

## Mixed Mode Effects in the Luxembourgish Labour Force Survey Collecting Objective and Subjective Questions via Web and Telephone

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### Abstract

*Web questionnaires are increasingly used to complement traditional data collection, leading to different combinations of survey modes. The flexibility of mixed modes provides many advantages such as less nonresponse issues, lowered expenditures, and compensation for the decreasing availability of other data sources, i.e. fixed-line telephone numbers. However, the increased usage of web data raises concerns whether web questionnaires lead to systematic measurement bias, since responses given to web questionnaires may be significantly different compared to other survey modes.*

*We argue that the size of mixed mode effects strongly depends on the content of a variable. We investigate differences in web and telephone data in terms of objective and subjective variables. The study is based on the Luxembourgish Labour Force Survey that collects both objective (employment status) and subjective employment variables (wage adequacy and job satisfaction). Analysis of the raw data reveals significant differences in sample composition (e.g. respondents' personal characteristics such as age or nationality) as well as in objective and subjective employment variables.*

*In order to investigate whether differences in employment variables are caused by sample composition or mode-specific measurement bias, we match web and telephone samples according to variables that lead to dissimilarities in sample composition. We identify these variables by a combination of automatic variable selection via random forest and a theory driven selection. Based on the selected variables, we then apply a Coarsened Exact Matching that approximates randomized experiments by reducing dissimilarities between web and telephone samples.*

*After matching, we show that employment status is not affected by systematic measurement bias, but web respondents report lower levels of wage adequacy and job satisfaction. Even though further research on subjective variables is advisable, our results support the implementation of mixed survey modes in official statistics such as the Labour Force Survey.*

**Keywords:** web survey, telephone survey, mode effects, Coarsened Exact Matching, Labour Force Survey

## 1. Introduction

Traditional data collection increasingly faces challenges such as declining response rates or less availability of traditional data sources (e.g. fixed-line telephone numbers). In order to deal with these challenges, web questionnaires are increasingly used to complement traditional data collection in mixed mode surveys. However, the increased usage of web questionnaires raises concerns whether collecting data online leads to mode-specific measurement bias, i.e. significantly different responses of the same participants to different survey modes.

Mixed mode effects on employment variables were, for instance, investigated within the framework of a European Statistical System Network (ESSnet) project on data collection for social surveys using multiple modes (Blanke & Luiten, 2014). Varying findings for different variables suggest that the size of mode-specific measurement bias strongly depends on the specific content of a variable. Hence, mode-specific measurement bias needs to be examined separately for different variables. By exploring mixed collection modes on the basis of Luxembourgish Labour Force Survey (LFS) data, we contribute to previous research about employment status and employment related variables. Our contribution is twofold:

First, the present study includes investigations on a battery of variables that is exclusively available in the LFS of Luxembourg. Contrary to typically collected employment variables (e.g. employment status or income), these variables contain subjective information (e.g. wage adequacy or job satisfaction). By investigating on these variables, we provide insights whether measurement bias varies within one survey depending on the type of a variable (i.e. objective vs. subjective). Hereby, we extend previous mixed mode research about employment variables that focuses mainly on objective contents.

Second, we use a different methodological approach compared to previous work about mixed mode effects on measuring employment variables. Most research in this field is based on randomized experiments and re-weighting approaches (Körner and Liersch, 2014; Pohjanpää, 2014; Schouten and van der Laan, 2014). Instead, we use Coarsened Exact Matching in order to harmonize web and telephone samples of the original LFS data after collection (Iacus et al., 2012). This provides us with the possibility to investigate whether a different methodology leads to similar results compared to randomized experiments.

## 2. Data

We use data of the Luxembourgish Labour Force Survey (LFS). Until 2015, the LFS was conducted via Random Digit Dialing. However, consistently dropping response rates led to

the introduction of a new sampling design in 2015, which is based on a mixed mode data collection consisting of Computer Assisted Telephone Interviewing (CATI) and Computer Assisted Web Interviewing (CAWI). Since 2015, a sample from the Luxembourgish population register is drawn and verified if a phone number of the sampling unit can be found in the official white pages telephone directories online. Sampling units for which a telephone number is available are approached by telephone. Remaining units are approached via an invitation letter containing the internet address where the web questionnaire can be found. As result of this design, participants are not allocated randomly to web and telephone samples.

**Figure 1. Cross tabulation of age, sex & nationality for the LFS 2017**

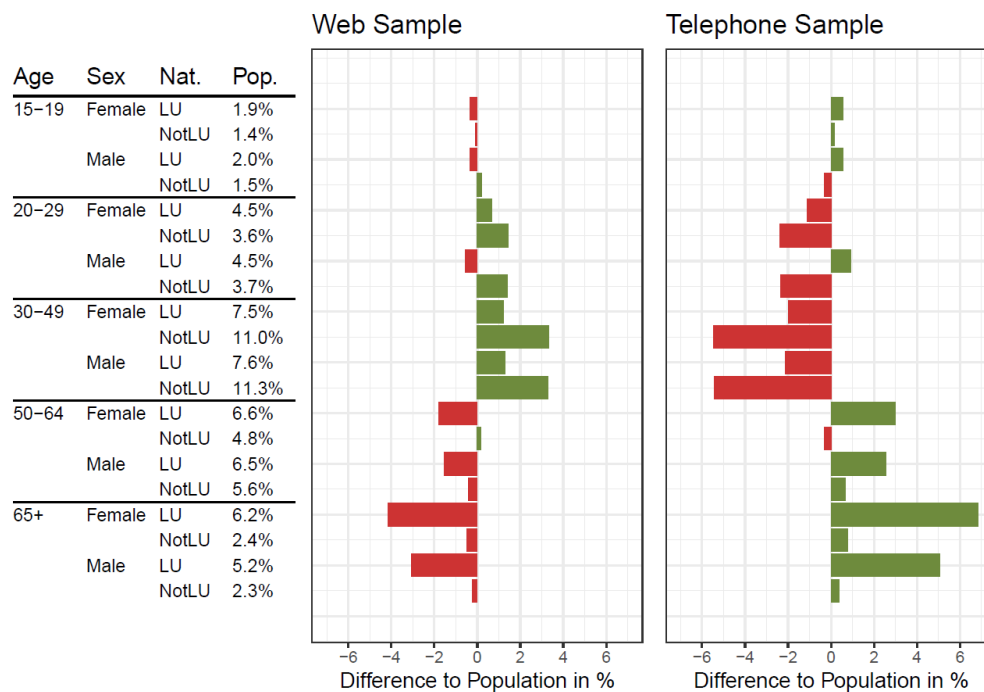


Figure 1 shows a cross tabulation of age, sex, and nationality. The share of the population of 2017 for each group is shown on the right column of the table. The two graphics illustrate weighted differences to the population of web and telephone samples of the LFS 2017. The figure reveals mainly two systematic differences: First, age groups between 20-49 are more often collected by web and age groups 50+ are more often collected by telephone. Second, Luxembourgish people are collected more often by telephone.

Based on a pooled data set of three LFS years (2015, 2016, and 2017), the present study examines whether differences in employment variables are caused by sample composition or mode-specific measurement bias. We investigate on three target variables: employment

status, wage adequacy, and job satisfaction. We consider employment status as objective variable (i.e. clear definition according to the ILO-classification of employment) and wage adequacy as well as job satisfaction as subjective variables (i.e. self-assessment of personal opinions).

### 3. Method

Differences in auxiliary variables (e.g. sex and age) may influence how respondents of the two groups (web and telephone) report target variables (e.g. employment status). To detect mode-specific measurement bias, we use Coarsened Exact Matching (CEM), a matching method that approximates randomized experiments by reducing dissimilarities in observed variables (Iacus et al., 2012). CEM creates strata using temporally coarsened variables (i.e. with values grouped into substantially meaningful categories) and retains only observations of strata that include at least one observation of both groups.

To find the best matching model, we identify the most relevant variables with a combination of algorithm-based and theory-driven variable selections. First, we conduct an automatic variable selection via random forest in order to find strong predictors for the target variables and for the group assignment (Breiman, 2001). Subsequently, we check theory-based whether the automatically selected matching model includes all important variables and adjust our model accordingly. As result of this process, we use two different matching models for the CEM (employment status: age, sex, nationality, country of birth, marital status, ISCED, interview week, panel wave, questionnaire language, and collection year; wage adequacy and job satisfaction: age, sex, nationality, ISCED, income, NACE, ISCO, questionnaire language, and collection year)

### 4. Results

Figure 2 illustrates the differences for web and telephone samples before and after CEM for the target variable employment status. The figure displays proportions for the three employment status categories active, unemployed, and inactive. Web and telephone samples pre CEM are represented by the colors dark blue and dark green and web and telephone post CEM are represented by light blue and light green. Proportions of web and telephone samples before matching are very different within the categories. In comparison to the telephone sample, web participants have much more often an active employment status and are slightly more often unemployed. In contrast, web participants are less often inactive than participants of the telephone sample. After CEM, however, differences between web and telephone in the target variable employment status are not statistically significant, indicating that differences before matching are exclusively due to sample compositions of

web and telephone data. Employment status is therefore not affected by mode-specific measurement bias.

**Figure 2. Mixed mode effects on employment status**

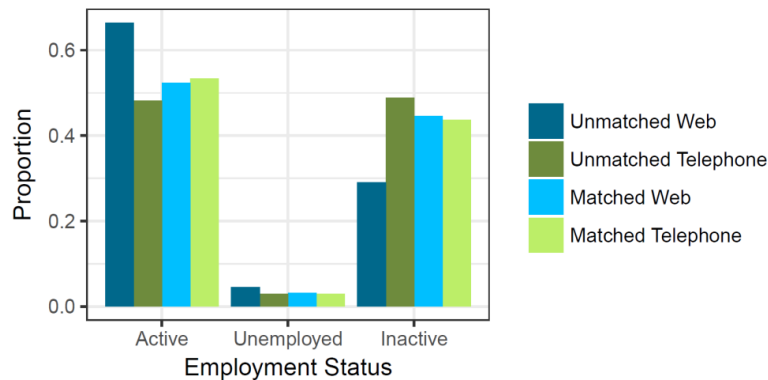
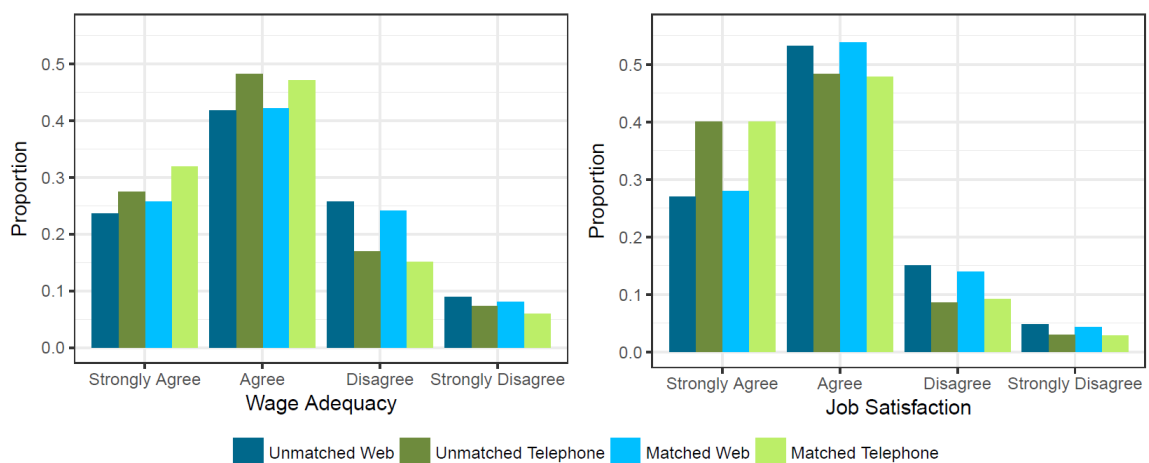


Figure 3 visualizes differences before and after matching for the two target variables wage adequacy and job satisfaction. Both variables consist of the categories strongly agree, agree, disagree, and strongly disagree, with strongly agree for people with the highest wage adequacy or job satisfaction, respectively. Before CEM, web participants perceive their salary less often as fair. Web participants select less often the categories strongly agree or agree and more often disagree or strongly disagree. Similar observations can be made for the variable job satisfaction. Web respondents select less often the category strongly agree and more often the categories agree, disagree, and strongly disagree. In the matched data, these differences remain – Telephone participants still have a higher probability to select positive categories. Wage adequacy and job satisfaction are therefore affected by mode-specific measurement bias.

**Figure 3. Mixed mode effects on wage adequacy & job satisfaction**



When comparing mode effects of the examined variables, it becomes noticeable that employment status does not suffer from mode-specific measurement bias, whereas wage adequacy and job satisfaction do. The main difference between those variables is the variable's objectiveness. Employment status is relatively stable and does not depend on personal opinions of the respondent. Wage adequacy and job satisfaction, in contrast, are very subjective.

We assume that social desirability effects have a larger impact on subjective variables. It might be unpleasant for respondents to reveal dissatisfaction with their employment situation to a real person and, hence, they might present their employment situation as too positive. Furthermore, the thinking process might be disturbed by an interviewer on the telephone. The results therefore suggest that objective variables are less affected by mode-specific measurement bias than subjective variables.

## References

Blanke, K. and Luiten, A. (2014). Query on data collection for social surveys. ESSnet Project "Data Collection for Social Surveys using Multiple Modes".

Breiman, L. (2001). Random forests. *Machine Learning*, 45(1):5-32.

Iacus, S. M., King, G., and Porro, G. (2012). Causal inference without balance checking: Coarsened exact matching. *Political Analysis*, 20(1):1-24.

Körner, T. and Liersch, A. (2014). Case study on mode effects in the German Labour Force Survey. Deliverable for work package III of the ESSnet on Data Collection for Social Surveys Using Multiple Modes.

Pohjanpää, K. (2014). The report of web pilot study of LFS (WP III). Statistics Finland. The ESSnet project on Data Collection for Social Surveys using Multiple Modes.

Schouten, B. and van der Laan, J. (2014). ESSnet deliverable WP III: Mode effect decompositions for the Dutch Labour Force Survey. Deliverable for work package III of the ESSnet on Data Collection for Social Surveys Using Multiple Modes.