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A comparative analysis on how much individuals are left behind in the former state socialist countries of the European Union

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ABSTRACT

This paper examines the extent to which individuals from the former state socialist countries of the EU's Central and Eastern European (CEE) countries have been left behind compared to the rest of EU individuals from Western European (WE) countries and across countries within the CEE bloc. To this end, a fuzzy approach is applied to a multidimensional setting made up of income, material deprivation, and work intensity to measure the 'Leaving no one behind' (LNOB) principle of the 2030 Sustainable Development Agenda. A certain process of convergence is found between both blocs of countries over the period 2007–2019 due to a decrease in the level individuals were left behind in the CEE countries, as well as an increase in the level individuals were left behind in the WE countries in the years following the 2007–2008 financial crisis. Significant cross-country disparities in the degree individuals lag behind are also revealed among the CEE countries related to the different models of post-socialist capitalism established in these countries and their subsequent development after joining the EU.

1. Introduction

Equality is one of the central features of state socialism. In most former state socialist countries that are now member states of the EU (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia joined in 2004; Bulgaria and Romania in 2007; and Croatia in 2013), income distribution was relatively egalitarian at the end of state socialism, although this does not mean that there was not a certain hidden inequality (Henderson et al., 2008). Around 1989, the estimates of income inequality for centrally planned European economies 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 centrally planned economies and non-democratic regimes to market economies and liberal democracy and the implementation of structural reforms as a condition for EU membership involved important distributional consequences, although with remarkable differences across countries (Alvaredo and Gasparini, 2015; Perugini and Pompei, 2016). Apart from the retrenchment of the redistributive state, increments in income inequality were related to the processes of privatisation, liberalisation, restructuration, and foreign investment penetration. This created opportunities for some individuals or groups to accumulate wealth faster than others and implied decentralised wage setting, resulting in a more disperse wage distribution (Ferreira, 1999; Mitra and Yemtsov, 2007; Brzezinski, 2018).

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Some two decades after the accession to the EU of the former state socialist countries, it is worth addressing the differences and evolution in the levels of inequality of these Central and Eastern European (CEE) countries, but going deeper than traditional aggregate measures of inequality. Specifically, we aim to gauge the extent to which individuals are left behind through comparisons with the rest of EU individuals and among individuals of former state socialist countries. For this purpose, we rely on the ‘Leaving no one behind’ (LNOB) principle of the 2030 Sustainable Development Agenda and its measure introduced by [García-Pardo et al. \(2021\)](#) to compute the extent to which individuals are left behind, understood as relative deprivation of the individuals. The measurement of the degree to which an individual is left behind is approached through a multidimensional setting that focuses on the three dimensions used to monitor the EU 2030 target on income and living conditions: income, material privation, and labour intensity. This strategy allows obtaining a quota of inequality at the individual level (or contribution of each individual to inequality) from the perspective of LNOB, thus going beyond overall inequality measures to assess how much each individual is left behind in each dimension and all dimensions jointly.

This research thus examines differences in the level to which individuals are left behind in the former centrally planned CEE countries of the EU compared to the rest of EU individuals from the so-called Western European (WE) countries over the period 2007–2019, that is, since Romania and Bulgaria joined the EU to the onset of the pandemic crisis. Let us recall that the CEE countries include 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 countries cover the remaining 16 EU countries.² This way, our contribution to the literature on the comparative analysis of multidimensional inequality, which usually relies on overall measures of inequality, focuses on providing novel evidence for a comparative analysis of individuals’ contribution to inequality through the perspective of LNOB for both blocs of countries and for each CEE country. To the best of our knowledge, this has not yet been addressed in the literature. Specifically, this work aims 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 parts of the income distribution of CEE and WE countries lag behind? And across CEE countries? Are there connections between the different degrees to which individuals are left behind across CEE countries and the diverse models of post-socialist capitalism developed in each country?

The remainder of the paper is structured as follows. [Section 2](#) reviews the distinct models of post-socialist capitalism across CEE countries and some stylized facts on inequality. [Section 3](#) presents the data and methodology. [Section 4](#) provides and discusses the empirical results. Finally, some conclusions are provided in the last section.

2. Models of post-socialist capitalism and inequality

Although each CEE country’s path has been unique in their transitions to democracy and market economies and later adaptation processes for accession to the EU, there exist broad similarities and dissimilarities across nations that allow differentiating between the models of capitalism among post-socialist CEE countries of the EU.

In general terms, there is a substantial body of literature that provides diverse frameworks and categorisations to understand the variety of capitalist models. Originally, the comparative analysis of capitalism models was confined to Western countries. Some of the pioneering works in this line include, for example, [Esping-Andersen \(1990\)](#) focused on welfare regimes, or [Hall and Soskice \(2001\)](#), which introduced a multidimensional institutional approach to study varieties of market economies. In the context of the EU, two of the most comprehensive studies that extended this multidimensional institutional approach were [Amable \(2003\)](#) and later [Farkas \(2011, 2016\)](#), who incorporated post-socialist CEE countries of the EU in her categorisation. Traditionally, the literature has characterised the EU according to five types of capitalism: Continental, Anglo-Saxon, Scandinavian (or Nordic), Mediterranean, and the CEE countries, although frequently acknowledging that these categories might be further split (see, e.g., [Nadobán, 2023](#)). Regarding the CEE countries, the well-known taxonomy proposed by [Bohle and Greskovits \(2012\)](#) is usually considered as a key reference in the literature on models of post-socialist capitalism in Central and Eastern Europe.³ These authors jointly assess dimensions such as democracy, government, welfare state, macroeconomic coordination, market efficiency, and corporatism and identify four different types of post-socialist capitalism across CEE countries belonging to the EU. Specifically, the pure neoliberal model of the Baltic States (in alignment with the fundamentals of neoliberal economic principles); the ‘embedded’ neoliberal type represented by the Visegrád countries and Croatia (with greater social spending and the search for balances between market reforms and social cohesion); the neo-corporatist capitalism of Slovenia (characterised by multi-level rules of negotiation and dialogue between business, employees and the state, and substantial social programmes); and the undefined profiles of capitalism of the South-Eastern European countries such as Bulgaria and Romania, which, although with their own specific characteristics, are more similar to the liberal models of the Baltic nations than the other models.

On the basis of these different models of market economies across CEE countries and from the perspective of interpersonal inequality, we hypothesise that individuals from the Baltic and South-Eastern States (Estonia, Latvia, Lithuania, Bulgaria, and Romania) are expected to present the greatest degrees of being left behind across CEE countries, given the greater emphasis of the institutional architecture of these countries on free-market mechanisms and their lower levels of welfare provision.

¹ Note that Croatia is not included in our analysis due to the lack of available data for the entire period examined here.

² As can be understood, this country classification does not correspond exactly to geographic criteria, but whether the country is a former socialist state economy. Thus, for example, Greece, which is geographically in Eastern Europe, is included as a WE country.

³ For a survey of the most representative theoretical and empirical studies in the ‘comparative capitalism’ literature in Central and Eastern Europe, see, for example, [Rapacki et al. \(2020\)](#).

Obviously, after the CEE countries' accession to the EU, the respective variants of capitalism of each CEE country have continued to evolve, with different responses by governments to new political and economic challenges in the framework of globalisation and European integration (see, e.g., [Jasiiecki, 2020](#)). Probably the most substantial reforms have been introduced in the Baltic republics and in Hungary and Poland, while other countries have maintained their institutional and policy approach without such significant alterations. During the second decade of the 21st century, the Baltic republics significantly advanced in the development of pro-market institutions and policies to create a business-friendly regulatory environment and more flexible labour markets in conjunction with a small welfare state. Meanwhile, Hungary and Poland have experienced remarkable political and economic changes, deviating from the paths of liberal democratic development and combining a higher centralisation of the economy with generous social transfer programmes (see, e.g., [Lendvai-Bainton and Szelewa, 2021](#)).

Likewise, distributional patterns have evolved quite differently across the CEE countries. According to the empirical literature, by the time these countries joined the EU in the 2000s, they already presented significant differences in income inequality levels. While a six-country cluster – Estonia, Lithuania, Latvia, Bulgaria, Romania, and Hungary – had experienced a large increase in inequality and monetary poverty in the years prior to accession to the EU, the increase was smaller in other countries such as the Czech Republic, Slovakia, Poland and Slovenia (see, for instance, [Tóth and Medgyesi, 2011](#); [Aristei and Perugini, 2012](#)). Later, during the Great Recession, the distributional impacts of the crisis and political responses differed significantly across CEE countries, with remarkable increases in income inequality measured by the Gini index in Bulgaria, Estonia, Hungary, and Slovenia, mainly by reducing full-time employment (see, e.g., [Brzezinski, 2018](#)). This process was clearly reverted during the recovery that followed the Great Recession in countries such as Slovakia and Poland, with a notable reduction in inequality and poverty supported by strong job creation and redistributive programmes. Meanwhile, inequality and poverty continued to rise in economies such as Bulgaria and Lithuania (see, e.g., [Medgyesi and Tóth, 2021](#); [Petrova and Sznajder Lee, 2023](#)).

Such events have prompted us to explore the degree to which individuals are left behind in a multidimensional setting across CEE countries as a preliminary step for our cross-country comparative analysis. More specifically, we assess the extent to which individuals from the former state socialist states of the EU as a whole are left more or less behind than those of the WE countries and how these differences have evolved over time. The aim is to determine whether the hypothesis of convergence between both blocs widely addressed in other economic and social spheres (see, e.g., [Vaughan-Whitehead, 2019](#); [European Commission, 2020](#); [Jasiiecki, 2020](#)) also applies to the degree to which individuals are left behind in a composite context.

3. Data and methodology

Our aim is to study the degree to which individuals are left behind in a multidimensional setting considering the three dimensions used to monitor the EU 2030 target on income and living conditions: income, material deprivation, and work intensity. These three policy-relevant dimensions, which are included in the At Risk of Poverty or Social Exclusion (AROPE) index,⁴ provide a holistic view of individuals' socioeconomic status, covering aspects related to economic resources (income), access to basic necessities (material deprivation), and employment situation (work intensity). 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 offers a standardised dataset on income and other sociodemographic variables at both household and individual levels. This dataset is particularly notable for its consistency across countries, enabling sound comparisons across diverse social contexts.

We propose to use the fuzzy measure introduced by [García-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, that is, the relative deprivation of each individual. This measure enables us to obtain the contribution to inequality of each individual 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, correspondingly. 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

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

where x_i is the value of dimension h for individual i , and values are ranked in ascending order, $0 \leq x_{h1} \leq x_{h2} \leq \dots \leq x_{hk}$. We study k individuals, and η_h is the average value of x_h . $F(x_{hi})$ is the distribution function and $L(F(x_{hi}))$ 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 possible 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.

⁴ There exists an extensive body of literature both supporting and expressing concerns regarding the AROPE index. Proponents emphasize its utility as a comprehensive measure capturing various dimensions of disadvantage within the EU context. However, numerous critics have raised significant concerns regarding the coherence, arbitrariness, and overall usefulness of the index, highlighting potential limitations in capturing nuanced aspects of poverty and social exclusion, the need for careful consideration of the index's implications for policy formulation and interpretation, as well as challenges associated with the aggregation of diverse dimensions (see, for instance, [Nolan and Whelan, 2018](#); [Guio, 2023](#)).

It is worth noting that this membership function in Eq. (1) is closer to 1 when individual i is more left behind. The degree to which an individual is left behind is related to the proportion of individuals with better achievements, $1 - F(x_{hi})$, and to the proportion of the achievements of people in a better position than individual i , $1 - L(F(x_{hi}))$. Moreover, given a share and proportion of individuals with better achievements, the lower the relative value of the variable with respect to the mean, $\frac{x_{hi}}{\eta_h}$ the more left behind. 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. Thus, an individual with a low level of achievement can be not distant from better-performing individuals, resulting in a low $LB(i)$. Alternatively, the individual can be distant from better performing individuals, leading to both a low level of achievement and a high $LB(i)$.

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 Online appendix 3).

Our income variable is real household equivalised disposable income.⁵ Work intensity is the ratio of the total number of months that all working-age household 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 (categories) 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).⁶

Once we compute the extent to which each individual is left behind (or is relatively deprived) 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 use a stringent aggregation method that does not allow compensation across dimensions. We aggregate these three fuzzy sets using the union criterion, which reflects the highest value attained by the individual. Specifically, it represents the maximum degree to which an individual is left behind in each of the three dimensions.⁷ This aggregation method aligns with well-known multidimensional indicators, among others, the mentioned AROPE index. Let us recall that in this index those who meet any of the thresholds (union criterion) are identified as multidimensionally poor, so that a deficit in one dimension is a sufficient condition to be AROPE.

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 degree of left behind 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 in a specific dimension, we compute the average of $LB_h(i)$ in that dimension, that is, the mean relative deprivation in such a dimension, and denote it as LB_{inc} , LB_{md} and LB_{wi} , respectively. To summarise the information on the degree to which individuals in one country are left behind in a multidimensional setting, LB , we use the average of the degree individuals are left behind, $LB(i)$. Finally, when we summarise the information on the degree to which individuals in a bloc (WE or CEE) are left behind, a population-weighted average of the mean degree of left behind by country 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 provided by AROPE, but does not replace it. Thus, individual i classified as AROPE can have a low level of LB because even though i is below at least one of the thresholds, i is not distant from better performing individuals. Or, otherwise, individual i classified as not AROPE can have a high level of LB because, even though i is above all the thresholds, i is distant apart from better performing individuals.⁸ In this line, the LB

⁵ 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 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.

⁶ 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.

⁷ As we are aware of the implication of using different methods of aggregation, in Online appendix 4 we provide a robust check of the ranking of countries considering a wide range of aggregation alternatives.

⁸ We refer the interested reader to Online appendix 1 for country-level statistics of the raw indicators (income, material deprivation, and work intensity) and the average degree of being left behind, as well as the AROPE rate for 2007 and 2019 (first and last year of analysis). We also explain the differences between AROPE and $LB(i)$ and discuss the comparison between the AROPE rate and the overall LB measure by European country in Online appendix 2.

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

	CEE bloc		WE bloc	
	2007	2019	2007	2019
LB	0.416 (0.4137, 0.4184)	0.370 (0.3677, 0.3725)	0.381 (0.3809, 0.3827)	0.372 (0.3721, 0.3739)
LB_{inc}	0.317 (0.3153, 0.3189)	0.294 (0.2920, 0.2958)	0.285 (0.2836, 0.2862)	0.285 (0.2836, 0.2862)
LB_{md}	0.111 (0.1096, 0.1122)	0.071 (0.0701, 0.0722)	0.058 (0.0572, 0.0585)	0.061 (0.0602, 0.616)
LB_{wi}	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 (EU-SILC, 2007, 2019).

measure could be used to complement information supplied by AROPE or, for instance, by other eventual measures based on Alkire and Foster's (2011a, 2011b) methodology. Note also that the LB_h measure defined in Eq. (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).

4. Results

4.1. 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), or mean relative deprivation, 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.⁹ 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. The only exception is 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.

The evolution of the LB in both blocs was not homogeneous over the period 2007–2019 (Fig. 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).¹⁰ 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.

We now replicate our analysis by dimension (see Figure A3 in Online appendix 5). 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), Fig. 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 more similar. In other words, individuals in both blocs differed in the extent to which they were left behind, except individuals in the tails. 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

⁹ This result is robust to the aggregation method used. See Online appendix 4.

¹⁰ There is a close relationship between confidence intervals and significance tests. Specifically, if the 95 % confidence intervals for LB measures do not overlap, the statistics are significantly different at the 0.05 level. Whenever the 95 % confidence intervals for LB measures do overlap, the statistics are not significantly different at the 0.05 level.

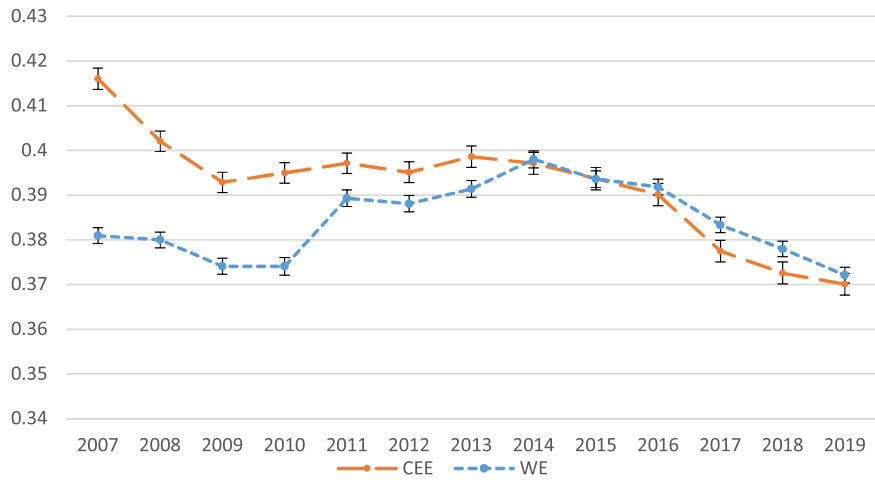


Fig. 1. Multidimensional *LB* evolution by bloc, 2007–2019. *Note:* Vertical lines represent 95 % confidence intervals. *Source:* Authors’ calculations based on the EU-SILC cross-sectional dataset (EU-SILC, 2007, 2019).

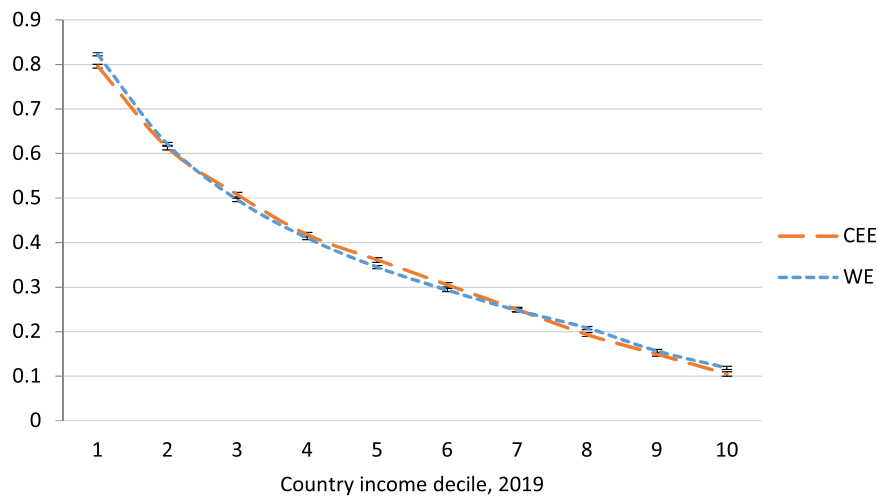
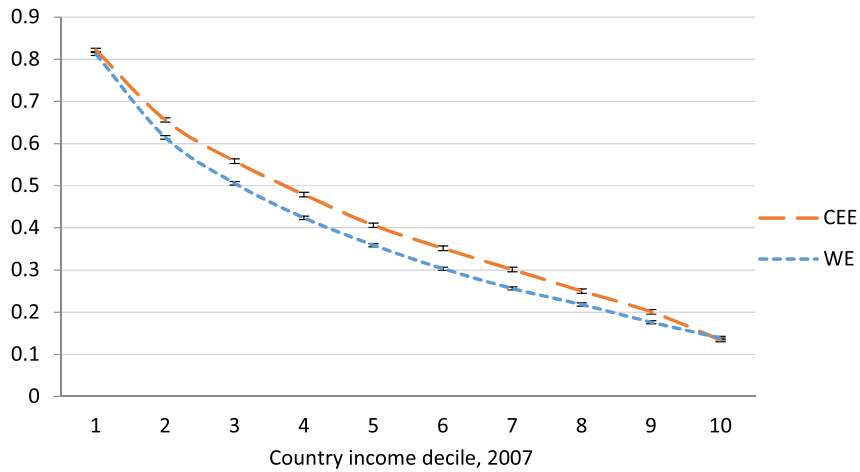


Fig. 2. Multidimensional *LB* by income decile, 2007 and 2019. *Notes:* (1) Vertical lines represent 95 % confidence intervals. (2) $LB = 0.82$ in 2019 for the first income decile of the WE bloc, indicating that the average *LB* of all individuals in the first decile of their corresponding countries in the WE bloc is 0.82. *Source:* Authors’ calculations based on the EU-SILC cross-sectional dataset.

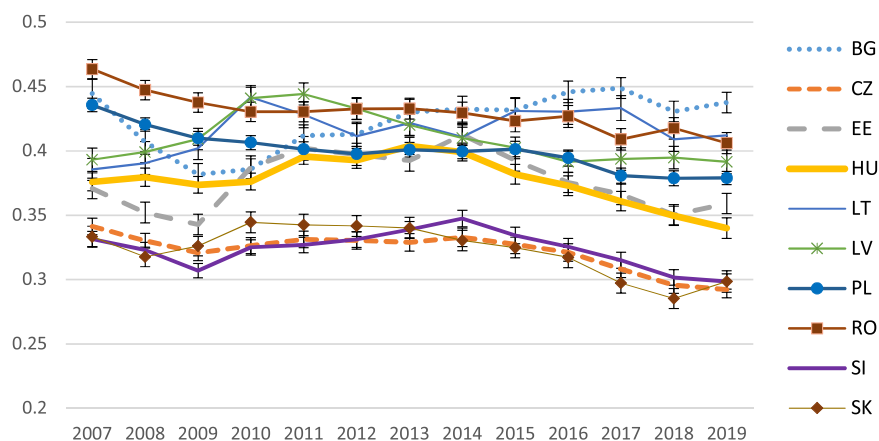


Fig. 3. Multidimensional *LB* evolution by CEE countries, 2007–2019. *Note:* (1) Vertical lines represent 95 % confidence intervals. (2) EU official country abbreviations are used.

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

the first, eighth, and tenth deciles, while the opposite occurred in the fifth decile, with no remarkable differences for the rest of the deciles. Obviously, the seriousness of the extent to which individuals are left behind is not the same along the distribution, requiring more attention from a policy standpoint those more left behind.

As Figures A4 and A5 in Online appendix 5 show, the degree individuals were left behind by dimension also differs by decile in both blocs. For 2007, Figure A4 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 A5 in the Online 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.

4.2. Comparison across CEE countries

In addition to differences between the CEE and WE country blocs, it is obvious that 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*. Fig. 3 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 economy. In line with previous empirical literature on economic inequality, such as Brzeziński et al. (2020) and Medgyesi and Tóth's (2021), 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, where inequality continued to grow during our period of analysis, exhibiting the greatest *LB* from 2016 to 2019.

From a unidimensional point of view (see Figure A6 in Online appendix 5), we observe that the division into two groups is also perfectly valid for income, consistently, for instance, with the findings of Brzezinski (2018) and Medgyesi and Tóth (2021). Nonetheless, while the Czech Republic and Slovakia 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, with neoliberal capitalist models and successive pro-market institutional and policy reforms, saw increases in *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 Poland¹¹ showed the highest average levels of *LB* in work intensity from 2016, while Latvia joined this group in 2019 (see Table 2 on the average multidimensional *LB* and average *LB* by dimension for CEE countries in 2007 and 2019).

¹¹ As discussed above, Poland was undergoing profound political and economic changes, including greater centralisation of the economy and the reversal of privatisation.

Table 2
Average multidimensional *LB* and average *LB* by dimension for CEE countries, 2007 and 2019.

	BG	CZ	EE	HU	LT	LV	PL	RO	SI	SK
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)	0.4635 (0.4560, 0.4710)	0.3315 (0.3255, 0.3375)	0.3334 (0.3252, 0.34149)
<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)	0.3795 (0.3732, 0.3858)	0.2258 (0.2219, 0.2298)	0.2422 (0.2365, 0.2481)
<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)	0.1536 (0.1488, 0.1584)	0.0613 (0.0591, 0.0635)	0.0836 (0.0799, 0.0873)
<i>LB_{wt}</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)	0.2789 (0.2705, 0.2872)	0.2369 (0.2300, 0.2437)	0.2297 (0.2205, 0.2390)
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)	0.4061 (0.3978, 0.4143)	0.2985 (0.2925, 0.3045)	0.2985 (0.2901, 0.3068)
<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)	0.3520 (0.3445, 0.3594)	0.2263 (0.2221, 0.2304)	0.2283 (0.2218, 0.2347)
<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)	0.0965 (0.0925, 0.1005)	0.0453 (0.0433, 0.0472)	0.0754 (0.0713, 0.0794)
<i>LB_{wt}</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)	0.2180 (0.2094, 0.2266)	0.1837 (0.1768, 0.1905)	0.2030 (0.1938, 0.2122)

Note: EU official country abbreviations are used.

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

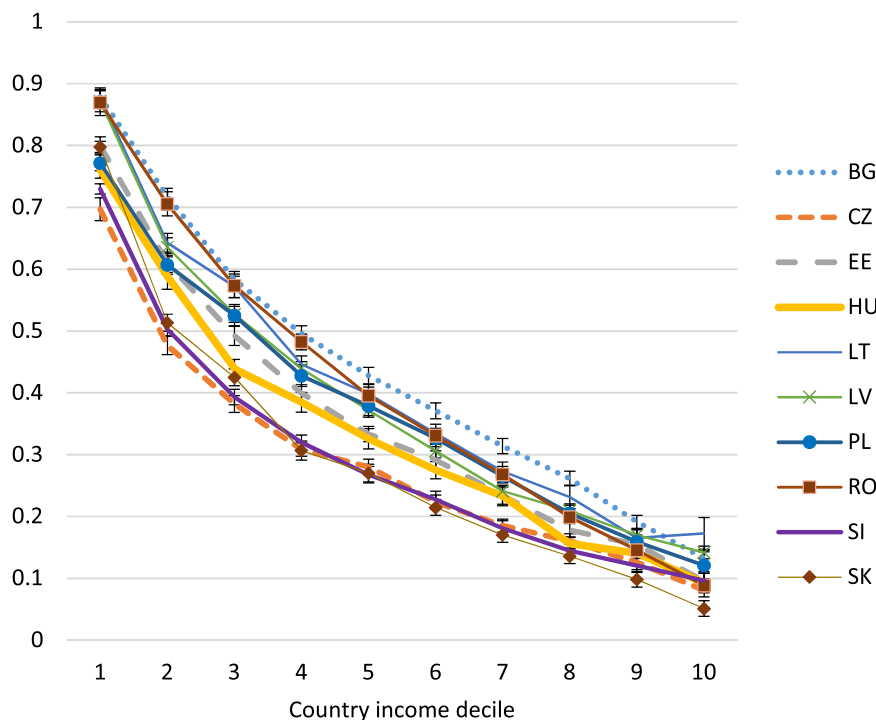


Fig. 4. Multidimensional LB by income decile, 2019. Notes: (1) Vertical lines represent 95% confidence intervals. (2) EU official country abbreviations are used. (3) $LB = 0.7$ for the first income decile of the Czech Republic, indicating that the average degree of all individuals in the first decile in the Czech Republic is 0.07. Source: Authors' calculations based on the EU-SILC cross-sectional dataset.

Fig. 4 presents LB by income decile for each country in 2019, revealing diverse reduction patterns by countries as the income decile increases.¹² 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 Fig. 4, 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 A7.

We recognise that the attention needed by individuals is not the same, with those falling further behind requiring more attention. Consequently, we conduct supplementary analysis focusing on the socio-demographic profiles of the top 20% of individuals in the $LB(i)$ distribution, that is, those lagging further behind. This analysis, detailed in Table 3, outlines the prevalence of specific characteristics within the general population (Overall) and contrasts them with their prevalence among the top 20% most left behind individuals.

Table 3 illustrates the distribution of individuals across the overall population and the 20% most left behind by characteristics. Additionally, we present the Prevalence ratio, indicating values above 1 when certain characteristics are more pronounced among the most left behind compared to the overall population. Our analysis highlights prevalent features among the most disadvantaged: individuals aged 60 or older, those without tertiary education, and individuals with chronic illnesses (across all 10 countries).

Certain countries notably exhibit a higher prevalence of specific characteristics among the top 20% most left behind individuals. For instance, Latvia stands out for its high proportion of individuals aged over 60, while Lithuania shows a significant concentration of individuals with chronic illnesses, and Bulgaria has a notable representation of young individuals.

Each country boasts its distinct characteristics, suggesting the need for tailored approaches by policymakers. A comprehensive examination of marginalized groups within each country could prove instrumental in addressing specific socioeconomic profiles and narrowing the gap between the most disadvantaged and the broader society.

¹² See Online appendix 6 for figures illustrating LB by sociodemographic characteristics in the CEE countries.

Table 3

Percentage of individuals by characteristics in the population and among the top 20% of individuals left behind, 2019.

Country		Woman	Young	Middle	Old	Non-Tertiary	Chronic	Children	Owner
BG	Overall	49.45	12.17	74.43	13.40	77.07	14.55	56.18	83.77
	Top 20 %	49.53	17.03	66.79	16.19	94.62	20.52	61.42	83.10
	Ratio	1.00	1.40	0.90	1.21	1.23	1.41	1.09	0.99
CZ	Overall	49.46	12.84	77.64	9.52	79.16	26.09	54.26	78.84
	Top 20 %	53.20	16.34	70.83	12.83	90.85	41.08	58.40	63.64
	Ratio	1.08	1.27	0.91	1.35	1.15	1.57	1.08	0.81
EE	Overall	50.29	13.21	77.49	9.30	62.21	33.91	49.80	81.40
	Top 20 %	48.03	14.83	71.44	13.73	79.51	49.26	46.95	74.19
	Ratio	0.96	1.12	0.92	1.48	1.28	1.45	0.94	0.91
HU	Overall	50.71	16.25	71.77	11.98	78.06	30.43	51.63	91.24
	Top 20 %	51.21	19.23	65.60	15.17	87.97	39.09	51.69	91.63
	Ratio	1.01	1.18	0.91	1.27	1.13	1.28	1.00	1.00
LT	Overall	51.55	14.93	75.13	9.95	65.65	25.13	50.33	89.76
	Top 20 %	52.65	16.41	69.79	13.80	85.97	41.26	45.27	81.18
	Ratio	1.02	1.10	0.93	1.39	1.31	1.64	0.90	0.90
LV	Overall	52.44	12.55	75.01	12.44	67.69	32.68	49.88	80.65
	Top 20 %	53.07	11.56	66.00	22.44	83.92	49.64	40.64	75.61
	Ratio	1.01	0.92	0.88	1.80	1.24	1.52	0.81	0.94
PL	Overall	50.61	13.17	72.55	14.28	74.59	31.16	51.83	84.26
	Top 20 %	49.80	14.54	66.85	18.61	89.94	46.64	45.05	81.13
	Ratio	0.98	1.10	0.92	1.30	1.21	1.50	0.87	0.96
RO	Overall	49.42	14.10	72.26	13.64	84.59	11.85	58.85	95.85
	Top 20 %	49.65	18.41	66.62	14.97	97.47	15.73	60.14	95.06
	Ratio	1.00	1.31	0.92	1.10	1.15	1.33	1.02	0.99
SI	Overall	48.55	13.29	75.30	11.41	70.24	29.63	54.49	74.91
	Top 20 %	48.93	12.66	71.38	15.96	82.99	42.68	44.48	63.80
	Ratio	1.01	0.95	0.95	1.40	1.18	1.44	0.82	0.85
SK	Overall	50.22	13.34	72.01	14.65	80.00	25.86	54.35	91.11
	Top 20 %	51.96	17.17	66.29	16.54	90.06	33.81	62.45	84.28
	Ratio	1.03	1.29	0.92	1.13	1.13	1.31	1.15	0.93

Note: (1) EU official country abbreviations are used. (2) Variables are defined as follows: *Woman* refers to gender; *Youth* denotes an individual under 25 years; *Middle* denotes an individual between 26 and 60 years old; *Old* is considered for individuals over 60 years old; *Non-tertiary* refers to individuals with non-tertiary education; *Chronic* denotes an individual with a chronic illness; *Children* identify those living in a household with at least one person under 18 years old; *Owner* identifies individuals who live in an owned house. (3) *Overall* is the proportion of individuals with the specific characteristic in the overall population; *Top 20%* refers to the proportion of individuals with the specific characteristic among the 20% most left behind; *Ratio* is *Top 20%/Overall*.

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

5. Conclusions

This study investigates the level at which individuals of the EU's former state socialist countries (CEE countries) are left behind over the period 2007–2019. To that end, a multidimensional setting is used that jointly addresses income, material deprivation, and work intensity to compare CEE individuals to the rest of EU individuals (WE countries) and establish comparisons among countries within the CEE bloc. We employ a fuzzy approach to compute the degree to which an individual is left behind that allows us to go beyond traditional overall inequality measures, in line with the principle of LNOB of the 2030 Sustainable Development Agenda.

Our findings highlight, first, that individuals in CEE countries as a whole were clearly more left behind in 2007 than individuals in WE countries, even though the former have considerably reduced the extent to which individuals 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 as a result of a decrease in the level individuals were left behind in the CEE countries, as well as the greater extent individuals were left behind after the 2007–2008 financial crisis in the WE bloc. By dimensions, the reduction in the degree individuals have been left behind in work intensity in the CEE bloc is particularly remarkable, reaching even lower levels than those of the WE countries since 2014.

To analyse the information in greater depth, we estimate the extent to which individuals were left behind in each part of the income distribution. 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 find that while the *LB* for income and material deprivation 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.

As for cross-country differences in the degree individuals are left behind in the former CEE socialist states of the EU, our results are consistent with previous empirical literature using traditional measures of inequality and highlight the links between the different

models of capitalism and their development, and the degrees to which individuals are left behind in each CEE country. Thus, our analysis reveals that Slovenia (with 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, which are 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. The case of Bulgaria is especially striking, as its individuals became the most left behind in all deciles in 2019, together with Romania in lower deciles.

An in-depth look into the characteristics of the most disadvantaged individuals in CEE countries shows that older individuals (60+), those without higher education, and people dealing with chronic illnesses are among the most left behind. However, in some countries, certain traits stand out more in the top 20% most disadvantaged group (such as young people in Bulgaria). These conclusions highlight the need for policymakers to come up with tailored solutions to address different socioeconomic profiles and bridge the gap between the most disadvantaged and the rest of society.

This research opens new paths for the analysis of economic inequality and the contribution of each individual to inequality beyond aggregate measures, and taking into account 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 specific CEE countries how particular institutional and policy reforms in the framework of a certain model of capitalism might affect the degree to which individuals with different socioeconomic profiles are left further behind.

CRedit authorship contribution statement

F. García-Pardo: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **S. Pérez-Moreno:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **E. Bárcena-Martín:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Data availability

European Union Statistics on Income and Living Conditions (EU-SILC) data have been used. These data are public and can be freely accessed by contacting EUROSTAT, although we cannot provide them due to the privacy clause in the contract signed with EUROSTAT.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ecosys.2024.101255](https://doi.org/10.1016/j.ecosys.2024.101255).

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