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ORIGINAL RESEARCH

Regional Public Opinions on LGBTI People Equal Opportunities in Employment: Evidence from the Eurobarometer Programme using Small Area Estimation

Angelo Moretti[1]

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Abstract
In recent years, the attention to lesbian, gay, bisexual, transgender and intersex (LGBTI) people' rights from institutions, society and scientific bodies has clearly progressed. Although equal opportunities in employment are promoted within European countries and by the EU legislation, there are still evident discriminations in Europe. Many LGBTI people still face bullying and anti-LGBTI discrimination in the workplace and job market. Considerably more progress must be made before every LGBTI person feels accepted and comfortable for who they are in the workplace. Importantly, views on equal opportunities in employment are characterised by spatial heterogeneity at a sub-national level. Therefore, it is necessary to disaggregate estimates of relevant indicators, at least, at a regional level. This is crucial to identify the regions requiring more attention by policy makers. However, large-scale sample surveys are not designed to produce precise and accurate sub-national estimates. Small area estimation methods offer powerful tools in this context. Here, we produce regional estimates of three indicators measuring views of discrimination in employment of people from LGBTI communities in Europe. The analyses are based on the Eurobarometer 91.4 2019. Our empirical evidence shows that the estimates produced by small area estimation are reliable, giving important information to policy makers.

Keywords LGBT + · Job market · Local level · Homosexuality · Social indicators

1 Introduction

Public attitudes towards lesbian, gay, bisexual, transgender and intersex (LGBTI) people have changed in the last three decades where there has been a growing attention by governments, academia, and society. Although the greatest change in Europe happened in the 1990s, the pace and direction of these changes is country-specific (Kuyper, et al., 2013). Recently, institutions such as governments, the European Parliament, The Fundamental

✉ Angelo Moretti
a.moretti@uu.nl

[1] Department of Methodology and Statistics, Utrecht University, Utrecht, The Netherlands

Rights Agency, and the European Commission addressed issues related to LGTBI people in their statements, resolutions, and directives (European Social Survey, 2016).

Here, gender identity refers to each person's felt internal and individual experience of gender, which can or cannot correspond with the sex assigned at birth. This can include the personal sense of the body (which can involve modification of bodily appearance or function) and other expressions of gender (Yogyakarta Principles, 2007). Transgender persons relate to people who have a gender identity different from the gender assigned to them at birth and those persons who wish to portray their gender identity differently from the gender assigned at birth (Council of Europe, 2011). Intersex relates to a person that has both female and male sex organs or other sexual characteristics. Whereas the word homosexual refers to a person who is sexually attracted to people of one's own sex (lesbian for women and gay for men). Bisexual is a person who is sexually attracted to both women and men (according to the Oxford Dictionary; see also Frick, 2016). In this article, we consider the LGBTI people only, since the variables collected by the survey we use focus on those only.

Although an important shift in public attitudes towards LGTBI has taken place, Fitzgerald et al. (2014) point out that there are still extensive different national views on public attitudes in Europe. Hence, these result into disaccords between governments. This can be seen also from a legal point of view, where legal discriminations towards LGBTI people often take place. In some countries located in Central and Eastern Europe, there are still evident political and socio-cultural barriers against LGBTI people' rights, particularly in Poland and Romania; although governments from Croatia and Hungary have adopted unregistered same-sex cohabitations (Štulhofer & Rimac, 2009). In Northern European countries, such as Sweden, Denmark and The Netherlands, support for LGBTI communities is considerably higher than in Central and Eastern European countries.

Equality of people and the right of non-discrimination is embalmed in Chapter 3 of the European Union (EU) Charter of Fundamental Right.[1] Discrimination can be defined on a set of different domains, such as race, sex, ethnic group, religion, sexual orientation, and disability. The European commission sets a variety of schemes and laws to advance the equality of LGBTI people in Europe. The way that these are applied and translated within each member state country suffers from a large spatial heterogeneity (see e.g., ILGA Europe, 2018 on the equality laws and policies section). As a results, surveys with the aim of examining discriminations in the EU are launched. The Eurobarometer is a survey commissioned by the Directorate-General for Justice and Consumers and it is coordinated by the Directorate-General for Communication. Among the other topics studied in the survey, variables on attitudes towards LGBTI people, rights, and level of comfort with displays of affection in public are collected (European Commission & Brussels, 2019). In this article, by spatial heterogeneity we mean variability in space (in our case regions) in the distribution of the indicators (see e.g., Dutilleul et al., 1993).

The literature studying public opinions towards LGBTI covers different domains. Attitudes towards homosexuality were investigated in Canada and the United States by Andersen and Fetner (2008a, 2008b). Smith (2011) presents a cross-national studies of attitudes towards homosexuality considering a large number of European countries, America and Asia, whereas a study across time with a focus on gay rights is carried out by Smith et al. (2014). Flores and Barclay (2016) study anti-gay attitudes and adoption in the United States, showing that adopted same-sex marriage report the largest reduction of anti-gay

[1] Details on this can be found at the following link https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012P/TXT.

attitudes after adoption. Related to this aspect, Hooghe and Meeusen (2013) found a strong positive correlation between acceptance of homosexuality and same-sex marriage legislation in Europe. Regarding research on relationship between attitudes and socio-economic groups Smith et al. (2014) and Kite and Whitley (1996) found that men have less positive attitudes towards homosexuality than women. We can also find interesting studies on the role of urban and rural areas as places where people live (Ohlander et al., 2005; Rosenfeld & Kim, 2005, and Black et al., 2007). Attitudes towards homosexuality in Asia, i.e., Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam are studied by Manalastas et al. (2017), whereas Badgett (2014) conducts research on India. Norton and Herek (2013) and Flores (2015) investigate attitudes towards transgenders people in the United States, and other regional analyses in the United States can be found in Jelen (2017). In Africa, Izugbara et al. (2020) address the issue of both policy and legal instruments at regional level. Worthen et al. (2017) also investigate such attitudes in Italy and Spain, and Konopka et al. (2020) in Poland. Interesting comparison between Turkey and the United Kingdom on attitudes in relation to sexual orientation and gender identity is presented by Ozeren et al. (2016).

In this article, we focus on public opinions of discriminating members of the LGBTI community when accessing to the labour market. As mentioned by Frick (2016) and Valfort (2017), LGBTI individuals face extensive discriminations in employment, often characterised by negative attitudes which may result into non-disclosive behaviours of their sexual orientation and/or gender identity (Markovic, et al., 2022). Recent European surveys among gays and lesbians show that an important amount of people experienced discrimination or harassment in the workplace (Frick, 2016). According to SEN (2010), factors such as the ones related to the general social and legal context have an important impact onto the labour market in the EU. Public opinions around these topics are very much unevenly distributed within and between EU Member States (Frick, 2016), hence, providing information on the geographical distributions of such indicators is crucial.

The need for better data is stressed in the Sustainable Development Goals (SDGs), in particular through SDG 17 and its target 17.18 which is about data disaggregation by income, gender, age, and other characteristics. However, high-quality data on the economic inclusion of LGBTI communities is largely unavailable (Human Development Report, 2016). In addition, the SDG 10 focuses on reducing inequalities both within and among countries. Thus, there is the need for data disaggregation sub-nationally. Here, we use the term "region" as intended by the European Union regional statistics following the Nomenclature of Territorial Units for Statistics (NUTS) classification (Brandmüller & Önnerfors, 2021). This classification subdivides each Member State into regions at three different levels. Statistics based on those regions are used when allocating funds. Indeed, the NUTS classification is used to define regional boundaries and determine geographic eligibility for structural and investment social funds. The regions are used for application of regional policies (Eurostat, 2022).

The importance of sub-national entities has increased with the start of new public management decentralisation, where local governments control many important areas such as social services, health, education, and other domains (Bache & Flinders, 2004). Regions and smaller geographies are the places where citizens live and engage with the communities and services. In some of the European countries, e.g. Austria, Germany and Italy, there is a lack of central state parliamentary law on specific LGBTI issues which has encouraged some regional and/or local authorities to intervene and fill this gap via ad-hoc policies and actions in order to support LGBTI people. There have been numerous initiatives on regional cooperation between different authorities aiming to increasing the rights

and improving wellbeing of LGBTI people within a region. As a results, any region, or smaller area, having an active LGBTI policy or showing the intention of working towards this direction can join a network called Rainbow Cities (Council of Europe, 2016). E.g., the city councils of Cologne, Turin and Barcelona have developed policies with a focus on fighting homophobia and transphobia under the project Against Homophobia European local Administration Devices (AHEAD), whose goal is the preparation of a White Book collecting recommendations and good practices to promote local public policies with the goal of fighting discrimination against LGBTI communities. Similar policies have also been developed in Antwerp, Berlin, Dumfries, Galloway and Ghent. In the Netherlands, national governmental funding is provided via a national centre, which assists civil servants in order to design policies with the aim of improving attitudes towards LGBTI people in 18 municipalities (Council of Europe, 2011; Rainbow Cities, 2010). Therefore, in order to provide support for policy makers in this sense, it is crucial to produce accurate and precise empirical evidence at a sub-national level.

Unfortunately, large-scale national sample surveys are not usually designed to produce reliable analysis for sub-national areas. Hence, in this article we make use of small area estimation methods (Rao & Molina, 2015) to provide estimates of indicators measuring views on discrimination towards LGBTI people when looking for a job in Europe. Of course, in the context of LGBTI communities, it is extremely relevant to provide studies also at a sub-regional level, i.e., local level (provinces and municipalities) where LGBTI discriminations take place. However, a cross-country survey that records and releases such data in Europe at a sub-regional level is not available yet.

The remainder of this article is structured as follows. Section 2 gives an overview of the theoretical framework followed in this article. Section 3 presents the data and variables. Section 4 gives a brief overview of the small area estimation methods adopted. Section 5 presents the results of the analysis and the discussion. The article concludes in Sect. 6 with a conclusion future research directions.

2 Discrimination in Employment and Theoretical Framework

Discrimination against LGBTI people at work is "a form of violence that denies them full participation in essential social and economic activities and institutions, perpetuates economic injustice, and reduces their opportunities for fulfilling human potential" (Anastas, 1998). In addition, it constitutes a direct violation of article 23 of the 1948 Universal Declaration of Human Rights of the United Nations, on the universal right to work, free choice of employment, just and favourable conditions of work, protection against unemployment and equal pay for equal work (United Nations, 1948). Discrimination can take place at any stage of working life. Bryson(2017) and Chuang et al. (2011) point out that there can differences in pay and benefits compared to non-LGBTI employees. Discrimination happens, e.g., when individuals can be denied a job, or get fired because of being part of the LGBTI community (Ahmed et al., 2013; Burdge, 2008; Drydakis, 2015; Laurent & Mihoubi, 2017). Other studies investigate discrimination regarding equal employment opportunities (Colvin, 2009) and the provision of a safe work environment in relation to people's sexual orientation, gender identity or expression (Mennicke, et al., 2018; Röndahl et al., 2007).

The literature around discrimination in the workplace has studied the issue with a particular focus on the role of stereotypes. The framework based on the stigma theory by Goffman (1963) is often adopted (Bhankaraully et al., 2022). In line with the literature, this is

the framework we also consider. Researchers investigating sexual orientation and/or identity discriminations have paid attention on the occurrence of different types of workplace discriminations. Specifically, two types of discrimination in employment against LGBTI employees may occur (Bhankaraully et al., 2022): harassment (Bowling & Beehr, 2006; DeSouza et al., 2017) and ostracism (DeSouza et al., 2017). Harassment seeks to deliberately harm somebody in the workplace; whereas ostracism relates to the exclusion of an employee from a community, hence, the person finds themself in a position of disadvantage compared to non-LGBTI people. In terms of discrimination in employment, ostracism has been interpreted as prejudice (DeSouza et al., 2017). Both phenomena can lead to occupational segregation and other serious issues (Tilcsik et al., 2015); e.g., they can affect LGBTI employees' health (Carlson et al., 2015; Delgado et al., 2016), their "personal, interpersonal and institutional behavior", families and communities of LGBTI individuals (Anastas, 1998; Biaggio, 1997). Our research relates to ostracism only, since the variables of interest mention whether a candidate at work "is put at a disadvantage". As an example, Riggle (2017) highlights that refusing to hire a transgender or gender non-conforming person is a workplace exclusion, hence, an exemplification of ostracism.

Employers may look for a number of characteristics in a potential employee, depending on the particular job (Ahmed et al., 2013). Then, they compare those applicants' characteristics with the ones required for the specific job; e.g., societal stereotypes, such as, gay men being feminine and lesbians being masculine can create issues for gay men and lesbians because of an incongruousness between their assumed characteristics, which do not conform to typical gender-role stereotypes, and the assumed requirements of the job. This could result into issues, e.g., when gay men apply for a job in a male-dominated occupation. Qualities that are considered to be necessary by employers, e.g., in occupations that are traditionally dominated by males, are typically those consistent with stereotypes of men (Dennis & Kunkel, 2004; Heilman et al., 1989; Willemsen, 2002). If employers have those stereotypes, these can affect their hiring decisions (Ahmed et al., 2013).

3 Data and Variables

The analyses make use of the Eurobarometer 91.4, in particular, we focus on the special topic "Discrimination in the European Union" (European Commission & Brussels, 2019, 2020). The universe is the population of the respective nationalities of the EU member states and other EU nationals who are resident in any of the 28 Member States and aged 15 years and over (European Commission & Brussels, 2020).[2] The sampling is based on a multistage design. In the first stage, units are selected after a stratification by the distribution of the national, resident population (in terms of metropolitan, urban and rural areas), via proportional to the population size and to the population density. These primary sampling units (PSU) are drawn from each of the administrative regions in each country. In the second stage, a cluster of addresses is selected from each sampled PSU systematically. Then, within household, a respondent is selected via a random selection procedure, such as the first birthday method (see European Commission & Brussels, 2020).

[2] The data collection took place in May 2019; thus, the EU countries part of these analyses are the ones belonging to the EU at that time.

Table 1 Descriptive statistics of region sample sizes and sampling fractions

	Minimum	1st Quartile	Median	Mean	3rd quartile	Maximum
Sample size	8	40	86	111	149	514
Sampling fraction	0.00001	0.00003	0.00009	0.00018	0.00024	0.00136

The following countries are included in the analysis: Austria, Belgium, Bulgaria, Republic of Cyprus, Czechia, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Croatia, Hungary, Ireland, Italy, Lithuania, Luxemburg, Latvia, Malta, The Netherlands, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia, and United Kingdom (UK). The regions object of the analysis are the ones available at the lowest level of the NUTS European classification in the data. The sample size is equal to $n = 27{,}438$.

We present in Table 1 the descriptive statistics of the sample sizes and sampling fractions across the regions. It can be seen that the regional sample sizes are small with an average sampling fraction of 0.00018 (median equal 0.00009). Considering these it is not possible to produce precise and reliable direct estimates at regional level for all the European regions. These would produce large standard errors in the direct estimates in many of areas (Chandra et al., 2011; Guha & Chandra, 2021). Therefore, we face the small area estimation problem. In order to address this issue, we adopt model-based small area estimation methods. In particular, the direct regional estimates are improved via the use of an area-level model, i.e., Fay–Herriot model. In this article, we focus on small area predictors based on both univariate and multivariate Fay–Herriot models (Benavent & Morales, 2016; Fay, 1987; Fay & Herriot, 1979). These methods are described in detail in Sect. 4. The Fay–Herriot model is a statistical model that includes some specific variation for each of the subgroups in the population (small areas). It is an area-level model, which means that the model is estimated at area level, hence the independent variables are aggregates (from reliable Official Statistics sources—see Sect. 4 for details on the methods and Appendix 1 for the R software). The model is widely applied in small area estimation of social indicators where aggregated data at area level is usually available. We refer also to Pratesi (2016) for more small area estimation approaches that can be used for social indicators.

Table 2 shows the Eurobarometer questions measuring opinions of discrimination towards LGBTI people in employment used to produce the regional proportions presented in Sect. 5.

Thus, the indicators object of study are three, i.e., the proportions of each binary variables described in Table 2. For example, the first indicator is related to gender identity, and it is the proportion of respondents who reported that "The candidate's gender identity (being transgender)" may put one candidate at a disadvantage. The same can be formulated for the other two variables, i.e., sexual orientation and intersex. We consider the three items separately, since they measure different discriminations, i.e., on transgender people, gays and lesbians, and intersex people. Creating a single variable would neglect important differences within the LGBTI communities.

Table 3 presents the frequency distributions, in percentage, of the variables presented in Table 2. These are obtained at European level.

Figure 1 shows three maps of the public opinions related to discriminating people in employment on the basis of gender identity, sexual orientation and being an intersex person at country level in Europe. These country estimates are obtained by using the survey data

Table 2 Eurobarometer 91.4 questions measuring discriminations towards LGBTI people in employment

Question	Measurement	Variable
[QC4] In [country] when a company wants to hire someone and has the choice between two candidates with equal skills and qualifications, which of the following criteria may, in your opinion, put one candidate at a disadvantage?		
[qc4.8][a] The candidate's gender identity (being transgender)	1 = yes 0 = no	Gender identity
[qc4.9] The candidate's sexual orientation (being gay, lesbian or bisexual)	1 = yes 0 = no	Sexual orientation
[qc4.10] The candidate's sex characteristics (being intersex)	1 = yes 0 = no	Intersex

[a]The code in […] denotes the question ID in the datafile. QC4 contains other possible outcomes, not related to LGBTI people, thus, those are not considered in this work

Table 3 Frequency distributions (in percentage) at country level of each variable presented in Table 2

Variable	Measurement		Total (%)
	0 = no (%)	1 = yes (%)	
Gender identity	76	24*	100
Sexual orientation	77	23	100
Intersex	80	20	100
Sample size (*n*)	27,438		

*For example, 24% means that 24% of 27,438 respondent (in the sample) mentioned that "The candidate's gender identity (being transgender)" […] put one candidate at a disadvantage

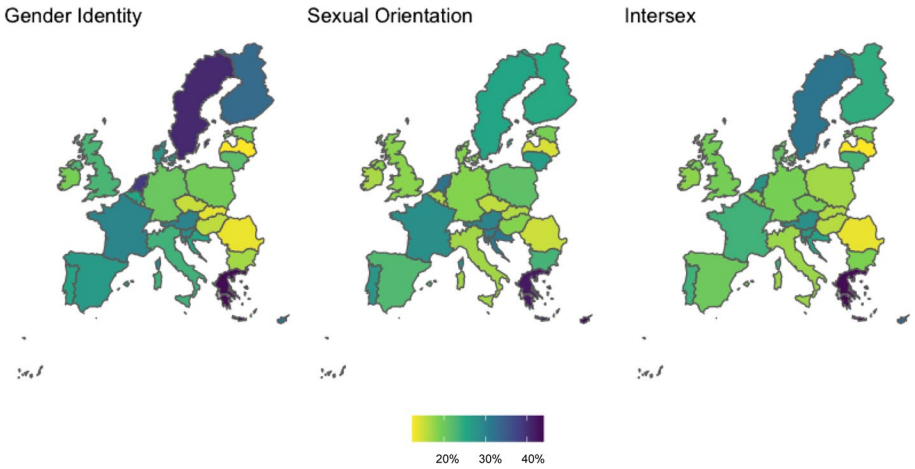

Fig. 1 Maps of the estimates of the indicator described in Table 2 at country level

only based on the available survey weights. Darker colours in these maps denote higher levels of public opinions of perceived discriminations towards LGBTI communities.

In order to provide regional estimates via small area estimation, reliable auxiliary variables at regional level are used. These are available from administrative and/or Census sources. Crime is one of the key factors affecting attitudes towards LGBTI people, and this is widely studied in the literature (Mahomed & Trangoš, 2016; Mkhize et al., 2012) where it is highlighted that they are victims of different forms of crimes. Crime is also known to be heterogeneous at regional level in Europe (Buil-Gil et al., 2021), hence, crime indicators provide an important contribution to the analysis in terms of spatial variability. Gender is also an important variable that can be associated to these attitudes (Arndt & Bruin, 2006; Mahomed & Trangoš, 2016). Age is a factor to consider as well. In fact, as found by Landén et al. (2002) and Patrick et al. (2013), young people tend to show more positive attitudes towards LGBTI people. Socio-economic factors play also an important role in the explanation of public attitudes, and these are known to be heterogeneous at sub-national level. In particular, there is literature investigating these factors in the study of public attitudes towards gay and lesbian people. Educational attainment is also a crucial element. Ohlander et al. (2005) and Grapes (2006) found that individuals with a higher level of education are more accepting towards homosexual sex. Interestingly, individuals with higher

Table 4 Area-level models estimated between the direct estimates (proportions) and the auxiliary variables used to construct the regional estimates of the three indicators

Variable	Gender identity		Sexual orientation		Intersex	
	$\hat{\beta}$	$s.e.(\hat{\beta})$	$\hat{\beta}$	$s.e.(\hat{\beta})$	$\hat{\beta}$	$s.e.(\hat{\beta})$
Intercept	−1.000	0.442	−0.040	0.440	−0.656	0.453
Tertiary education	0.199	0.098	0.113	0.097	0.111	0.100
GDP	0.003	0.025	0.004	0.025	0.011	0.026
Over 65	0.902	0.298	0.905	0.297	1.040	0.305
Male	1.938	0.896	0.159	0.892	0.963	0.919
Vehicle theft	0.019	0.009	0.002	0.009	0.005	0.009
Population density	0.001	0.000	0.002	0.000	0.001	0.000
Married/in civil partnership	0.127	0.217	0.342	0.216	0.312	0.223
Long term unemployment	−0.011	0.018	−0.007	0.018	−0.013	0.019
D*	247		247		247	

*Since the models are area-level models, the units are the regions, hence $D = 247$

levels of education are more likely to spend time in different areas where they originally grew up and possibly meet gay and lesbian people. This can lead onto more positive attitudes towards LGBTI people. Detenber et al. (2013), Herek and Capitanio (1996) and Hinrichs and Rosenberg (2002) provide more detailed analyses into this important topic. As discussed by Lee (2021), economic development plays an important role onto social tolerance (see also Vu, (2022)). The relationship between employment and discrimination of LGBTI people and attitudes is also studied in the literature (Fric, 2017, 2019, and Rollè et al., 2018). Furthermore, it is found that the marital status shapes public attitudes towards same-sex marriage and parenting (Vecho, et al., 2019).

We show in Table 4 the results of some area-level models where the independent variables are the regional indicators (the proportions obtained via the direct estimator) and the independent variables are also at regional level and described above. In this table, $\hat{\beta}$ denotes the regression coefficient estimate, and $s.e.(\hat{\beta})$ its standard error. The correlations between the predictors are very small indicating that no multicollinearity issues arise (Dormann et al., 2013) (see Table 5 in Appendix 2 for the correlations between predictors). In addition, the Variation Inflation Factor (VIF) for the predictors in each model is around 1 (hence not reported here since they give the same information presented in Table 5), indicating no multicollinearity (see e.g., Rawlings et al., 1998).

These variables measure aspects that are the most influential ones onto LGBTI discrimination, and therefore candidates for auxiliary variables to provide better regional estimates than the ones obtained on the survey data only. In addition, we use these variables since these are all available in the EU regional data archives for all the European regions object of study, and they are reliable for such regions according to Official Statistics guidelines (Eurostat, 2022). We highlight that, since the small area model adopted is an area level model (hence estimated at regional level), the auxiliary variables are regional aggregates, i.e.,: proportion of people holding tertiary education level, GDP, proportion of people over

Table 5 Correlation matrix of the predictors used in the model presented in Table 4

	Tertiary Education	GDP	Over 65	Male	Vehicle theft	Population density	Married/in civil partnership	Long term unemployment
Tertiary education	1.000							
GDP	0.242	1.000						
Over 65	−0.146	−0.277	1.000					
Male	−0.027	0.178	−0.082	1.000				
Vehicle theft	0.261	0.184	0.103	0.114	1.000			
Population density	0.106	0.309	−0.300	−0.028	0.147	1.000		
Married/in civil partnership	−0.179	−0.276	0.274	0.015	−0.266	−0.208	1.000	
Long term unemployment	0.023	0.001	0.048	−0.097	0.356	0.028	0.187	1.000

65, proportion of males, rate of vehicle thefts,[3] population density, proportions of people that are married or in civil partnership, and long-term unemployment rate. These variables are accessed from the regional statistics by NUTS classification available in Eurostat (2022), and they allowed for good model diagnostics which are presented in Appendix 2 in detail. Therefore, we do not include extra variables to avoid multicollinearity problems.

4 Small Area Estimation Methods

Small area estimation is a family of techniques increasingly in demand from both researchers and policy makers given the growing need for detailed geographical understanding of social phenomena of small areas in the population (Pratesi, 2016).

There are different approaches one can use to perform small area estimation and we refer to Rao and Molina (2015) for a review of those. The small area estimation approach followed in this article consists of an Empirical Best Linear Unbiased Predictor (EBLUP), which is a composite estimator combining the direct estimator, based on the sample information only, with the synthetic estimator based on the area level Fay–Herriot model (Benavent & Morales, 2016; Fay, 1987; Fay & Herriot, 1979). The two estimators are combined within the composite estimator using the shrinkage estimator, which is function of the variance of the direct estimator and synthetic estimator. Particularly, on the one hand, a larger weight will be attached to the direct estimates when the variance of these is small (this is in case of large area sample sizes); on the other hand, more weight will be given to the synthetic estimate when the variance of the direct estimate is large (Fay & Herriot, 1979). The small area estimation literature has shown that in case of correlated responses, this correlation can be incorporated into the model, instead of estimating separate univariate models for each response variable to improve the efficiency of the estimates (Benavent & Morales, 2016; Moretti, et al., 2020). Hence, we will consider a multivariate Fay–Herriot model, where the univariate model can be seen as a particular case of it (see Sect. 4.1). An important reason why we decide to adopt this small area estimation approach is that the accuracy of the Fay–Herriot small area estimates is fully explored in the literature, and this method can be considered as a traditional one in small area estimation (Pratesi et al., 2021).

First, a multivariate area level model (Fay–Herriot model) is estimated at regional level in order to obtain the model synthetic estimates for each region and indicator. In this model, the response variable is the direct estimate (obtained via the use of the survey weights), and the independent variables are the auxiliary variables (aggregates) at regional level.[4] From this step, regional synthetic estimates are obtained; these will have a smaller variance compared to the direct estimates but a potential bias due to the use of a model. Finally, in order to optimise the trade-off between variance and bias, hence produce an efficient small area estimate, we combine the two set of estimates (synthetic and direct) using the shrinkage factor described above. As output, we have a new set of estimates for the European regions, which will be more reliable than ones obtained via the use of the survey data only.

[3] We chose one crime rate only given that they are all strongly correlated at regional level causing serious multicollinearity problems.

[4] In order to show that the multivariate model provides more efficient estimates than the univariate setting, univariate models are also estimated. We refer to Appendix 2 for the comparisons.

4.1 Multivariate Fay–Herriot Model

Let us consider a target finite population U with size N partitioned into D non-overlapping (disjoint) small areas, with indexes $d=1,...,D$ and size N_d such that $N = \sum_d N_d$. A random sample s of size n is selected from U. n_d denotes the sample size in small area d, hence $n = \sum_d n_d$. Let $\boldsymbol{y}_d = \left(y_{d1}, \ldots, y_{dK}\right)^T$ be a vector of direct survey estimators for $\boldsymbol{Y}_d$ denoting the population mean of K variables of interest. Notice that in our case we have three indicators, hence, $K = 3$.

Following Benavent and Morales (2016); Fay (1987), a multivariate area-level Fay–Herriot model for K target variables can be written as follows:

$$\begin{aligned} &\boldsymbol{y}_d = \boldsymbol{Y}_d + \boldsymbol{e}_d \\ &\text{and} \\ &\boldsymbol{Y}_d = \boldsymbol{X}_d\boldsymbol{\beta} + \boldsymbol{u}_d. \end{aligned} \tag{1}$$

Model (1) is the multivariate extension of the univariate Fay–Herriot model (Fay & Herriot, 1979). It is well-known that the first modelling stage takes into account for the sampling variability of the direct estimators denoted by $\boldsymbol{y}_d$, whereas the second stage links true small area means, $\boldsymbol{Y}_d$, to the auxiliary variables denoted by the following matrix: $\boldsymbol{X}_d = \text{diag}\left(\boldsymbol{x}_{d1}, \ldots, \boldsymbol{x}_{dK}\right)_{K\times p}$. Therefore, we can write model (1) as an area-level models as follows:

$$\boldsymbol{y}_d = \boldsymbol{X}_d\boldsymbol{\beta} + \boldsymbol{u}_d + \boldsymbol{e}_d, d = 1, \ldots, D, \tag{2}$$

where $\boldsymbol{\beta} = (\boldsymbol{\beta}_1^T, \ldots, \boldsymbol{\beta}_K^T)_{p\times 1}^T$ denotes the fixed effect unknown parameters. $\boldsymbol{u}_d \overset{ind}{\sim} N\left(0, \boldsymbol{V}_{u_d}\right)$ and the vectors of sampling errors $\boldsymbol{e}_d$, $\boldsymbol{e}_d \sim N\left(0, \boldsymbol{V}_{e_d}\right)$. $\boldsymbol{u}_d$ and $\boldsymbol{e}_d$ are assumed being independent within and across small areas. The covariance matrix $\boldsymbol{V}_{e_d}$ is known whereas $\boldsymbol{V}_{u_d}$ depends on unknown parameters $\boldsymbol{\theta} = \left(\theta_1, \ldots, \theta_K\right)$.

In order to introduce the predictor is easier to write the D models in (2) in matrix form:

$$\boldsymbol{y} = \boldsymbol{X}\boldsymbol{\beta} + \boldsymbol{Z}\boldsymbol{u} + \boldsymbol{e}. \tag{3}$$

Here, $\boldsymbol{y} = \text{col}_{1\le d\le D}\left(\boldsymbol{y}_d\right)$ is a $DK \times 1$ vector of direct estimates, $\boldsymbol{X} = \text{col}_{1\le d\le D}\left(\boldsymbol{X}_d\right)$ is a $DK \times p$ matrix of auxiliary variables, $\boldsymbol{Z} = \text{col}^T_{1\le d\le D}\left(\boldsymbol{Z}_d\right)$ is a $DK \times DK$ diagonal matrix whose d^{th} column is an indicator variable which takes the value 1 if the unit is in area d and 0 otherwise. $\boldsymbol{u} = \text{col}_{1\le d\le D}\left(\boldsymbol{u}_d\right)$ is a $DK \times 1$ vector of random area effects and $\boldsymbol{e} = \text{col}_{1\le d\le D}\left(\boldsymbol{e}_d\right)$ is a $DK \times 1$ vector of sampling errors with the following: $\boldsymbol{u} \overset{ind}{\sim} N\left(0, \boldsymbol{V}_u\right)$ and $\boldsymbol{e} \sim N\left(0, \boldsymbol{V}_e\right)$. $\boldsymbol{V}_u = \text{diag}_{1\le d\le D}\left(\boldsymbol{V}_{u_d}\right)$ and $\boldsymbol{V}_e = \text{diag}_{1\le d\le D}\left(\boldsymbol{V}_{e_d}\right)$.

If we set $\boldsymbol{V}_{u_d} = \text{diag}_{1\le k\le K}\left(\sigma^2_{uk}\right)$ and $\boldsymbol{V}_e = \text{diag}_{1\le k\le K}\left(\sigma^2_{edk}\right), d = 1, ..., D$, the reader may want to note that we are in presence of the univariate Fay–Herriot model (Fay & Herriot, 1979). Whereas, if we set $\boldsymbol{V}_{u_d} = \text{diag}_{1\le k\le K}\left(\sigma^2_{uk}\right)$ and we assume a known but not necessarily diagonal matrix $\boldsymbol{V}_e$ we have the multivariate Fay–Herriot model (Benavent & Morales, 2016; Fay, 1987).

In order to estimate the parameters $\boldsymbol{\theta} = \left(\theta_1, \ldots, \theta_K\right)$, with generic element being $\theta_k = \sigma^2_{uk}$, we use the Restricted Maximum Likelihood (REML) method following Benavent and Morales (2016). Therefore, the Multivariate Empirical Best Linear Unbiased Predictor (MEBLUP) of $\boldsymbol{Y}$ is given by:

$$\hat{\boldsymbol{Y}}^{MEBLUP} = \boldsymbol{X}\hat{\boldsymbol{\beta}} + \boldsymbol{Z}\hat{\boldsymbol{u}}, \tag{4}$$

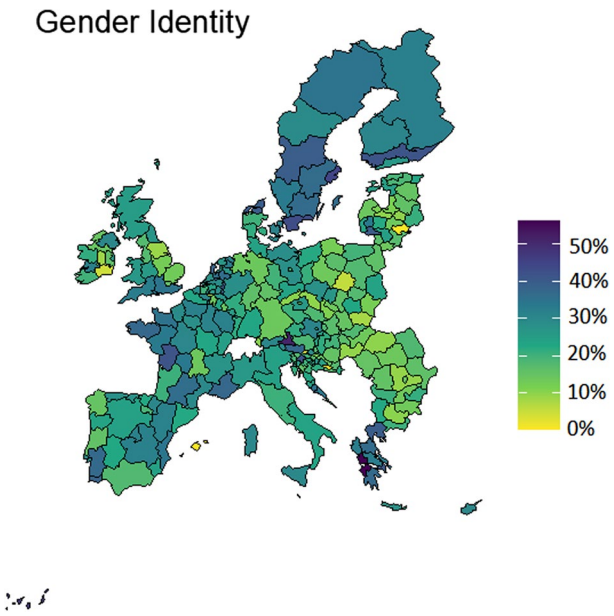

Fig. 2 MEBLUP estimates based on the multivariate Fay–Herriot model showing the spatial distribution of public opinions of discrimination in employment towards gender identity in Europe

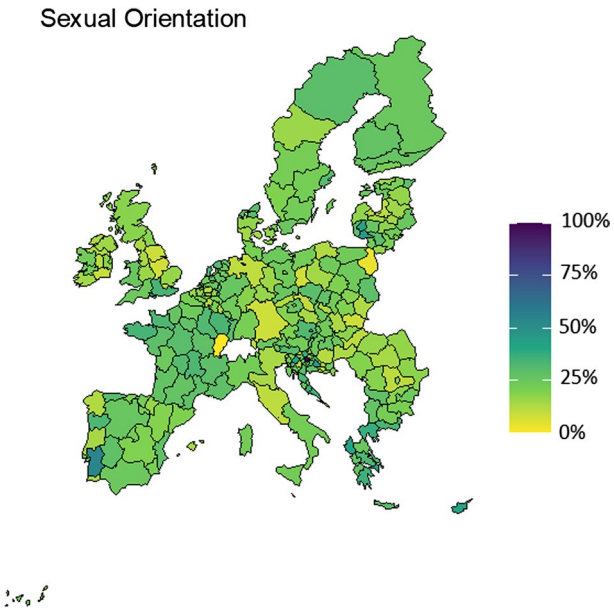

Fig. 3 MEBLUP estimates based on the multivariate Fay–Herriot model showing the spatial distribution of public opinions of discrimination in employment towards sexual orientation in Europe

where $\hat{\boldsymbol{\beta}}$ and $\hat{\boldsymbol{u}}$ are the estimator and predictor of $\boldsymbol{\beta}$ and $\boldsymbol{u}$, respectively. We refer to Benavent and Morales (2016) for details on this. In order to provide a measure of uncertainty of (4) the Mean Squared Error (MSE) can be estimated. We follow the approach in Benavent and Morales (2016) where an analytical approximation is derived. For the MSE of the

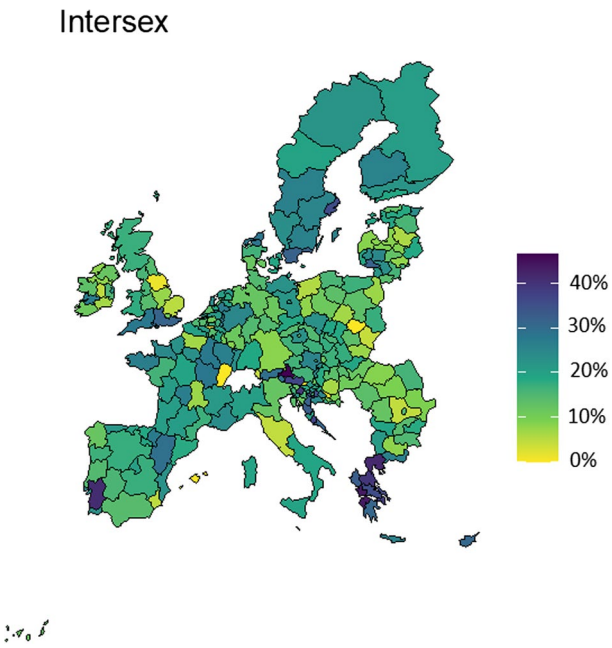

Fig. 4 MEBLUP estimates based on the multivariate Fay–Herriot model showing the spatial distribution of public opinions of discrimination in employment towards being intersex in Europe

predictor obtained under the univariate setting, we follow Prasad and Rao (1990). We refer to Appendix 1 for references of the R packages that users can use to apply the approaches.

5 Results and Discussion

We present in Figs. 2, 3, and 4 the MEBLUP estimates based on the multivariate Fay–Herriot model depicting the regional estimates of public opinions of discrimination in employment towards gender identity, sexual orientation, and intersex people, respectively. Darker colours in the maps show a larger number of respondents stating that LGBTI people can be discriminated.

In order to evaluate both the reliability and the validity of the small area estimates, we consider some diagnostics measures in Brown et al. (2001) and Chandra et al. (2011). We focus on the estimates based on the multivariate Fay–Herriot model only since these are the estimates focus of this section. Due to space constraints, the diagnostics analyses are presented in detail in Appendix 2.

By looking at Fig. 1, but also Figs. 2, 3, and 4, where the estimates are disaggregated regionally, it can be seen that there is a large spatial heterogeneity between and within European countries. This can be seen in particular for both the gender identity and being intersex person indicators.

The country-level findings presented in Fig. 1 are in line with the results shown in European Commission and Brussels (2019).[5] Here, it is stressed that, more than four in ten

[5] We refer to the table published in European Commissiona and Brussels (2019) at page 165.

respondents in Greece and Cyprus mention that a candidate can be discriminated because of their sexual orientation. Larger proportions can also be found in The Netherlands, Norway, and Finland, denoting that citizen perceived discriminations towards LGTBI communities that take place in the labour market are higher. On the contrary, smaller proportions can be seen in East European countries, i.e., Romania, Latvia, Poland, and Hungary, confirming previous European Commission and Brussels (2019) findings. This between-country spatial heterogeneity motivates the disaggregation of the indicators at a sub-national level to depict difference between European regions.

Van Balen et al. (2011) point out that sexual orientation discrimination is rare to be reported across European countries, suffering from a lack of official court cases. In addition, many members of staff tend not to disclose that they are part of a sexual minorities. This is to prevent any discrimination in the workplace (Frick, 2016). Therefore, this problem can generate conclusions that discrimination against sexual minorities is not a diffused problem in the labour market (Fric, 2019). Particularly, in those countries where it is known that negative attitudes towards LGTBI people prevail, opinions might not be representing well the real discriminations that LGBTI communities face in the workplace, since those may be affected by what the public hear, such us reporting.

According to research carried out by the Lithuanian Gay League, most homosexual and bisexual people hide their sexual orientation at their workplace. This results in very few complaints related to discrimination on the ground of sexual orientation; e.g., only five complaints claiming discrimination in the workplace were based on sexual orientation in 2015; no data is collected on discrimination of transgender people (Frick, 2016). In Latvia, these topics are very sensitive. According to LGBT rights organisation Mozaīka[6] international studies, Latvia is one of most homophobic EU member states. Furthermore, Latvian social partners seem neutral towards LGBT and their integration in the labour market; they (including Lithuanian trade unions and employers' organisations) have not recently taken any initiatives on this issue. The National LGBT rights organisation[7] states that the representatives of trade unions believe that the issue of discrimination based on sexual orientation at work is invisible, hence, it does not require particular attention (Frick, 2016). These issues related to public opinions and policies that we discussed above may justify lower values in the indicators compared to the other European countries. By looking at the regional maps in Figs. 2, 3, and 4, it can be seen that there is not much within-country variability in Latvia, where public opinions of discrimination are located on the lower side for all the three indicators. However, larger values, especially for the gender identity and intersex indicators, can be seen in the Latvian region of Latgale. This is located on the East border, and we note that it is the region where Riga (the capital) is. Regarding Lithuania, the values of the indicators are larger, showing more awareness of discriminations, and the estimates differ considerably between-regions. Larger values relate to regions situated in the southwest area of the country.

Poland presents interesting between-region differences. Larger values in the indicators can be seen in the regions close to Germany and Czechia borders. It is interesting to note that the lowest values in the indicators (mainly for the intersex and gender identity proportion) are observed in the southeast areas (close to Slovakia). In fact, some municipalities and regions located in this area have decelerated themselves to be unwelcoming

[6] Mozaīka an LGBT organisation in Latvia founded in 2006 working for the protection of LGBT rights and human rights (https://www.mozaika.lv/).

[7] National LGBT rights organisation in Latvia: https://www.lgl.lt/en/?cat=6&paged=10.

towards LGBT during the last decade. These areas belong to the "LGBT-free zones" in Polish "Strefy wolne od LGBT" (see Noack, 2019; Herbert, 2019). This leads onto important consequences, e.g., the European Union denying access to funding from the Structural Funds and Cohesion Fund to municipalities that follow the LGBT-free policy, violating the EU Charter of Fundamental Rights (Frater & Kolirin, 2020). In Romania, we can observe smaller proportions compared to other countries, and the within-country variability is not large. Importantly, the issue of underreporting mentioned above can also be observed here. In fact, the Romanian National Council for Combating Discrimination showed that only 2% of total submitted complaints in the workplace are related to discrimination on sexual orientation. In addition, the council stresses that the social stigma in relation to these communities is very strong, discouraging them from complaining about forms of discrimination (Frick, 2016). Therefore, public opinions can be affected by this.

Regions located in Greece appear to have high values in the indicators, with small between-regions variability. Citizens appear to be concerned of discriminations that LGBTI people face at work. In the last decade, there have been joint actions carried out by employees and employers aiming to stress the importance of a public dialogue to improve diversity awareness in the workplace (Frick, 2016).

Regarding West European countries, i.e., Portugal, Spain, and France, we can see crucial between-region variability. LGBTI rights in Portugal improved considerably in the 2000s, and they are now among the best in the world, as stressed by Ellingham et al. (2002). People living in the Portuguese region of Alentejo appear to be the most aware of discriminations faced by LGBTI communities in employment. This region, according to Alentejo Promotion Office and Turismo do Alentejo—ERT (2019), is the most left-wing, and progressive area of the country, and many mayors' towns are from the Coligação Democrática Unitária party. This is a coalition characterised by an environmentalist, pro-labour and left spirit. Furthermore, Alentejo is undoubtedly not the most religious part of Portugal. As part of its agenda, there are principles such as equality and social justice (Alentejo Promotion Office & Turismo do Alentejo—ERT, 2019). The context that identifies this country might drive public opinions in the public opinion regarding LGBTI discrimination in the workplace. In 2015, there was an amendment on the Portuguese Labour Code, enriching gender identity within the right to equal access to employment (Frick, 2016).

Regions located in France show also interesting between-region variability. Research carried out by Laurent and Mihoubi (2012) show that gay men, compared to heterosexual men, suffer from a wage penalty of -6.5% in the private sector and -5.5% in the public sector. This is higher for older employees compared to younger people. Overall, respondents from the Northern and Southern regions in France seem to be more aware of discriminations. Franche-Comte region stands out compared to the rest of French regions. This is a Southern region sharing the border with Switzerland; it has the lowest values of the indicators for intersex and sexual orientation compared to the other areas. This region is characterised by a strong rural environment, and it is sparsely populated (Encyclopedia Britannica, 2022).

Finland and Sweden, along with The Netherlands show the largest values of the indicators. The between-region variability is also smaller for these countries. In Sweden, almost all organisations of employers and employees take an official position against any discrimination. Furthermore, the three Finnish most important trade unions aim to promote LGBTI rights. In particular, as stated by Frick (2016) they stress the need for a reform of the Non-Discrimination Act (see Ministry of Justice Finland, 2022). They also participated to the Helsinki Pride since 2014.

The Netherlands along with the UK have the lowest proportion of people who hide their identity or sexual orientation at work. As mentioned above, this has an impact on reporting and public opinion. In The Netherlands, both government and social organisations oppose all forms of discriminations actively. In the UK there have been a large number of initiatives with the goal of fighting discriminations in workplace. E.g., Stonewall publishes a list of the top 100 workplaces for LGBT employees annually. In addition, another important initiative relates to the top 50 LGBT business role models published in the UK by OUTstanding (a professional network for LGBT executives and their allies), aimed at inspiring future leaders (Frick, 2016).

6 Conclusion

In this article, we studied public opinions towards discriminations of LGBTI communities in the workplace in Europe. In particular we considered three indicators related to gender identity, sexual orientation, and being intersex. The analyses were carried out at regional level via small area estimation. The empirical results obtained were evaluated by diagnostic measures showing that the model-based small area estimation estimates based on the multivariate Fay–Herriot model provide important gains in efficiency in obtaining regional level estimates for the three indicators compared to the survey direct estimates. The multivariate approach provided superior estimates, in terms of efficiency, compared to its univariate setting. Whilst the literature has studied the topic at country-level, the attention has not been paid on sub-national analyses across European countries. To the best of our knowledge, this is the first study that investigates public opinions towards discriminations of LGBTI communities in employment at a sub-national level in Europe.

As a whole, we can see large between-region variability for both gender identity and intersex indicators (i.e., Figs. 2 and 4), whereas, smaller variability can be observed for sexual orientation indicator, presented in Fig. 3. This shows that public opinions on discrimination towards sexual orientation in the workplace tend to be more homogenous across European regions compared to the other two indicators.

We found that public opinions in some of the countries where a large amount of discriminations towards LGBTI people take place are lower compared to other countries. This point is discussed both in the literature and policy reports (see Valfort, 2017 and Takács, 2016). As stressed by Valfort (2017), it can happen that the general public may be less informed about anti-LGBTI discriminations than LGBTI people themselves. Therefore, a respondent who reports a low perceived level of discrimination towards LGBTI people can reflect two situations: 1. the fact that LGBTI people indeed suffer low discriminations, or 2. the fact that the respondent does not care/know about such discrimination; and this translates into a low, level of social acceptance of LGBTI people. Indeed, discrimination against LGBTI communities "can remain hidden in many instances because coming out of invisibility is a very critical process for most" LGBTI people, which generates risks of being ostracised in a social environment that can be heteronormative (Takács, 2016). This might lead to the conclusion that discrimination against such minorities is not a widespread problem (or it does not exist) in the labour market. Future research will study the results of the Nordic and Eastern European countries discussed above. In fact, as discussed along this article, previous empirical evidence for Northern European countries found that these are liberal and tolerant towards LGBTI communities, whereas in Eastern European countries a larger amount of discriminations takes place widely. This may find explanation in different

degrees of visibility of LGBTI people. E.g., public opinions expressed by respondents may be also mediatised by factors that cannot be modelled on the basis of the available data. In particular, public media coverage of discrimination against LGBTI people in the workplace, and topics related to the sensitivity to LGBTI discrimination play an important part here. Regarding the role of the media on shaping public views towards these communities, we refer to Ayoub (2018) and Ayoub and Garretson (2017). In their research, it is argued that "free media" are crucial in order to advance gay rights, and media freedom may need to anticipate "efforts to secure gay rights legislation". Therefore, as it is stressed in the discussion around the available literature in the previous section, it can be the case that in Nordic countries the argument of "overreporting" and "awareness", compared to the rest of Europe, leads to more perceived discrimination due to greater sensitivity to the topics. Whereas, in countries where more discriminations take place, but less reported, respondents may not be concerned about LGBTI discriminations or simply think that they do not take place. Thus, we argue that when our regional estimates are used in future research and policy making, they should be contextualised. In fact, from a first glance users may come to the conclusion that discriminations in the workplace are not present, contradicting the usual findings. However, this is not necessarily the case since the estimates are based on public perceptions. Future research will study this problem in detail, taking into account for issues related to items measurement at regional level.

We believe that our research has important implications for a wide range of actors, and not only policy makers and local governments working on the issue of LGBTI discriminations in employment. LGBTI organisations, in particular NGOs, can benefit of regional analysis in order to understand geographical areas in order to establish campaigns and develop actions. For example, an NGO in Slovenia, i.e., ŠKUC, run an initiative to improve attitudes towards LGBTI via TV advertisements. There are also examples of good practices, where trade unions are informed about measures to fight discriminations in employment which are formulated on the basis of attitudes towards LGBTI (see e.g., Quinn & Paradis, 2007, p. 26; Council of Europe, 2011). Other initiatives within trade unions can be found in European Commission (2010) and European Trade Union Confederation (2007). Our study can also benefit the public in order to raise awareness of discrimination towards LGBTI communities generating social activism (see e.g.,Pham et al., 2022)).

Future research will take into account other types of discriminations and attitudes towards LGBTI which can be related to the indicators studied in this article. Interesting comparisons across time can be produced as well, e.g., by using the European Social Survey data. However, the current European Social Survey items only consider gay men, lesbians and bisexual people. Of course, it would be ideal to produce estimates a sub-regional level in Europe, however, currently, such data is not available in an across Europe sample surveys, which is an important limitation that has be considered for future European data collection projects.

Appendix 1

Software used to produce the small area estimates

The direct estimates that used as a dependent variables in the Fay–Herriot models are obtained via the function "direct" of the R package "sae" (Molina & Marhuenda, 2015). The function returns both the direct estimates and their estimated standard deviations.

The univariate Fay–Herriot models and their mean squared errors can be estimated via the function "mseFH" of the R package "sae" (Molina & Marhuenda, 2015). Similarly to the case of the direct estimates, the function returns both the small area estimates (EBLUPs) and their mean squared errors.

Regarding the multivariate Fay–Herriot model presented in Sect. 4.1, this can be estimated via the function "eblupMFH1" in the R package "msae" (Permatasari & Ubaidillah, 2022). As in the case of the univariate Fay–Herriot model, the function returns both the small area estimates and their mean squared errors. Other software to estimate the models applied in this article can be found in Morales et al. (2021).

Appendix 2

Small area models diagnostics measures and extra modelling outputs

In order to evaluate both the reliability and the validity of the small area estimates, we consider some diagnostics measures in Brown et al. (2001) and Chandra et al. (2011). We focus on the estimates based on the multivariate Fay–Herriot model only since these are the estimates presented in Sect. 4.1. These diagnostics are based on the following hypotheses:

(i) The model-based small area estimates should be consistent with the unbiased direct survey estimates, i.e., they should provide an approximation to the direct survey estimates that is consistent with these values being 'close' to the expected values of the direct estimates.

(ii) The model-based small area estimates should be more precise than the direct estimates. This can be checked by comparing the mean squared error estimates. In particular, the model-based small area estimates should have MSEs significantly smaller

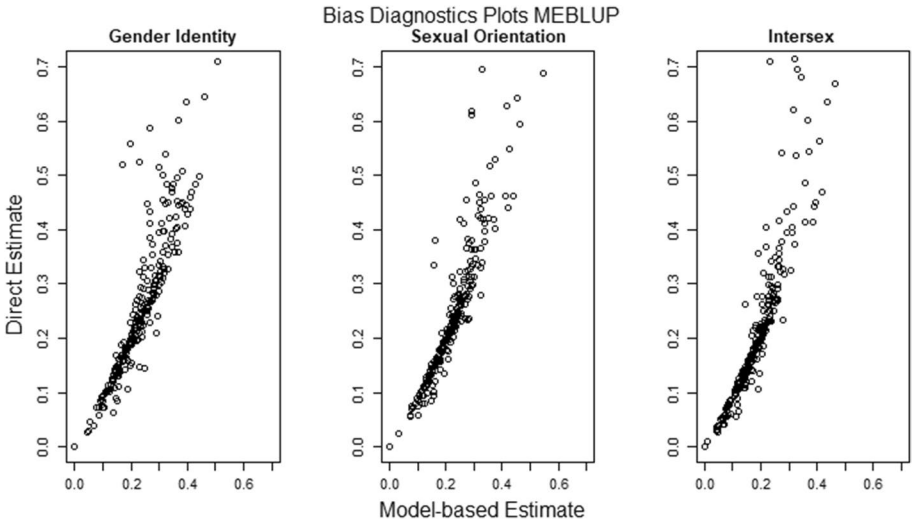

Fig. 5 Bias diagnostics plots for gender identity, sexual orientation, and intersex indicators for European regions: model-based multivariate Fay–Herriot model estimates versus direct estimates

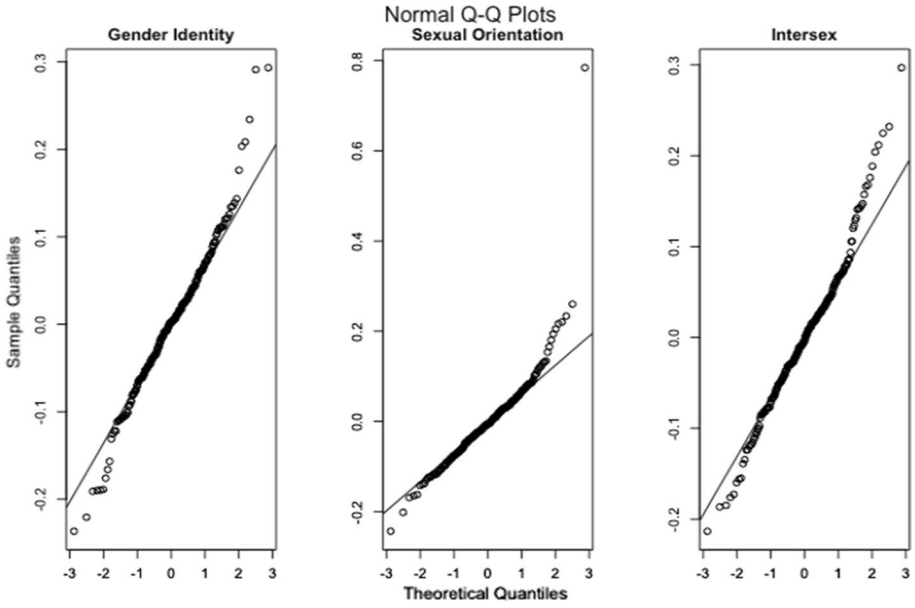

Fig. 6 Normal Q–Q plots of the multivariate area-level residuals for gender identity, sexual orientation, and intersex indicators

than the variances of the corresponding direct estimates. Since we also produce the small area estimates under the multivariate Fay–Herriot model, we check whether these are more precise than the ones obtained under the univariate setting.

In addition, since the Fay–Herriot model assumes that the random area effects are normally distributed, this assumption should also be checked.Figure 5 shows the bias diagnostics plots in order to test the hypothesis in i. above. Given that the direct estimates are unbiased, we should expect a linear relationship between these and the model-based estimates. By looking at A2.1 we can see that the model-based small area estimates are not much extreme to the direct estimates, showing that the model-based approach did not introduce much bias in the small area estimates. Related to this, we also estimated a regression model between the direct and model-based estimates, showing good results, i.e., R^2 is equal to 0.81, 0.84, and 0.82 for gender identity, sexual orientation, and intersex models, respectively. This is a good outcome following the bias diagnostics literature (see e.g., Chandra et al., 2011).

In addition, we estimate the Spearman's ranking correlation coefficients between the direct estimates and the model-based estimate to investigate whether the ranking between the two sets of estimates is preserved at regional level. This is part of the bias diagnostics also evaluated in a simulation study conducted in Moretti et al. (2021). These are equal to 0.95, 0.96, and 0.96 for gender identity, sexual orientation, and intersex indicators, respectively. We show in Fig. 6 the normal Q–Q plots of the multivariate area-level residuals for gender identity, sexual orientation, and intersex models.

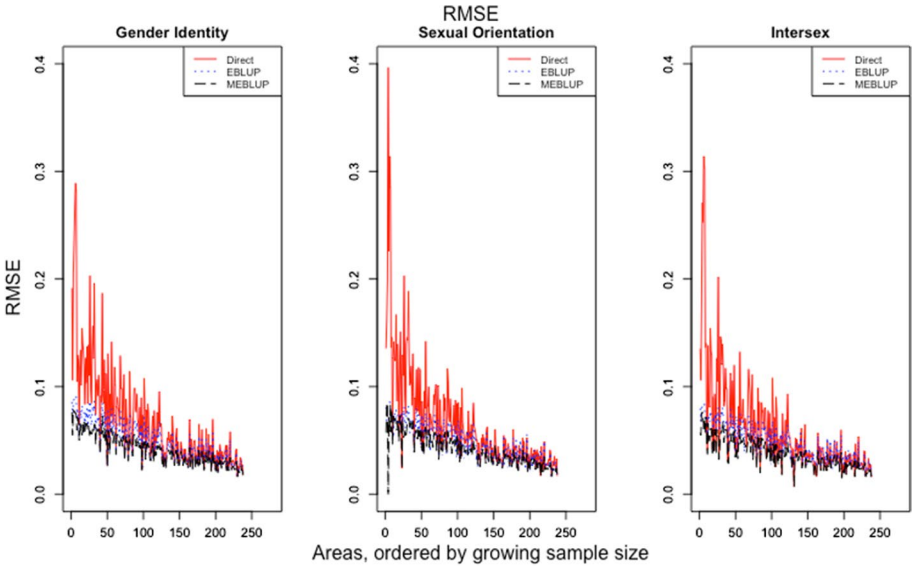

Fig. 7 Root Mean Squared Error (RMSE) of the regional estimates. There are arranged by growing region sample size

We now investigate whether the model-based multivariate models estimated for the three indicators improved in precision of the small area estimates compared to the univariate setting and the direct estimates.

Figure 7 shows the RMSE of the direct estimates and the model-based estimates based on the univariate and multivariate Fay–Herriot models for the three indicators. These are ordered by growing area sample size. As expected, the variability of the direct estimates is much larger than the ones arising from the model-based estimates, hence unstable in case of small area sample sizes. Importantly, by looking at Fig. 7, it can be seen that the multivariate Fay–Herriot model produces more reliable regional estimates compared to the univariate case, in fact their RMSEs estimates are smaller than the ones from the univariate Fay–Herriot for all the three models.

Declarations

Conflict of interest The author has no conflicts of interest to disclose.

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