversity divide': Public opinion differences among internet users and nonusers. *IT & Society*, *1*(1), 284–302.

Rookey, B. D., Hanway, S., & Dillman, D. A. (2008). Does a probability-based household panel benefit from assignment to postal response as an alternative to internet-only? *Public Opinion Quarterly*, *72*(5), 962–984.

Scherpenzeel, A., & Bethlehem, J. (2010). How representative are online-panels? problems of coverage and selection and possible solutions. In M. Das, P. Ester, & L. Kaczmirek (Eds.), *Social research and the internet: Advances in applied methods and new research strategies*. New York: Routlegde Academic.

Schneider, S. (2009). Confusing credentials: The cross-nationally comparable measurement of educational attainment. DPhil. Thesis. University of Oxford.

Schnell, R., Noack, M., & Torregroza, S. (2017). Differences in general health of internet users and non-users and implications for the use of web surveys. *Survey Research Methods*, *11*(2), 105–123.

Schouten, B., Bethlehem, J., Beullens, K., Kleven, Ø., Loosveldt, G., Luiten, A., & Skinner, C. (2012). Evaluating, comparing, monitoring, and improving representativeness of survey response through r-indicators and partial r-indicators. *International Statistical Review*, *80*(3), 382–399.

Schouten, B., Cobben, F., & Bethlehem, J. (2009). Indicators for the representativeness of survey response. *Survey Methodology*, *35*(1), 101–113.

Schouten, J., & Cobben, F. (2007). *R-indexes for the comparison of different fieldwork strategies and data collection modes*. Netherlands: CBS Statistics.

Singer, E., Hoewyk, J., Gebler, N., & McGonagle, K. (1999). The effect of incentives on response rates in interviewer-mediated surveys. *Journal of Official Statistics*, *15*(2), 217.

Stoop, I., Billiet, J., Koch, A., & Fitzgerald, R. (2010). *Improving survey response: Lessons learned from the european social survey*. John Wiley &Sons.

Valliant, R., & Lee, S. (2005). Economic characteristics of internet users vs. nonusers and implications for wed-based surveys. *Webuse & Society*, *1*(8), 34–51.

Van der Laan, J. (2009). Representativity of the liss panel. In *Discussion paper (09041*. Statistics Netherlands, The Hague.

Vannieuwenhuyze, J., Loosveldt, G., & Molenberghs, G. (2010). A method for evaluating mode effects in mixed-mode surveys. *Public opinion quarterly*, *74*(5), 1027–1045.

Villar, A., & Fitzgerald, R. (2017). Using mixed modes in survey research: Evidence from six experiments in the ess. In B. M. (Ed.), *Values and identities in europe: Evidence from the european social survey* (pp. 273–310).

Villar, A., Sommer, E., Finnøy, D., Gaia, A., N., B., & G, B. (2018). *CROss-National Online Survey (CRONOS) panel data and documentation user guide*. London: ESS ERIC.

Yeager, D., Krosnick, J., Chang, L., Javitz, H., Levendusky, M., Simpser, A., & Wang, R. (2011). Comparing the accuracy of RDD telephone surveys and internet surveys conducted with probability and non-probability samples. *Public opinion quarterly*, *75*(4), 709–747.

Zhang, C., Callegaro, M., Thomas, M., & DiSogra, C. (2009). Do we hear different voices?: Investigating the differences between internet and non-internet users on attitudes and behaviors. In *Proceedings of the section on survey research methods, american statistical association* (pp. 6063–6076).

Appendix

(*Appendix tables follow on next page*)

Table A1

Interaction effect models for demographic variables

Age and Internet use					Country and Age					Country and Internet use				
variable	B	Sig.	Pred. margins	SE	variable	B	Sig.	Pred. margins	SE	variable	B	Sig.	Pred. margins	SE
Male			0.381	0.01	Male			0.381	0.01	Male			0.381	0.01
Female	0.149	0.023	0.413	0.01	Female	0.147	0.025	0.412	0.01	Female	0.148	0.023	0.413	0.01
65+		0.009	0.415	0.02	65+		0.406	0.388	0.02	65+		0.400	0.393	0.02
18–34	−0.417	0.688	0.373	0.02	18–34	0.228	0.180	0.386	0.01	18–34	−0.043	0.713	0.384	0.01
35–64	0.622	0.003	0.410	0.01	35–64	0.150	0.327	0.406	0.01	35–64	0.064	0.542	0.407	0.01
Primary		0.000	0.342	0.02	Primary		0.000	0.335	0.02	Primary		0.000	0.334	0.02
Secondary	0.248	0.010	0.394	0.01	Secondary	0.286	0.003	0.395	0.01	Secondary	0.299	0.002	0.397	0.01
Tertiary	0.451	0.000	0.438	0.01	Tertiary	0.494	0.000	0.441	0.01	Tertiary	0.487	0.000	0.438	0.01
Did not vote			0.332	0.01	Did not vote			0.332	0.01	Did not vote			0.333	0.01
Voted	0.417	0.000	0.420	0.01	Voted	0.415	0.000	0.419	0.01	Voted	0.410	0.000	0.419	0.01
Not paid work			0.424	0.01	Not paid work			0.426	0.01	Not paid work			0.427	0.01
Paid Work	−0.202	0.013	0.382	0.01	Paid Work	−0.219	0.007	0.380	0.01	Paid Work	−0.228	0.005	0.379	0.01
Difficult/Very difficult			0.366	0.02	Difficult/Very difficult			0.371	0.02	Difficult/Very difficult			0.371	0.02
Living comfortably or coping	0.179	0.065	0.404	0.01	Living comfort. or coping	0.148	0.127	0.403	0.01	Living comfort. or coping	0.152	0.119	0.403	0.01
Internet Use – Never		0.000	0.145	0.02	Internet Use – Never		0.000	0.142	0.01	Internet Use – Never		0.000	0.143	0.01
Occasionally/Most days	1.484	0.000	0.345	0.02	Occasionally/Most days	1.184	0.000	0.345	0.02	Occasionally/Most days	1.242	0.000	0.346	0.02
Every day	2.243	0.000	0.506	0.01	Every day	1.832	0.000	0.497	0.01	Every day	2.193	0.000	0.502	0.01
Estonia		0.000	0.389	0.01	Estonia		0.321	0.387	0.01	Estonia		0.067	0.389	0.01
GB	−0.112	0.147	0.366	0.01	GB	0.223	0.184	0.367	0.01	GB	0.495	0.062	0.372	0.01
Slovenia	0.331	0.000	0.461	0.01	Slovenia	0.237	0.220	0.458	0.01	Slovenia	0.495	0.033	0.461	0.01
Age × internet use		0.032			Country × Age		0.031			Country × Internet use		0.001		
18–34 × Never			0.078	0.07	18–34 × Estonia			0.406	0.02	Never × Estonia			0.107	0.02
18–34 × Occasionally	0.219	0.838	0.311	0.05	18–34 × GB	−0.615	0.006	0.325	0.03	Never × GB			0.164	0.03
18–34 × Every day	0.235	0.823	0.489	0.02	18–34 × Slovenia	−0.032	0.900	0.451	0.03	Never × Slovenia			0.164	0.02
35–64 × Never			0.190	0.02	35–64 × Estonia			0.389	0.02	Occasionally × Estonia			0.291	0.02
35–64 × Occasionally	−0.615	0.018	0.355	0.02	35–64 × GB	−0.303	0.116	0.373	0.02	Occasionally × GB	−0.116	0.709	0.373	0.03
35–64 × Every day	−0.764	0.002	0.499	0.01	35–64 × Slovenia	0.188	0.397	0.482	0.02	Occasionally × Slovenia	−0.047	0.872	0.389	0.03
65+ × Never			0.113	0.01	65+ × Estonia			0.358	0.03	Every day × Estonia			0.510	0.02
65+ × Occasionally			0.354	0.03	65+ × Great Britain			0.405	0.03	Every day × GB	−0.790	0.005	0.438	0.02
65+ × Every day			0.534	0.03	65+ × Slovenia			0.408	0.03	Every day × Slovenia	−0.203	0.423	0.580	0.02
Constant	−2.828	0.000			Constant	−2.707	0.000			Constant	−2.848	0.000		

Table A2
Interaction effect models for attitudinal variables

Country and Political participation					Country and Climate change				
variable	B	Sig.	Pred. margins	SE	variable	B	Sig.	Pred. margins	SE
Participation: no political action			0.332	0.01	Participation: no political action			0.333	0.01
At least 1 action	0.723	0.000	0.468	0.01	At least 1 action	0.609	0.000	0.468	0.01
Health: fair/bad			0.349	0.01	Health: fair/bad			0.348	0.01
Health: good	0.346	0.000	0.424	0.01	Health: good	0.350	0.000	0.424	0.01
Interpersonal trust: low			0.376	0.01	Interpersonal trust: low			0.376	0.01
Interpersonal trust: high	0.197	0.004	0.419	0.01	Interpersonal trust: high	0.196	0.004	0.419	0.01
Trust in country's parliament: low			0.385	0.01	Trust in country's parliament: low			0.385	0.01
Trust in country's parliament: high	0.168	0.020	0.422	0.01	Trust in country's parliament: high	0.169	0.019	0.422	0.01
Climate change: not worried			0.372	0.01	Climate change: not worried			0.382	0.01
Climate change: worried	0.163	0.025	0.407	0.01	Climate change: worried	0.360	0.001	0.409	0.01
Gays and lesbians free to live life as they wish: not agree			0.362	0.01	Gays and lesbians free to live life as they wish: not agree			0.363	0.01
Gays and lesbians free to live life as they wish: agree	0.221	0.004	0.410	0.01	Gays and lesbians free to live life as they wish: agree	0.216	0.005	0.410	0.01
Life satisfaction: low			0.360	0.02	Life satisfaction: low			0.360	0.02
Life satisfaction: high	0.217	0.013	0.406	0.01	Life satisfaction: high	0.213	0.014	0.406	0.01
Immigrants make country a worse place to live			0.389	0.01	Immigrants make country a worse place to live			0.389	0.01
Immigrants make country a better place to live	0.099	0.176	0.411	0.01	Immigrants make country a better place to live	0.104	0.158	0.411	0.01
Socially meet with friends: less than once a week			0.385	0.01	Socially meet with friends: less than once a week			0.386	0.01
Socially meet with friends: once a week or more	0.096	0.146	0.406	0.01	Socially meet with friends: once a week or more	0.092	0.160	0.406	0.01
Domicile – Country village		0.181	0.386	0.01	Domicile – Country village		0.197	0.387	0.01
Town/small city	0.134	0.090	0.415	0.01	Town/small city	0.124	0.116	0.414	0.01
City	0.018	0.820	0.390	0.01	City	0.003	0.966	0.388	0.01
Male			0.375	0.01	Male			0.375	0.01
Female	0.181	0.005	0.415	0.01	Female	0.186	0.004	0.415	0.01
Income: Difficult/Very difficult			0.370	0.02	Income: Difficult/Very difficult			0.369	0.02
Income: Living comfortably or coping	0.149	0.113	0.402	0.01	Income: Living comfortably or coping	0.155	0.099	0.402	0.01
65+		0.000	0.344	0.01	65+		0.000	0.343	0.01
18–34	0.270	0.007	0.402	0.02	18–34	0.282	0.004	0.403	0.02
35–64	0.334	0.000	0.416	0.01	35–64	0.344	0.000	0.417	0.01
Primary		0.000	0.312	0.02	Primary		0.000	0.311	0.02
Secondary	0.424	0.000	0.402	0.01	Secondary	0.430	0.000	0.403	0.01
Tertiary	0.601	0.000	0.442	0.01	Tertiary	0.608	0.000	0.443	0.01
Estonia		0.000	0.418	0.01	Estonia		0.005	0.420	0.01
GB	−0.337	0.005	0.342	0.01	GB	−0.125	0.356	0.345	0.01
Slovenia	0.309	0.006	0.446	0.01	Slovenia	0.496	0.007	0.457	0.02
Country × political participation		0.048			Country × Climate change		0.028		
Estonia × No political action			0.341	0.01	Estonia × Not worried			0.365	0.02
Estonia × At least 1 action			0.505	0.02	Estonia × Worried			0.444	0.01
Great Britain × No political action			0.273	0.02	Great Britain × Not worried			0.339	0.02
Great Britain × At least 1 action	−0.044	0.775	0.416	0.02	Great Britain × Worried	−0.323	0.040	0.347	0.01
Slovenia × No political action			0.409	0.02	Slovenia × Not worried			0.474	0.04
Slovenia × At least 1 action	−0.381	0.020	0.488	0.02	Slovenia × Worried	−0.471	0.021	0.449	0.02
Constant	−2.476	0.000			Constant	−2.558	0.000		