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**How Much Are Individuals Left
Behind in Central and Eastern
Compared to Western European
Countries? A Fuzzy Comparative**

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Abstract

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less left behind, to Bulgaria, Lithuania, and Romania, characterised by more market-based models where people lag further behind.

Keyword: Leaving no one behind, income, material deprivation, work intensity, fuzzy approach, Central and Eastern European countries

JEL Classification: I30, O57, C02

How Much Are Individuals Left Behind in Central and Eastern Compared to Western European Countries? A Fuzzy Comparative Analysis

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Abstract

This paper examines the extent to which individuals of Central and Eastern European (CEE) member countries of the EU are left behind compared to individuals from Western European (WE) countries, as well as across CEE countries. To this end, according to the principle of ‘Leaving no one behind’ (LNOB) of the 2030 Sustainable Development Agenda, a fuzzy approach is applied to a multidimensional setting made up of income, material deprivation, and work intensity. Comparing both blocs of countries, three decades after transitions to liberal democracy and market economies of CEE countries, a certain process of convergence between them is observed over the period 2007–2019 essentially as a result of two processes: a decrease in the level individuals were left behind in the CEE countries, and an increase in the level individuals were left behind in the WE countries in the years following the 2007–2008 financial crisis. Differences in the degree individuals were left behind along the income distribution are also analysed. Specifically, it is found that the extent to which individuals were left behind in both blocs in 2007 differs except in the tails. In contrast, the degree individuals were left behind in 2019 is very similar along the distribution for both the CEE and WE blocs and similar to the levels of the WE bloc in 2007. Focusing on the CEE countries, significant disparities among countries regarding the degree of being left behind and its distribution are also revealed. This finding may be related to the models of capitalism implemented, which ranged from mixed economy models (Czech Republic, Slovenia, and Slovakia), where citizens are less left behind, to Bulgaria, Lithuania, and Romania, characterised by more market-based models where people lag further behind.

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1. Introduction

Equality is one of the central features of state socialism. In most Central and Eastern European (CEE) countries income distribution was relatively egalitarian at the end of state socialism, although it does not mean that there was not a certain hidden inequality (Henderson et al., 2008). Around 1989, the estimates of income inequality for these countries based on the Gini coefficient ranged from 0.2 to 0.25 (Milanovic, 1998; Tóth, 2014), while the average Gini for the OECD countries was 0.3 at that time (Flemming and Micklewright, 2000).

After the fall of the Berlin Wall, the transition from non-democratic regimes to liberal democracy and from centrally planned economies to market economies of the CEE countries involved profound institutional changes that led to significant distributive consequences (Alvaredo and Gasparini, 2015; Perugini and Pompei, 2016). This entailed substantial increases in income inequality in all CEE countries, even though the magnitude of the increases was heterogeneous across countries (Brzezinski, 2018). Apart from the retrenchment of the redistributive state, these increments were related to the processes of privatisation, liberalisation, and foreign investment penetration that implied decentralised wage setting, resulting in a more disperse wage distribution (Ferreira, 1999; Mitra and Yemtsov, 2007).

Despite the broad similarities between the CEE countries in the transitions to representative democracy and competitive economies and later adaptation processes for accession to the EU, the institutions and economic and social policies that were adopted differed significantly across countries. These ranged from the pure neoliberal framework of the Baltic States to other models of post-socialist capitalism, such as the ‘embedded’ neoliberal type represented by the Visegrád countries or the neo-corporatist capitalism of Slovenia, as well as other undefined profiles of capitalism of the South-Eastern European countries (see, for instance, Bohle and Greskosvits, 2012; Jasiński, 2020). These types of capitalism have resulted in different socioeconomic dynamics across CEE countries, also in terms of inequalities, converging to some extent towards socio-economic environments like those of the Western European (WE) countries (Ahlborn et al., 2016; Medgyesi and Tóth, 2021).

Three decades after transitions and more than 15 years after their accession to the EU, it is worth assessing differences in economic inequality between CEE and WE countries and within the CEE region from the current lens of the principle of ‘Leaving no one behind’ (LNOB) of the 2030 Sustainable Development Agenda. Nevertheless, it is

evident that there are many analytical challenges embedded in translating this LNOB principle from policy language to quantitative assessment and the adoption of public policies. To start with, we need a precise understanding and identification of those who are left behind and to what extent they are lagging behind in order to obtain appropriate conclusions.

With the aim of measuring the degree to which an individual is left behind, this study relies on the fuzzy measure introduced by Garcia-Pardo et al. (2021) to compute the extent to which individuals are left behind. More specifically, we focus on the three dimensions included in the At Risk of Poverty or social Exclusion (AROPE) measure, the main indicator to monitor the EU 2030 target on income and living conditions: income, material privation and labour intensity. This approach allows obtaining a quota of inequality at the individual level from the perspective of LNOB. In this regard, it goes beyond overall inequality measures and assesses how much each individual is left behind in each dimension examined and by considering all dimensions jointly. In this regard, this work examines differences in the level in which individuals are left behind between CEE and WE countries as well as within the CEE region over the period 2007–2019, that is, from the moment Romania and Bulgaria joined the EU to the onset of the pandemic crisis. The CEE region includes the three Baltic States (Estonia, Latvia, and Lithuania), the four Visegrád countries (Czech Republic, Hungary, Poland, and Slovakia) and Slovenia, Romania, and Bulgaria,¹ while the WE group includes the remaining 16 EU countries.

Thus, we contribute to the literature on comparative analysis of inequality that usually focuses on overall measures of inequality by providing evidence of individuals' contribution to inequality through the perspective of LNOB by blocs of countries and for each CEE country. To the best of our knowledge, this has not yet been addressed in the literature. Specifically, we aim to answer the following questions: To what extent are individuals of the CEE countries left more behind than those of the WE countries? How have these differences evolved over the period analysed? Are there differences in the extent to which individuals of the different deciles of CEE and WE countries lag behind? Do the socio-demographic characteristics of those left behind differ between blocs? And across CEE countries?

Our first hypothesis is that individuals in CEE countries were more left behind than individuals in WE countries at the beginning of the period examined given the

¹ We do not consider Croatia, a former socialist state that joined the EU in 2013, due to the lack of available data for the entire period of analysis.

greater levels of economic inequality when the CEE countries joined the EU. In this regard, we expect the gap between blocs to close as the result of a convergent trend in the socioeconomic dynamics between CEE and WE countries. We also analyse how far behind individuals in different parts of the distribution were in 2007 and 2019 in each bloc of countries, as well as by individual socio-demographic characteristics. As for the CEE countries, our hypothesis is that there are remarkable differences among these countries in the extent to which individuals were left behind. We reproduce the analysis for each of the former socialist states to identify potentially different patterns among countries in terms of the levels and evolution of the degree to which individuals in these countries fell behind measured by income deciles and key socio-demographic characteristics associated with the degree of falling behind.

The remainder of the paper is structured as follows. Section 2 presents the data and methodology. Section 3 provides and discusses our empirical results. Finally, some conclusions are provided in the last section.

2. Data and Methodology

Our aim is to study the degree to which individuals are left behind in a multidimensional setting considering the three dimensions of the AROPE indicator: income, material deprivation, and work intensity. To this end, we use information from the cross-sectional data of the European Statistics on Income and Living Conditions (EU-SILC) survey over the period 2007–2019. The EU-SILC provides a standardised dataset on income and other sociodemographic variables at the household and individual level. We find this dataset to be the most adequate because it gathers homogeneous variables for all countries, enabling sound comparisons between diverse social contexts.

We propose to use the fuzzy measure introduced by Garcia-Pardo et al. (2021), which allows evaluating the degree to which an individual is left behind through the assessment of shortfalls of individuals relative to the ‘best-performing’ ones. This measure enables us to obtain a score of inequality at the individual level through the perspective of LNOB. We start by defining a fuzzy set (Zadeh, 1965) for each dimension (continuous or non-continuous) as being left behind in income, material deprivation, and work intensity. Thus, we assign each individual a degree of belonging to each set by using a membership function with values between 0 and 1. Specifically, we use fuzzy sets

defined from the population set, U , to interval unit, $LB_h: U \rightarrow [0, 1]$, with the following membership function for individual $i \in U$ in the dimension h as

$$LB_h(i) = \frac{\sum_{j=i+1}^k (x_j - x_i)}{k \eta_h} = 1 - L(F(x_i)) - \frac{x_i}{\eta_h} (1 - F(x_i)), \quad (1)$$

where x_i is the value of dimension h for individual i , and values are ranked in ascending order, $0 \leq x_1 \leq x_2 \leq \dots \leq x_k$. We study k individuals, and η_h is the average value of x . $F(x_i)$ is the distribution function and $L(F(x_i))$ is the value of the Lorenz curve for individual i (i.e., the cumulative share in the dimension h of the bottom $\frac{i}{k}$ %). This membership function provides a proper measure to quantify the extent to which individuals are left behind as it is the average of the relative shortfalls of an individual's achievements in a specific dimension with respect to other individuals with better achievements divided by the average achievement in that dimension.

It is worth noting that this membership function in (1) is closer to 1 when individual i is more left behind. That is, individual i is more left behind the greater the proportion of individuals with better achievements, $1 - F(x_i)$; the greater the share of the individuals with better achievements, $1 - L(F(x_i))$; and, given a share and proportion of individuals with better achievements, the lower the relative value of the variable with respect to the mean, $\frac{x_i}{\eta_h}$. Thus, an individual is totally left behind in a dimension if the assigned membership function is 1; that is, the individual is at the bottom of the distribution. On the other hand, the individual is not left behind at all if the assigned membership function is 0; that is, the individual leads the distribution. Likewise, it should be noted that the extent to which an individual is left behind complements the information on the level of achievement in the sense that even if an individual has a low level of achievement, the individual may be at the top of the distribution.

This approach is directly implementable when working with continuous dimensions, such as income or work intensity. However, when working with non-continuous dimensions (material deprivation in our case), we first need to transform the non-continuous dimension into a continuous dimension (see García-Pardo et al., 2021).

Our income variable is real household equivalised disposable income.² Work intensity is the ratio of the total number of months that all working-age household

² The equivalised disposable income is the total income of a household, after tax and other deductions, that is available for spending or saving, divided by the number of household members converted into equalised

members have worked during the income reference year and the total number of months the same household members theoretically could have worked in the same period. This includes individuals from 0–59 years living in households where the adults are those aged 18–59 but excluding students aged 18–24. To evaluate material deprivation, the enforced inability of nine items is analysed: to pay unexpected expenses; afford a one-week annual holiday away from home; a meal involving meat, chicken or fish every second day; the adequate heating of a dwelling; durable goods like a washing machine, colour television, telephone or car; and being confronted with payment arrears (mortgage or rent, utility bills, hire purchase instalments or other loan payments).³

Once we compute the extent to which each individual is left behind in each specific dimension (denoted as LB_{inc} , LB_{md} and LB_{wi}), the information for each one should be combined across dimensions, thus permitting an unambiguous ranking of individuals in the population. With this aim, we follow the AROPE philosophy. We aggregate these three fuzzy sets using the union criteria, that is, the maximum value of the degree an individual is left behind in each of the three dimensions. Thus, for all individuals $i \in U$

$$LB(i) = \max(LB_{inc}(i), LB_{md}(i), LB_{wi}(i)). \quad (2)$$

As before, an individual is totally ‘left behind’ if $LB(i) = 1$; that is, the individual is at the bottom of the ranking in any of the dimensions. An individual is not left behind at all if the LB measure is 0 in all dimensions; that is, the individual leads the ranking in all dimensions. Otherwise, the degree to which an individual is left behind will be between 0 and 1, and the closer to 1, the more left behind the individual.

To summarise the information on the degree to which individuals in one country are left behind, we use the average of the individual LB scores as a scalar, which provides information on how much citizens are left behind. When we summarise by one scalar the information on the degree to which individuals in a bloc (WE or CEE) are left behind, a

adults; household members are equalised or made equivalent by weighting each one according to their age, using the so-called OECD-modified equivalence scale. The equalised disposable income is imputed to all individuals of the same household. Incomes over the 99th percentile are attached the value of this percentile to nuance the effect of extreme incomes.

³ Note that we use the definitions of the three dimensions of AROPE established for the Europe 2020 strategy and not for the Europe 2030 targets. The AROPE rate was modified only in 2021 in accordance with the new objectives of the Europe 2030 Strategy. In the new indicator, work intensity and material deprivation have been modified, but data are only available from 2014.

population-weighted average of country LB scores is computed, giving more importance to more populated countries.

It should be noted that the LB measure complements the information on the rate of multidimensional poverty but does not replace it.⁴ In this line, the LB measure could be used to complement information on the AROPE or, for instance, on other eventual measures based on Alkire and Foster's (2011a, 2011b) methodology. Note also that the LB_h measure defined in (1) verifies several axioms which are desirable properties of a fuzzy set to measure the LNOB principle in a dimension h (for more details, see Bárcena-Martín and García-Pardo, 2022).

Finally, to analyse the competing drivers of the degree individuals are left behind, we estimate the following ordinary least squares (OLS) regression:

$$LB(i) = \beta_i X_i + \gamma_c + u_i, \quad (3)$$

where $LB(i)$ is a continuous variable that measures the extent to which an individual is left behind, X_i are individual socio-demographic characteristics, γ_c are country fixed effects, and u_i is the error term.

3. Results

3.1. Comparing CEE and WE blocs of countries

The average degree to which individuals in CEE countries were left behind in a multidimensional setting (LB; Table 1) decreased from 0.42 to 0.37 over the period 2007–2019. During this time, the CEE countries caught up with the LB of the WE countries, which practically did not change over the period.⁵ By dimensions, this same pattern is reproduced: the extent to which individuals were left behind decreased in the CEE bloc while it barely changed in the WE bloc, with the exception of LB for work intensity, which decreased in both blocs but more smoothly in the CEE bloc, such that the average LB for work intensity in the CEE countries was lower than that of the WE countries in 2019.

⁴ We refer the interested reader to García Pardo et al. (2021) for a comparison between the AROPE rate and the overall LB measure by country.

⁵ This result is robust to the aggregation method used. See Appendix.

Table 1. Average multidimensional LB and average LB by dimension for CEE and WE blocs, 2007 and 2019.

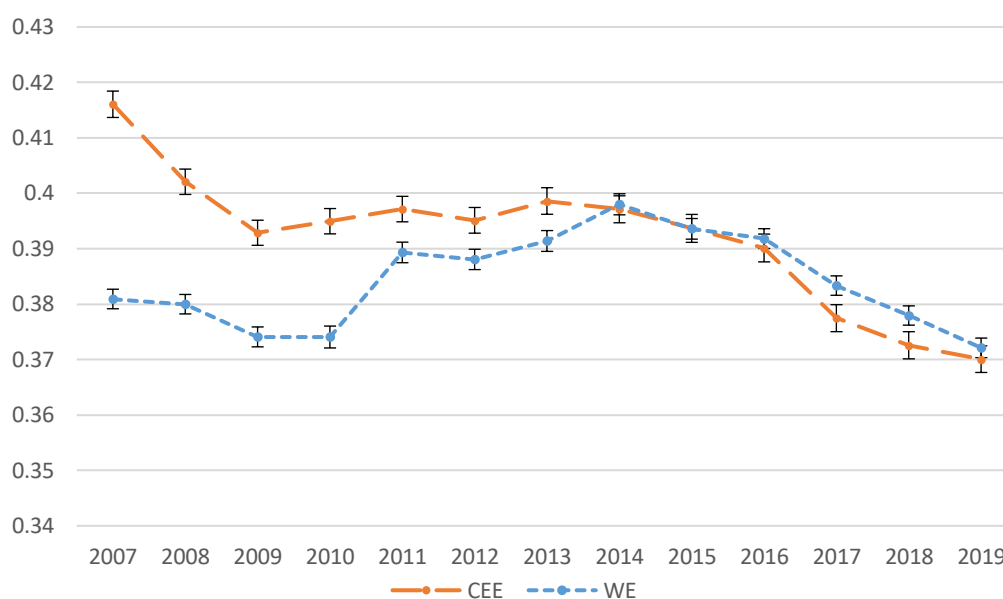
	CEE bloc		WE bloc	
	2007	2019	2007	2019
<i>LB</i>	0.416 (0.4137, 0.4184)	0.370 (0.3677, 0.3725)	0.381 (0.3809, 0.3827)	0.372 (0.3721, 0.3739)
<i>LB_{inc}</i>	0.317 (0.3153, 0.3189)	0.294 (0.2920, 0.2958)	0.285 (0.2836, 0.2862)	0.285 (0.2836, 0.2862)
<i>LB_{mp}</i>	0.111 (0.1096, 0.1122)	0.071 (0.0701, 0.0722)	0.058 (0.0572, 0.0585)	0.061 (0.0602, 0.616)
<i>LB_{wi}</i>	0.280 (0.2769, 0.2823)	0.216 (0.2135, 0.2188)	0.257 (0.2565, 0.2586)	0.233 (0.2313, 0.2354)

Note: (1) $LB = 0.381$ for the WE bloc in 2007 means that the average LB of individuals in the WE countries is 0.381. (2) Confidence intervals (95%) are shown in parentheses.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset (2007 and 2019).

The evolution of the LB in both blocs was not homogeneous over the period 2007–2019 (Figure 1). Although the LB in both blocs dropped from 2007 until 2009, the rate of decrease was higher for the CEE bloc and did not reach the levels of the WE bloc due to the CEE's worse starting situation (0.416 for CEE vs. 0.381 for WE countries). As a consequence of the Great Recession, LB worsened in both blocs from 2009 until 2014. The rate of increase was higher in the WE bloc, reaching levels similar to those of the CEE bloc in 2014, 2015, and 2016. After 2016, LB declined in both blocs but at a higher rate in the CEE bloc in 2017 and at a lower rate afterwards, so that both blocs reached levels similar to those of 2007 in the WE bloc (0.37). Hence, a certain process of convergence involving a reduction in LB occurred in the CEE bloc while the WE bloc remained at values similar to those of 2009, thus confirming the convergent trend in the socioeconomic dynamics between the CEE and WE countries also in terms of LB. In sum, the process of convergence between the CEE and WE blocs is the result of the worsening level individuals were left behind in the WE bloc after the financial crisis, together with a continued reduction in the degree individuals were left behind in the CEE bloc.

Figure 1. Multidimensional LB evolution by bloc, 2007–2019



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset (2007–2019).

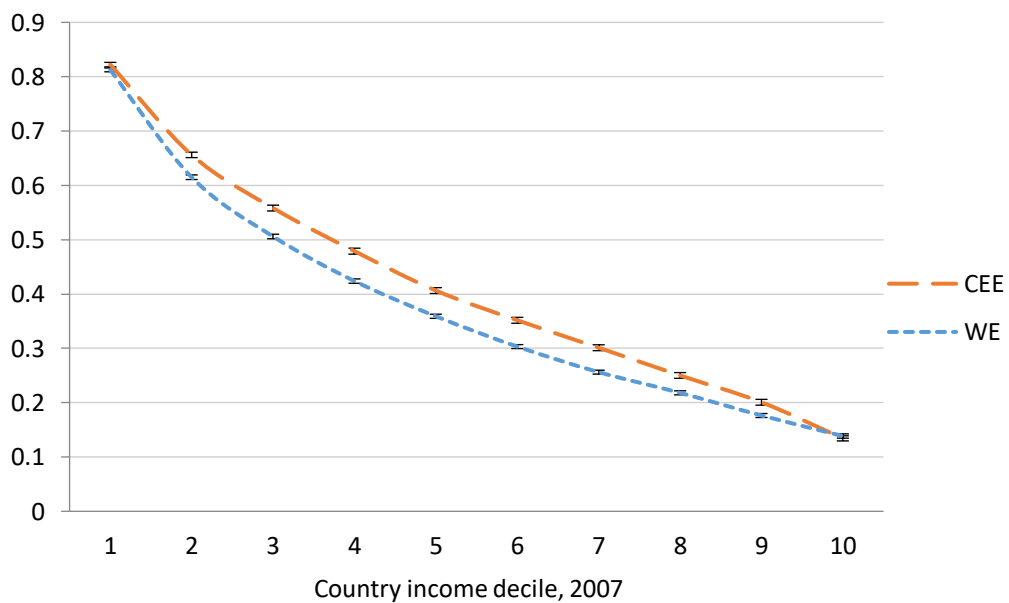
We now replicate our analysis by dimension (see Figure A2 in the Appendix). In general, LB was greater in the CEE than the WE bloc, except for work intensity from 2014 due to the marked reduction in LB in the CEE bloc in the labour sphere. In this vein, work intensity can be regarded as the key dimension driving the reduction in multidimensional LB in the CEE countries, with improvements in employment in these countries much higher than those in the WE countries.

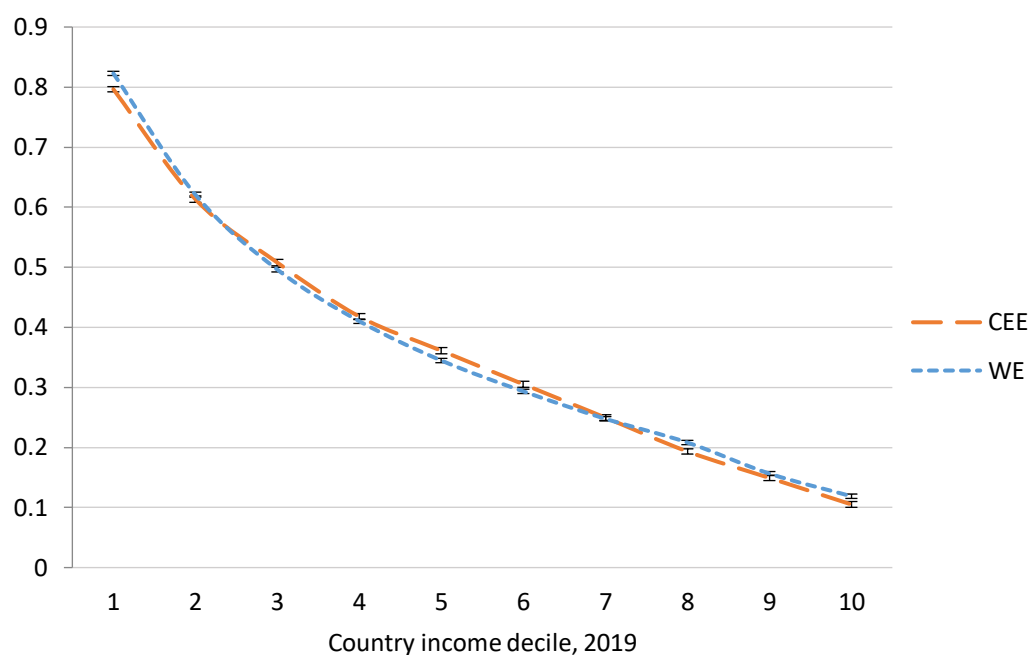
Focusing on the first and last years of the period (2007 and 2019), Figure 2 displays LB by income decile. As expected, LB decreased in both blocs as the level of income increased. In 2007, LB was greater for the CEE than for the WE countries in all deciles except for the tails (i.e., the first and tenth deciles) where LB was similar. In other words, individuals left behind in both blocs differed except in the tails, where they were equally left behind. This result suggests that the middle part of the distribution and not only the lower tail deserves attention in terms of LNOB. Specifically, it is important to highlight that the situation of the middle segments of the distribution was clearly better in the WE than in the CEE bloc at the beginning of the period. However, this changed notably in 2019 when the degree individuals were left behind was very similar along the distribution in both blocs and similar to the LB of the WE bloc in 2007. More precisely, the degree of LB in 2019 was slightly but significantly higher in the WE bloc than in the

CEE bloc for the first, eighth, and tenth deciles, while the opposite occurred in the fifth decile, with no remarkable differences for the rest of the deciles.

As Figures A3 and A4 in the Appendix show, the degree individuals were left behind by dimension also differs by decile in both blocs. For 2007, Figure A3 shows that individuals from the CEE bloc at different levels of income and for all three dimensions were always further behind than those from the WE bloc, except for the first and last deciles in work intensity. Likewise, we can infer that the closer degree of LB in the two tails of the multidimensional LB distribution is related to the situation in the work intensity dimension. Figure A4 in the Appendix highlights that the degree individuals were left behind in 2019 converged in both blocs in all dimensions, except for the extreme deciles in work intensity, where individuals of the WE bloc were more left behind. Thus, when computing the multidimensional LB, work intensity seems to drive the higher degree individuals are left behind in the WE in the extreme deciles.

Figure. 2. Multidimensional LB by income decile, 2007 and 2019.





Notes: (1) Vertical lines represent 95% confidence intervals. (2) LB = 0.82 in 2019 for the first income decile of the WE bloc, indicating that the average LB of all individuals in the first decile of their corresponding countries in the WE bloc is 0.82.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Given that our methodological approach allows us to disaggregate by individuals' socio-demographic characteristics, we can examine whether the degree an individual is left behind is closely linked to some specific socio-demographic aspects. To this end, we consider household type, owned home, and the number of children in the household as household characteristics of interest that might be related to the degree of LB. Furthermore, since the dimensions of LB are computed at the household level, we also control for socio-demographic characteristics of the household (gender, age, health, level of education, part-time work, etc.). Previous studies have shown these variables to be closely correlated with aspects related to 'left behind' status such as poverty (see, for instance, Kyzyma 2020, Bárcena-Martín et al. 2021).

To ensure that the sample of individuals is representative of the population of both the CEE and WE blocs of the EU, we apply non-rescaled cross-sectional individual weights throughout our analysis.

Table 2. Ordinary least squares of LB by blocs, 2019.

	CEE bloc OLS	WE bloc OLS
Gender – % women in the household	0.036*** (0.010)	0.031*** (0.005)
Age		
% younger than 25 in the household	0.059*** (0.012)	0.103*** (0.019)
% older than 59 in the household	-0.043 (0.031)	0.033 (0.021)
Health – % chronically ill in the household	0.038*** (0.008)	0.022*** (0.007)
Level of education		
% tertiary educated in the household	-0.306*** (0.068)	-0.196*** (0.020)
% secondary educated in the household	-0.124* (0.055)	-0.083*** (0.014)
% part-time work among working members	0.162** (0.060)	0.065*** (0.007)
% immigrants in the household	0.038*** (0.011)	0.085*** (0.013)
Single-parent household	0.066*** (0.014)	0.068*** (0.007)
Multigenerational household	-0.019 (0.018)	0.007 (0.029)
House owned	-0.023** (0.007)	-0.071*** (0.006)
Number of children	0.079*** (0.007)	0.058*** (0.012)
Country dummies	Yes	Yes
Observations	37,084	74,223
R-squared	0.222	0.195

Notes: (1) References to categorical variables are as follows: not single-parent household, not multigenerational household, household not owned. (2) ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. (3) Standard errors are shown in parentheses.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset (2019).

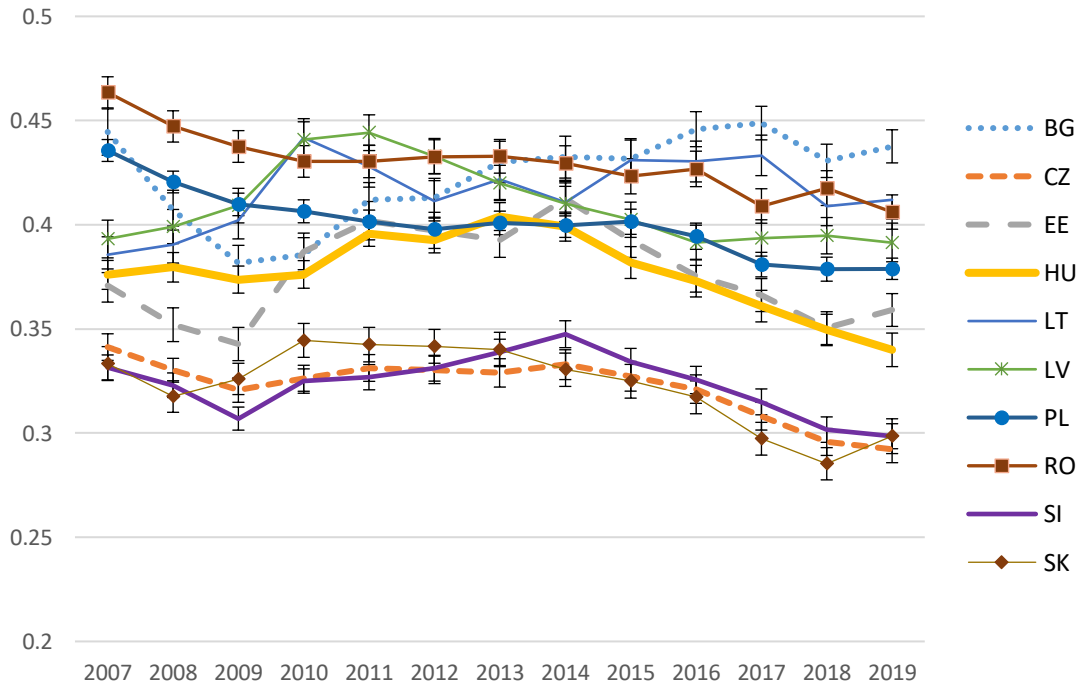
Table 2 shows similar results in the CEE and WE blocs, albeit with some noteworthy nuances. In both cases, women, young people, the chronically ill, part-time work, single-parent household, and number of children are associated with higher degrees of being left behind. Likewise, LB decreases in households with a secondary and tertiary educational level compared to a primary level of education, although with less intensity in the CEE bloc, and in households that own their house, but with greater intensity in the WE bloc. However, living in a multigenerational household and the proportion of individuals older than 60 in the household have no effect on the degree of LB and show

similar outcomes in terms of characteristics of left-behind individuals in both groups of countries at the end of the period under study.

3.2. Comparison across CEE countries

In addition to differences between the CEE and WE country blocs, there is a notable heterogeneity between countries within each bloc. In this section we focus on CEE countries to highlight their main dissimilarities in terms of LB. Figure 5 displays the evolution in the overall LB measure of the ten countries of the CEE bloc over 2007–2019 to assess the extent to which progress has been widely distributed and has reached the least favoured individuals in each country. Two non-overlapping groups can be identified. The first comprises the Czech Republic, Slovenia, and Slovakia, which were in a better situation than the rest of countries for the entire period. Moreover, these countries showed a decreasing pattern in LB over the period with a steeper decrease from 2014. The other group displays greater average levels of LB over the period analysed with Romania – the country that left people behind to a greater extent from 2007 to 2009 – and Bulgaria, which exhibited the greatest LB from 2016 to 2019.

Figure 5. Multidimensional LB evolution by CEE countries, 2007–2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

From a unidimensional point of view (see Figure A5 in the Appendix), we observe that the division into two groups is also perfectly valid for income. Nonetheless, while the Czech Republic and Slovenia still showed the lowest values of LB for material deprivation (this is no longer the case for Slovakia, although the country had low LB values), at the other extreme, Romania and Bulgaria are always the two countries where people were more left behind in terms of material deprivation, together with Lithuania at the end of the period, with marked differences with respect to the rest of the countries of the CEE bloc. In general, there is a decreasing trend in LB for material deprivation over the period, except for Lithuania. Overall, the three Baltic countries, which have neoliberal policy frameworks, saw increases in the LB for material deprivation in the years following the Great Recession.

Finally, as regards work intensity, the countries' positions are less stable over the period and exhibit changing patterns, with an overall decreasing trend in LB for work intensity in all countries. Bulgaria, Romania, and Poland showed the greatest average levels of LB in work intensity from 2016, while Latvia joined this group in 2019 (see Table 3 on the average multidimensional LB and average LB by dimension for CEE countries in 2007 and 2019).

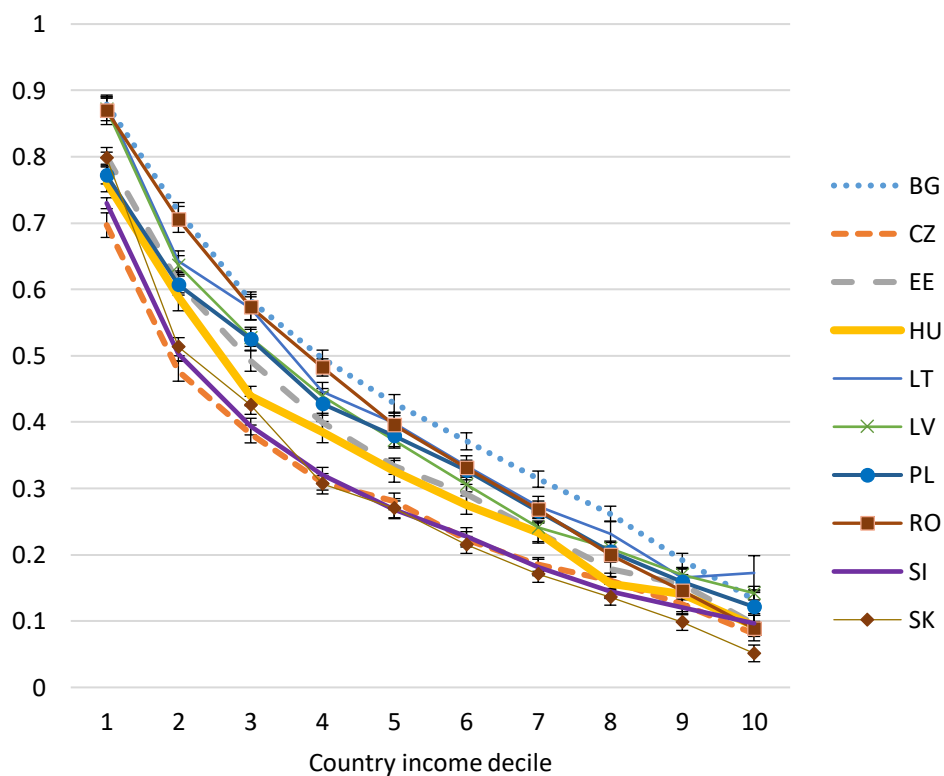
Table 3. Average multidimensional LB and average LB by dimension for CEE countries, 2007 and 2019.

	BG	CZ	EE	HU	LT	LV	PL
2007							
<i>LB</i>	0.4445 (0.4333, 0.4555)	0.3413 (0.3348, 0.3476)	0.3708 (0.3629, 0.3788)	0.3759 (0.3689, 0.3829)	0.3856 (0.3770, 0.3942)	0.3931 (0.3841, 0.4022)	0.4356 (0.4304, 0.4409)
<i>LB_{inc}</i>	0.3432 (0.3343, 0.3521)	0.2490 (0.2447, 0.2532)	0.3116 (0.3049, 0.3183)	0.2555 (0.2510, 0.2600)	0.3320 (0.3246, 0.3394)	0.3403 (0.3322, 0.3483)	0.3238 (0.3199, 0.3277)
<i>LB_{mp}</i>	0.1975 (0.1886, 0.2064)	0.0683 (0.0655, 0.0701)	0.0668 (0.0633, 0.0701)	0.0975 (0.0942, 0.1008)	0.0988 (0.0941, 0.1035)	0.1036 (0.0986, 0.1086)	0.0944 (0.0921, 0.0967)
<i>LB_{wi}</i>	0.3268 (0.3142, 0.3393)	0.2477 (0.2404, 0.2550)	0.2180 (0.2090, 0.2270)	0.2821 (0.2742, 0.2901)	0.2176 (0.2080, 0.2272)	0.2175 (0.2074, 0.2275)	0.2991 (0.2930, 0.3052)
2019							
<i>LB</i>	0.4376 (0.4297, 0.4455)	0.2922 (0.2858, 0.2987)	0.3591 (0.3512, 0.3669)	0.3400 (0.3319, 0.3480)	0.4120 (0.4027, 0.4212)	0.3915 (0.3822, 0.4008)	0.3789 (0.3737, 0.3839)
<i>LB_{inc}</i>	0.3836 (0.3768, 0.3905)	0.2262 (0.2215, 0.2308)	0.2894 (0.2827, 0.2960)	0.2711 (0.2646, 0.2775)	0.3419 (0.3341, 0.3498)	0.3260 (0.3183, 0.3337)	0.2792 (0.2756, 0.2827)
<i>LB_{mp}</i>	0.1221 (0.1166, 0.1277)	0.0396 (0.0373, 0.0419)	0.0879 (0.0834, 0.0925)	0.0726 (0.0690, 0.0762)	0.1384 (0.1316, 0.145)	0.0737 (0.0695, 0.0778)	0.0512 (0.0496, 0.0528)
<i>LB_{wi}</i>	0.2396 (0.2302, 0.2489)	0.1803 (0.1730, 0.1877)	0.1821 (0.1735, 0.1906)	0.1840 (0.1752, 0.1928)	0.2127 (0.2020, 0.2232)	0.2232 (0.2124, 0.2339)	0.2341 (0.2282, 0.2400)

Source: Authors' calculations based on the EU-SILC cross-sectional dataset (2007 and 2019).

Figure 6 presents LB by income decile for each country in 2019, revealing diverse reduction patterns by countries as the income decile increases. All countries show a steeper reduction in LB between the first and fourth deciles. However, while the reduction is smoother between the fourth and tenth deciles in countries such as Slovenia, Latvia, and the Czech Republic, the most remarkable decrease is observed for Slovakia. As in Figure 5, two groups of countries can be clearly distinguished, with the Czech Republic, Slovenia, and Slovakia showing the lowest levels of LB along the income distribution except in the first and last deciles (extremes of the income distribution). This reflects a significant difference in the LB of citizens in the intermediate class (fourth to seventh deciles) compared to the rest of the CEE countries. On the other hand, Bulgaria again exhibits the highest levels of LB from the fourth decile onwards, except for the last decile. The contribution of each dimension to LB by income deciles is shown in Figure A6.

Figure 6. Multidimensional LB by income decile, 2019.

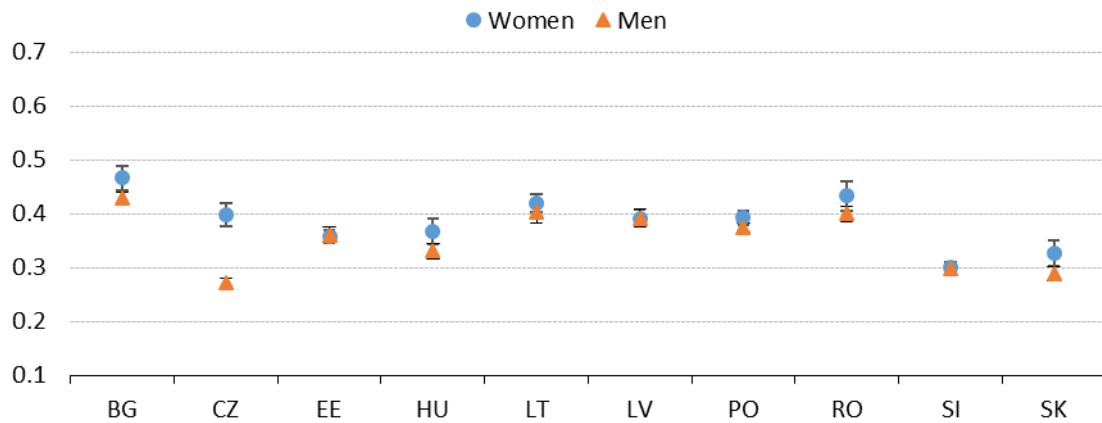


Notes: (1) Vertical lines represent 95% confidence intervals. (2) LB = 0.7 for the first income decile of the Czech Republic, indicating that the average degree of all individuals in the first decile in the Czech Republic is 0.07.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

We will now try to answer the question on the extent to which the socio-demographic characteristics of those left behind differ between individuals across countries. To this end, we first examine the average degree individuals were left behind considering socio-demographic characteristics by country in 2019 and then estimate an OLS regression for LB according to these socio-demographic characteristics.

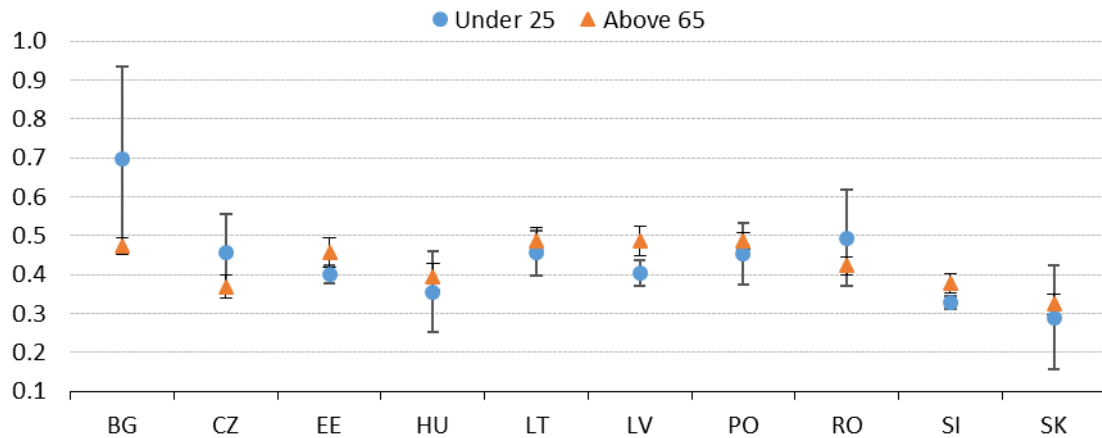
Figure 7. LB by gender, 2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

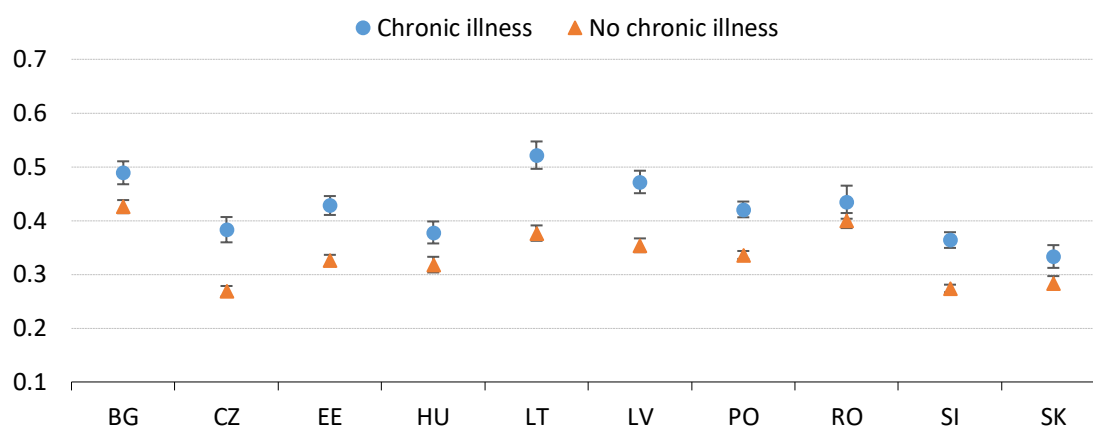
Figure 8. LB by age, 2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Figure 9. LB by chronic illness, 2019.



Note: Vertical lines represent 95% confidence intervals.

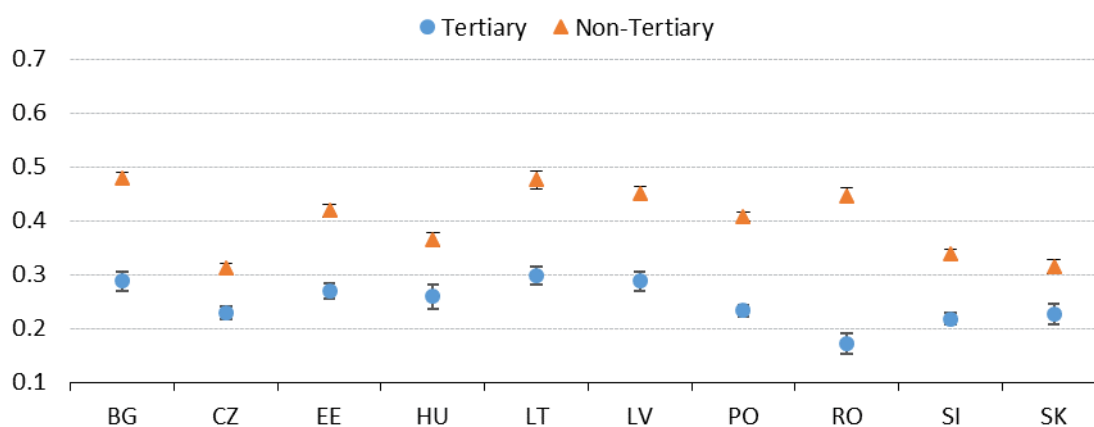
Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Figure 7 shows the average degree to which women and men were left behind. As LB is built on household income and most households are composed of adult men and women, we do not expect significant gender differences in the degree to which individuals were left behind. Nonetheless, significant gender differences are found for the Czech Republic, where women were more left behind than men.

As regards the age of the household members (Figure 8), the presence of individuals aged less than 25 is, on average, associated with lower degrees of being left behind in all countries except Bulgaria, the Czech Republic, and Romania.

Moreover, as can be observed, the chronically ill were left significantly further behind in all the countries of this bloc (Figure 9) with Lithuania being the country with the highest degree of leaving behind its chronically ill.

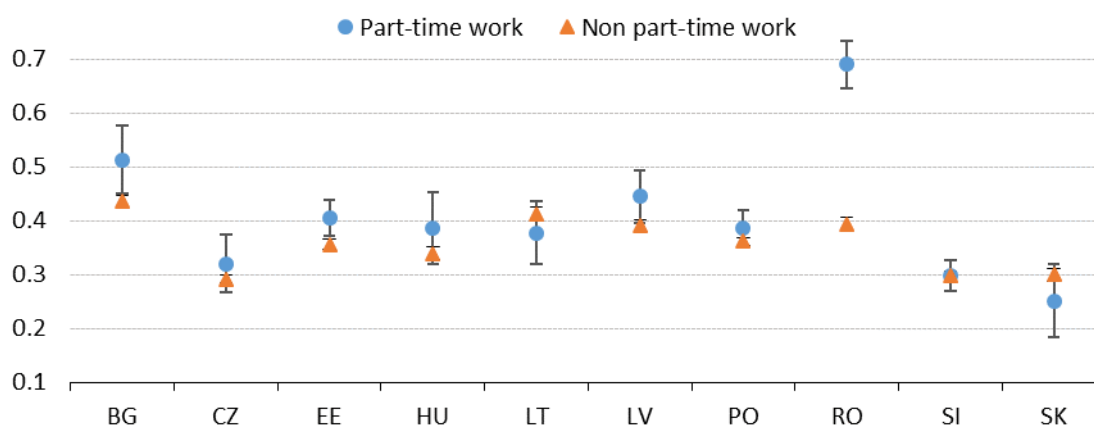
Figure 10. LB by education, 2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Figure 11. LB by type of work, 2019.



Note: Vertical lines represent 95% confidence intervals.

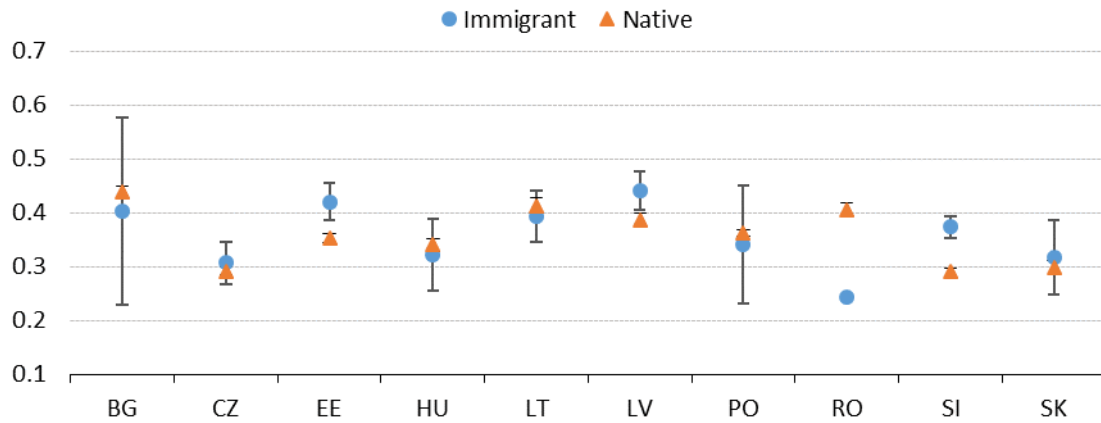
Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Individuals with a lower educational level (Figure 10) show a higher degree of being left behind. It is noteworthy that in terms of type of work (Figure 11), people in Romania who work part-time were the furthest behind.

Regarding other socioeconomic characteristics (see Figures 12 to 16), as a general rule, immigrants, people living in a multigenerational household, not owning a house, and living in a single-parent household or in a household with children are associated with being left more behind than in the other types of households. Some exceptions should be noted. In terms of immigration, Romania stands out because natives lagged further behind than immigrants. Nonetheless, we should be cautious in interpreting these results, given

the limitations of the dataset in the coverage of migrant populations. By design, EU-SILC targets the whole resident population and not specifically migrants, particularly in countries with a small migrant population.

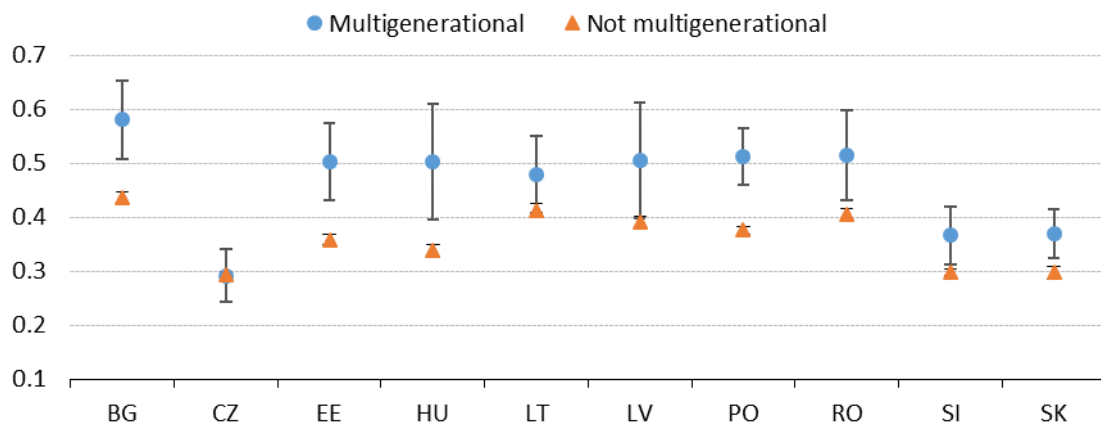
Figure 12. LB by immigrant status, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

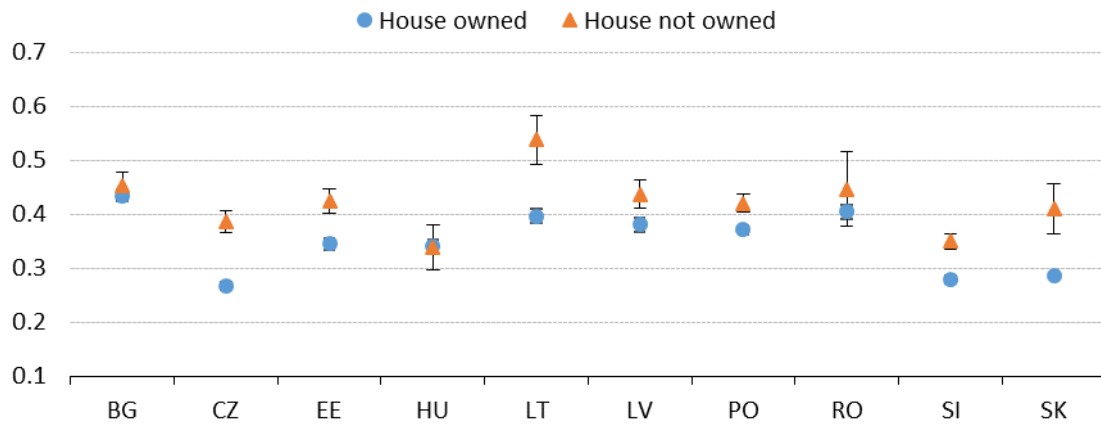
Figure 13. LB by individuals living in multigenerational households, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

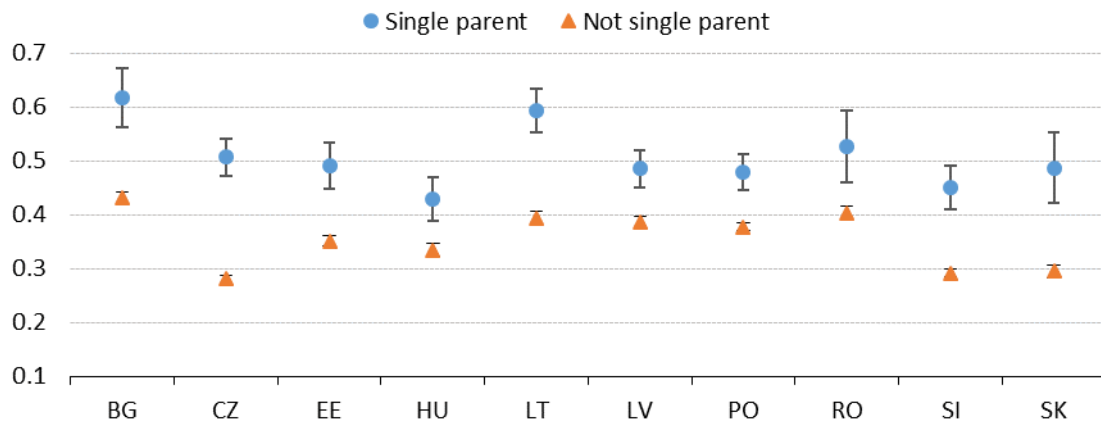
Figure 14. LB by homeowners, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

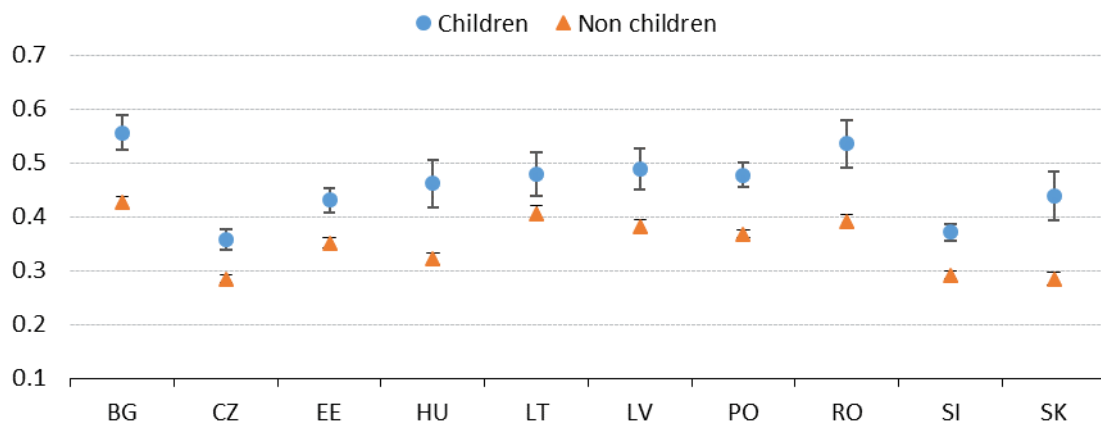
Figure 15. LB by people who live in single-parent household, 2019.



Notes: Vertical lines represent 95% confidence intervals

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Figure 16. LB by household with children, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Lastly, we present the estimates of our regression analysis of the degree to which individuals were left behind in each country controlling for socio-demographic characteristics. Table 4 shows that, for all countries, a greater proportion of women, chronically ill persons, part-time workers, number of children in the household, and living in a single-parent household are associated with higher degrees of being left behind.

Table 4. OLS regression of the degree individuals were left behind by countries, 2019.

	Bulgaria (BG)	Czech Republic (CZ)	Estonia (EE)	Hungary (HU)	Lithuania (LT)	Latvia (LV)	Poland (PL)
Gender – % women in the household	0.042** (0.020)	0.063*** (0.015)	0.012 (0.017)	-0.004 (0.024)	0.055*** (0.020)	0.048*** (0.018)	0.015 (0.018)
Age							
% younger than 25 in the household	0.032 (0.031)	0.054** (0.021)	0.045** (0.020)	-0.004 (0.027)	0.005 (0.030)	-0.005 (0.026)	0.005 (0.026)
% older than 60 in the household	0.016 (0.022)	0.026 (0.026)	0.103*** (0.029)	-0.010 (0.030)	-0.024 (0.033)	0.080*** (0.029)	-0.010 (0.029)
Health – % chronically ill in the household	0.027 (0.017)	0.053*** (0.013)	0.042*** (0.011)	0.015 (0.015)	0.041* (0.021)	0.057*** (0.013)	0.015 (0.013)
Level of education							
% tertiary educated in the household	-0.523*** (0.025)	-0.526*** (0.154)	-0.068 (0.047)	-0.381*** (0.071)	-0.218*** (0.048)	-0.276*** (0.047)	-0.068 (0.047)
% secondary educated in the household	-0.330*** (0.024)	-0.447*** (0.153)	0.101** (0.048)	-0.273*** (0.070)	-0.031 (0.048)	-0.099** (0.047)	0.101** (0.048)
% part-time work among working members	0.156*** (0.024)	0.055 (0.042)	0.129*** (0.018)	0.054** (0.024)	0.118*** (0.030)	0.168*** (0.023)	0.055 (0.023)
% immigrants in the household	0.045 (0.062)	0.002 (0.023)	0.090*** (0.020)	0.007 (0.047)	0.045 (0.030)	0.023 (0.022)	0.002 (0.022)
Single-parent household	0.097*** (0.027)	0.111*** (0.015)	0.100*** (0.016)	0.069*** (0.018)	0.127*** (0.018)	0.075*** (0.016)	0.097*** (0.016)
Multigenerational household	-0.015 (0.027)	-0.028 (0.025)	-0.019 (0.028)	-0.015 (0.036)	-0.007 (0.030)	0.011 (0.057)	-0.015 (0.057)
House owned	-0.018 (0.011)	-0.047*** (0.010)	-0.068*** (0.010)	0.019 (0.014)	-0.067*** (0.016)	-0.032*** (0.011)	-0.018 (0.011)
Number of children	0.078*** (0.017)	0.070*** (0.012)	0.079*** (0.012)	0.110*** (0.018)	0.044** (0.018)	0.096*** (0.019)	0.078*** (0.019)
Observations	3,564	3,047	3,627	3,228	2,596	2,569	8,000
R-squared	0.282	0.151	0.199	0.110	0.224	0.216	0.110

Notes: (1) References to categorical variables are as follows: not single-parent household (marital status), not multigenerational household (house). (2) ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. (3) Standard errors are shown in parentheses.

4. Conclusions

This study has examined the level at which individuals have been left behind in Central and Eastern versus Western EU Member States (CEE and WE countries, respectively) in a multidimensional setting that jointly addresses income, material deprivation, and work intensity. Our approach to compute the degree to which an individual is left behind is based on a fuzzy measure, thus going beyond traditional overall inequality measures and allowing us to obtain a quota of inequality at the individual level from the perspective of the principle of LNOB of the 2030 Sustainable Development Agenda.

We provide a comparative analysis between the CEE and WE blocs and across the former CEE socialist states. We analyse the period 2007–2019 after the accession of these countries to the EU and years after the transition from non-democratic regimes to liberal democracies and from centrally planned economies to market economies. We highlight that individuals in CEE countries were more left behind in 2007, even though they considerably reduced the extent to which they were left behind over the period examined and converged towards values similar to those of WE countries. This occurred especially during the second half of the 2010s due to the greater extent individuals were left behind after the 2007–2008 financial crisis in the WE bloc. These findings corroborate the well-known negative effects of the Great Recession on economic inequality and the policy responses to it, particularly in some WE countries, including large countries such as Italy and Spain. By dimensions, the reduction in the degree individuals have been left behind in work intensity in the CEE bloc is particularly remarkable, even reaching lower levels than those of the WE countries since 2014.

By country income decile, we observe that, while at the beginning of the period examined the central deciles of the WE countries were less left behind in all dimensions, there are no significant differences between blocs by deciles in 2019. Nevertheless, if we compare dimensions, we observe that, while the LB for income and material deprivations in the CEE countries remained slightly greater than the LB for WE countries in all deciles, the level of LB for work intensity in the CEE countries becomes lower in the extreme deciles, thus driving up the overall level of LB for the extreme deciles of the WE countries. This seems to point to a greater importance of sources of income other than labour (i.e. cash benefits for the poor and capital income for the rich) in the degree of falling behind of the extreme deciles for the WE countries. In contrast, the reduction in

the degree individuals lag behind in work intensity in the CEE countries plays a highly significant role throughout the entire income distribution, including the extreme segments.

To compare key socio-demographic characteristics, we also analyse the extent to which such characteristics of the left behind differ between both blocs of countries. We find that women, the chronically ill, part-time work, single-parent households, and number of children display higher degrees of LB in both blocs. Likewise, in both cases the degree of LB decreases with a higher educational level, although with less intensity in the Eastern bloc for secondary education. LB also decreases with being a homeowner, although with greater intensity in the Western bloc. These findings corroborate the growing convergence in socioeconomic dynamics between the CEE and WE countries, highlighting how systematic disadvantages that leave or threaten to leave some groups of society behind in both blocks tend to be similar.

As for differences in the degree individuals have been left behind in the former CEE socialist states, our results reveal that Slovenia (which has a neo-corporatist capitalist system similar to that of Austria, Switzerland, or Germany) and Slovakia and the Czech Republic (both Visegrád countries with neoliberalism models constrained to some extent by state regulation and social protection or 'embedded' neoliberalism) are the countries where individuals are less left behind over the period analysed. This conclusion applies for all income deciles. By contrast, Romania and Bulgaria – likely the most politically and institutionally differentiated states of the CEE region without a defined profile of capitalism although closer to the liberal models of the Baltic nations – are the countries where individuals were most left behind at the beginning and end of the period, respectively. In 2019, Bulgarian individuals were also the most left behind in all deciles, together with Romania in lower deciles.

This research opens new paths in this analysis of economic inequality at the individual level beyond aggregate measures and its potential to examine profiles of individuals lagging further behind in relation to a given institutional and policy framework. In this regard, challenging extensions of this paper would allow examining in depth for a specific CEE country how institutional and policy reforms, in the framework of a model of capitalism, might affect the degree to which different profiles of individuals are left further behind.

Our approach may have some limitations. In computing the LB measure, we collect data at household level and attach the same degree of being left behind to each member of the household. This approach assumes that resources are equally shared among members of the households and does not consider intra-household disparities. This might not be a problem for indicators of material deprivation (which arguably do not vary across household members), but it is a problem for income which gets divided up among members. In the absence of individual-level income data, we look at what we can learn from assuming shared positive (or negative) effects of achieving (or not achieving) certain outcomes. As all members of the household are assigned the same LB level or score and intra-household disparities are ignored, we could consider the results a lower benchmark.

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Appendix

Robustness

In this work, we consider the union of fuzzy sets as the way to aggregate information in our composite indicator, which is the maximum degree of LB of the three dimensions following the philosophy supporting the AROPE (see Equation (2)). Nevertheless, there are multiple ways to formulate a composite indicator of multidimensional poverty with fuzzy sets.

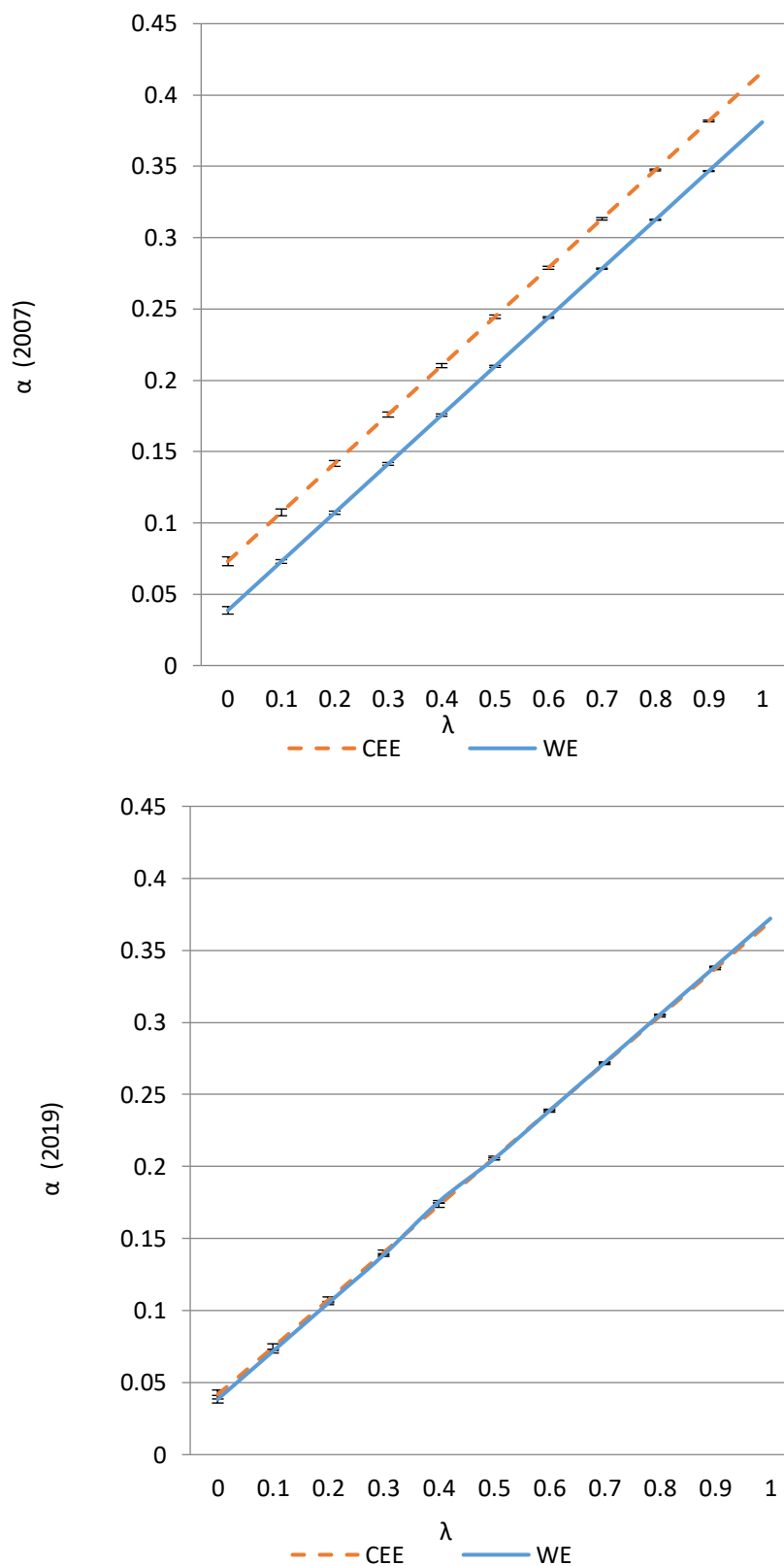
We propose other alternatives to aggregate the information across dimensions: the intersection of fuzzy sets and combinations of the intersection and union criterion. The intersection of fuzzy sets is defined as the mapping $\beta: U \rightarrow [0,1]$ as follows $\beta(i) = \min(LB_{inc}(i), LB_{md}(i), LB_{wi}(i))$. Thus, we propose two alternative value judgements and mixed positions in between them. Let us define $\lambda \in [0,1]$ and the mapping $\gamma: U \rightarrow [0,1]$ for all individuals i as:

$$\alpha(i) = \lambda \max(LB_{inc}(i), LB_{md}(i), LB_{wi}(i)) + (1 - \lambda) \min(LB_{inc}(i), LB_{md}(i), LB_{wi}(i))$$

The intersection criterion allows for partial compensation between dimensions and captures the worst value achieved by an individual whereas the union criterion does not allow for compensation but rather reflects the best value achieved by the individual. It is possible to find many different value judgements in between. In this section we check the robustness of the ranking of blocs of countries considering a wide range of aggregation alternatives. Figure A1 shows the values of LB by bloc in 2007 and 2019, respectively, for different value judgements. The judgements range from the worst value ($\lambda = 0$) or minimum degrees (intersection criterion) to the best value ($\lambda = 1$) or maximum degrees (union criterion). In the middle there are intermediate criteria, which are a linear combination of the union and intersection criteria ($0 < \lambda < 1$).

The blocs show a robust order. Thus, we do not expect our results to change under other aggregation criteria. As expected, the ranking of countries changes depending on the aggregation criterion used. Nonetheless, we can obtain robust conclusions for an intermediate combination of criteria, which can be very informative for policy purposes.

Figure A1. LB by country under different aggregation methods, 2007 and 2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

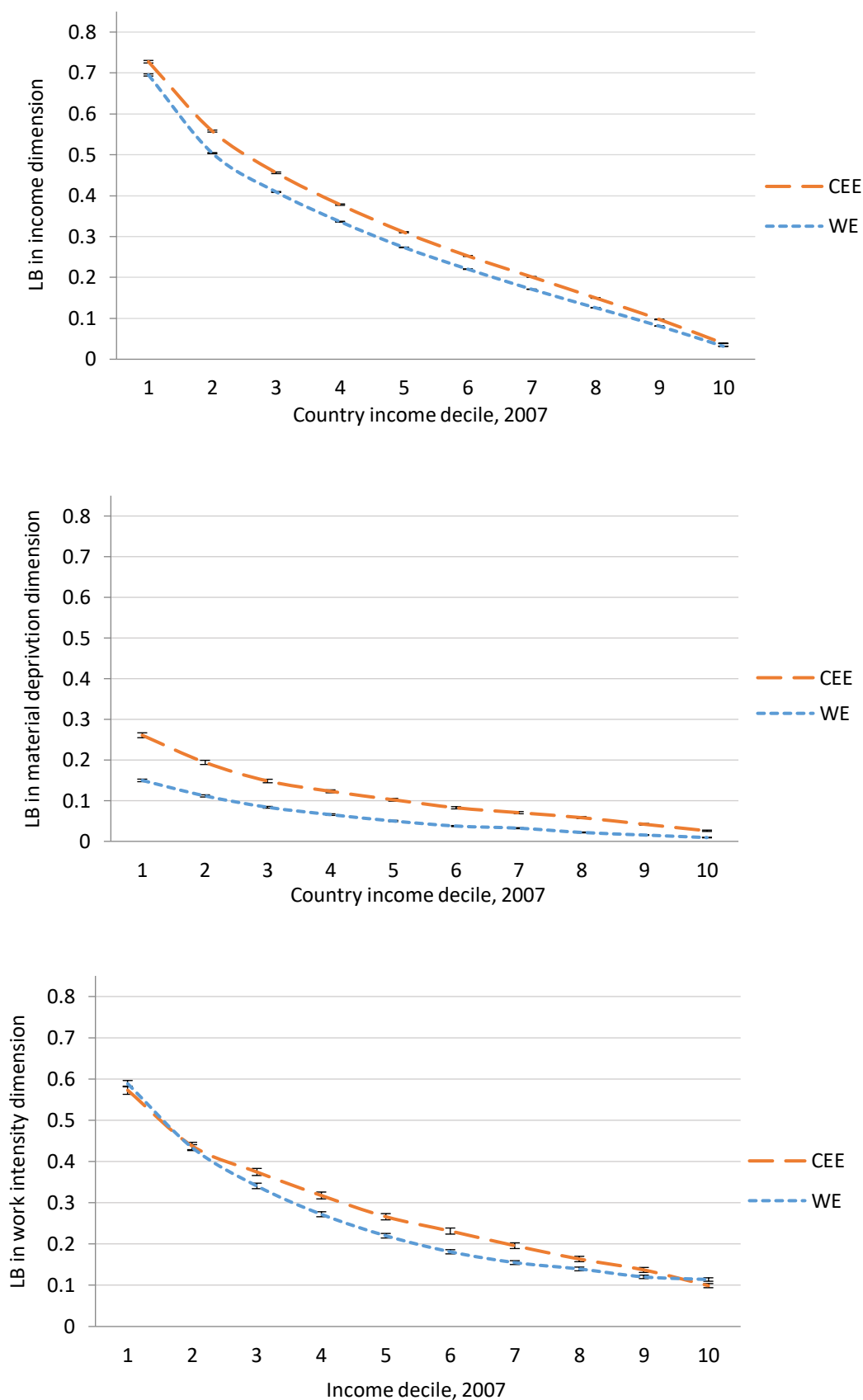
Figure A2. LB evolution by dimensions and blocs, 2007–2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset (2007-2019).

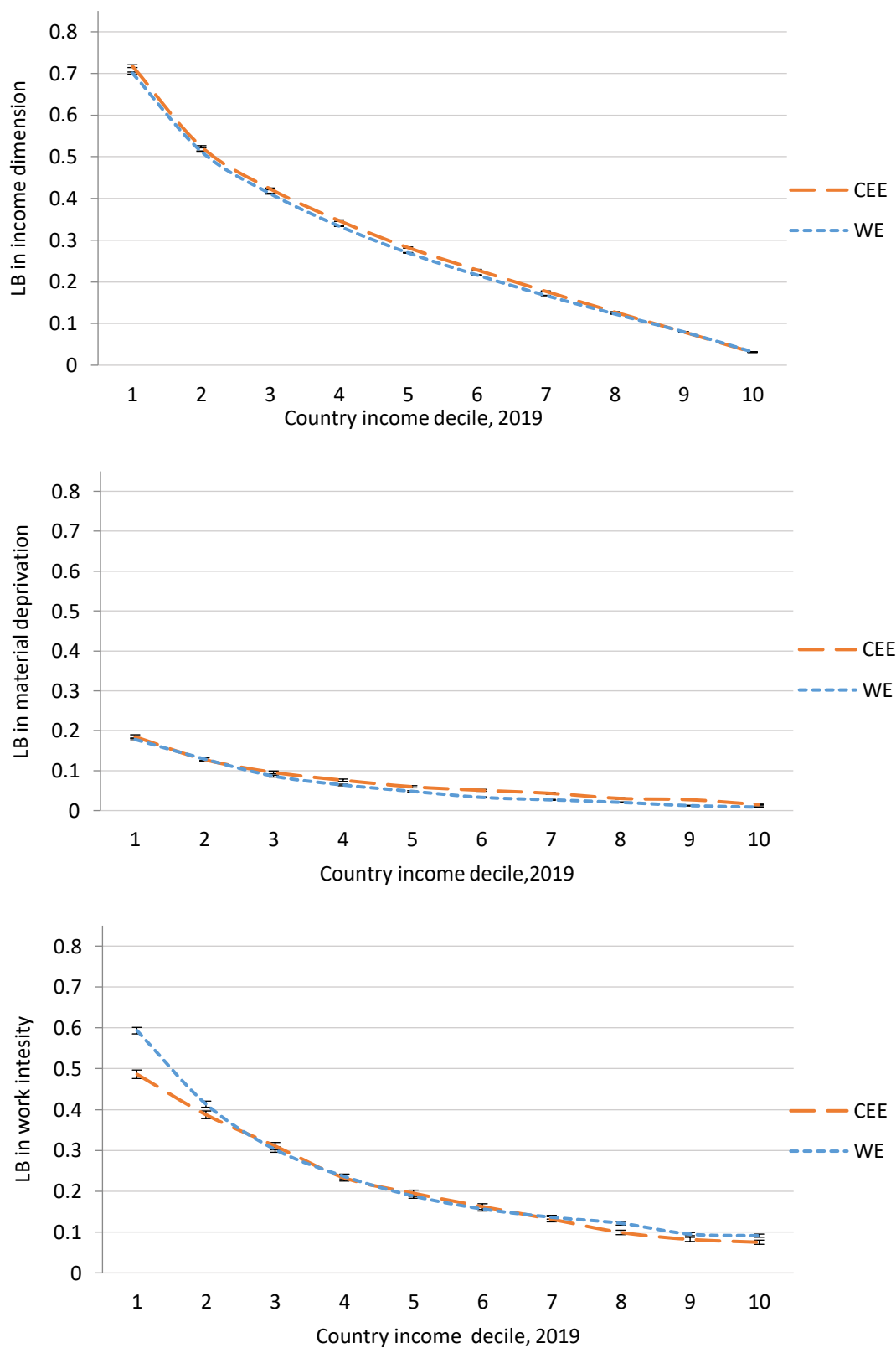
Figure A3. LB by dimensions and blocs by country income decile, 2007.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

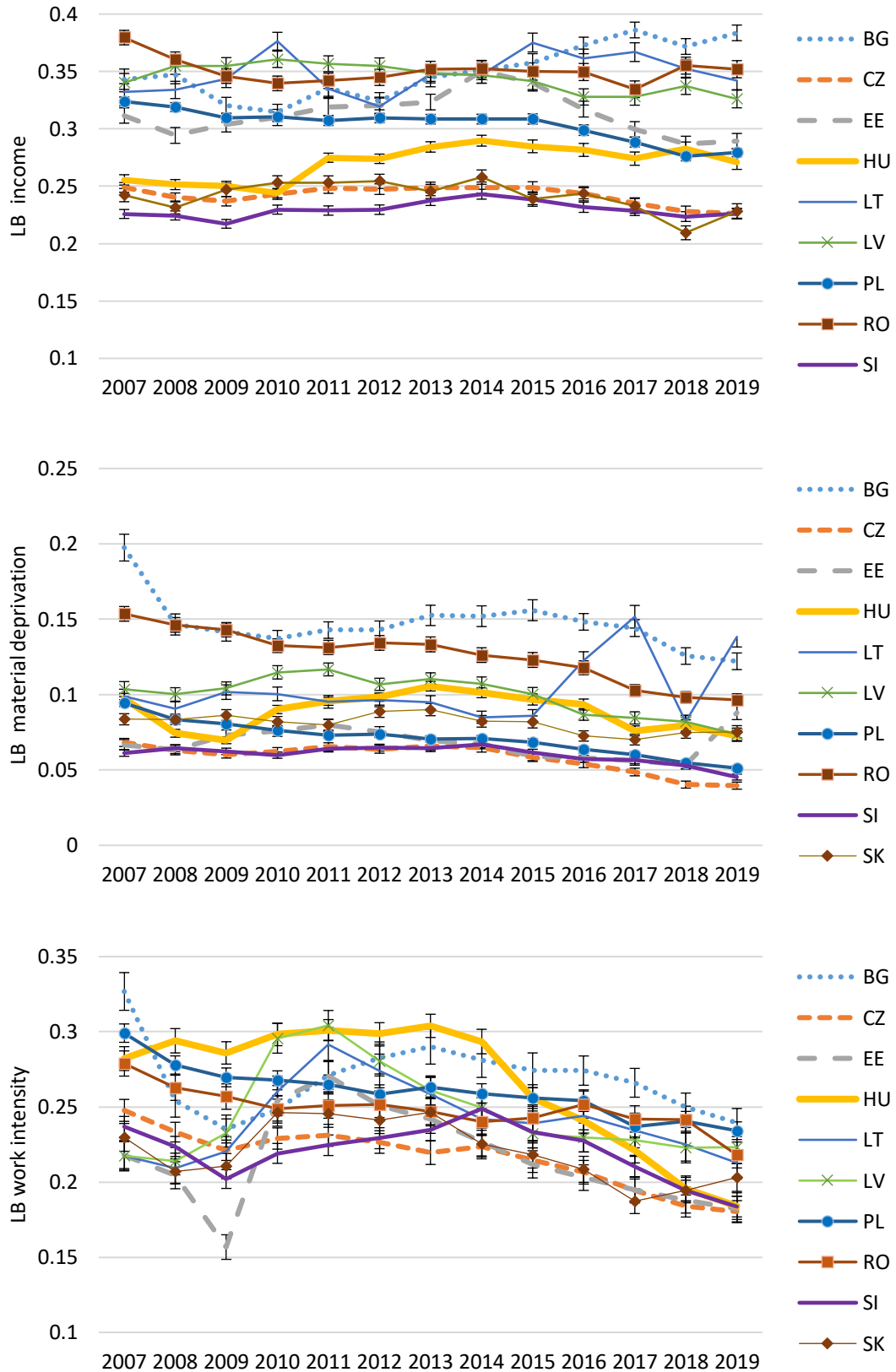
Figure A4. LB by dimensions and blocs by country income decile, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

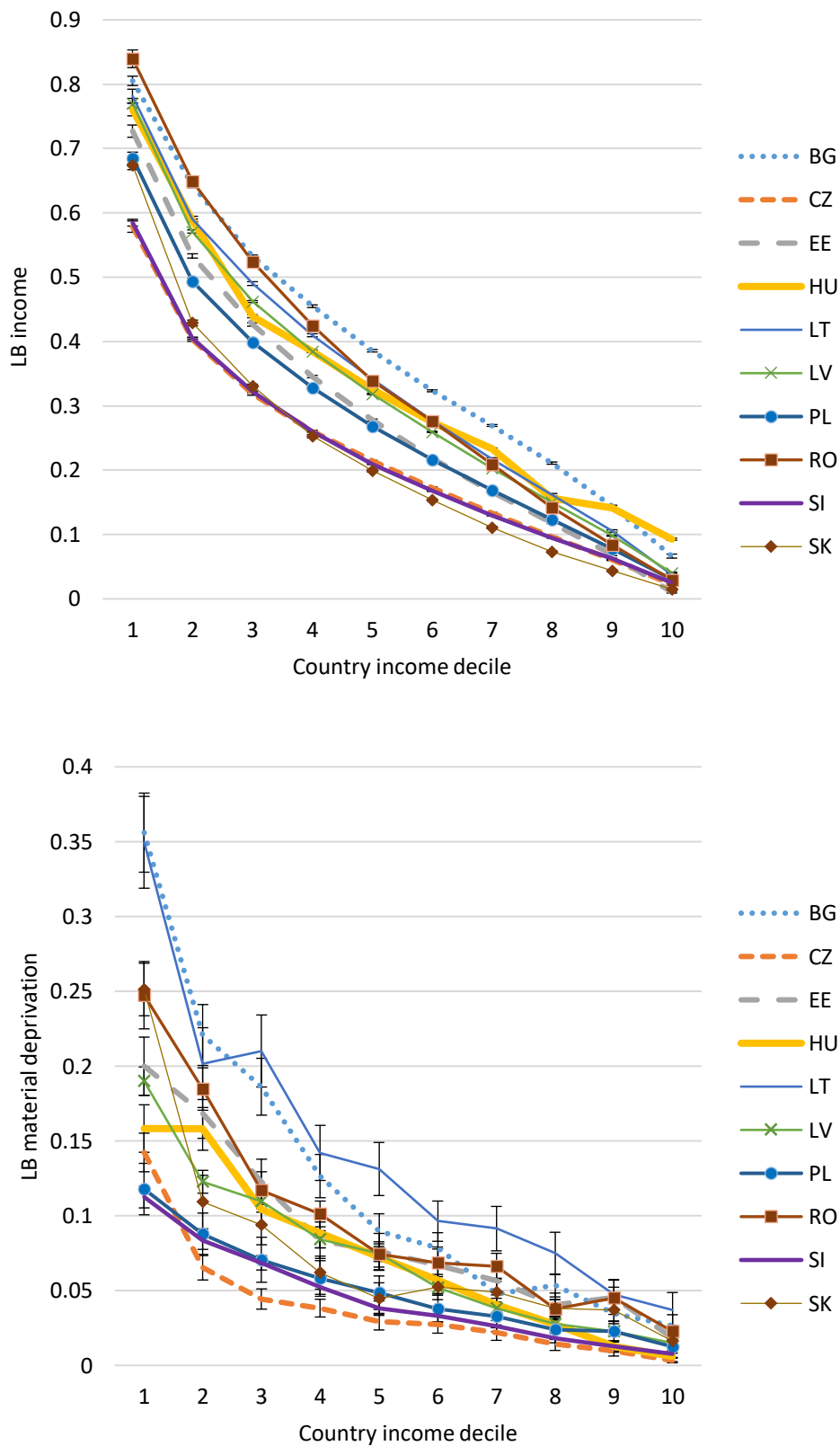
Figure A5. LB evolution by dimensions and CEE countries, 2007–2019.



Note: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

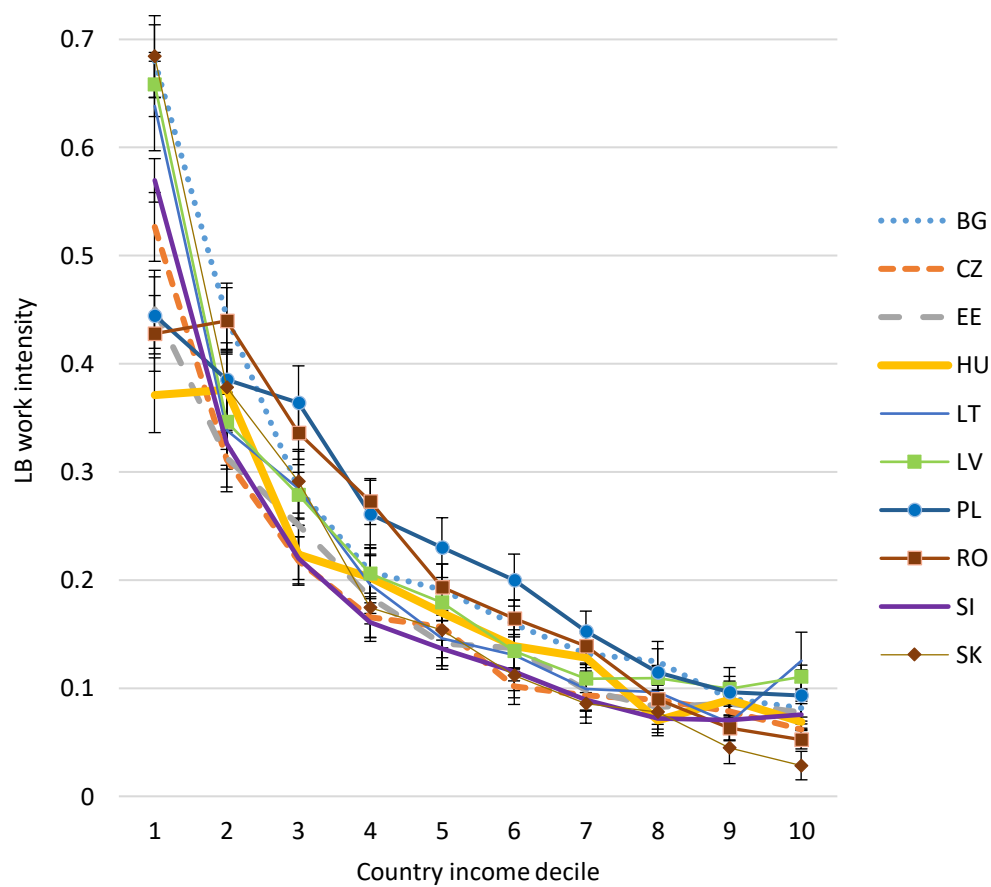
Figure A6. LB of each dimension and CEE countries by country income decile, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Figure A6 (cont.). LB of each dimension and CEE countries by country income decile, 2019.



Notes: Vertical lines represent 95% confidence intervals.

Source: Authors' calculations based on the EU-SILC cross-sectional dataset.