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ORIGINAL RESEARCH

Comparing Precarious Employment Across Countries: Measurement Invariance of the Employment Precariousness Scale for Europe (EPRES-E)

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Abstract
Comparing precarious employment (PE) across countries is essential to deepen the understanding of the phenomenon and to learn from country-specific experiences. However, this is hampered by the lack of internationally meaningful measures of PE. We aim to address this point by assessing the measurement invariance (MI) of the Employment Precariousness Scale for Europe (EPRES-E), an adaptation of the EPRES construct in the European Working Conditions Survey (EWCS). EPRES-E consists of 13 proxy-indicators sorted into six dimensions: temporariness, disempowerment, vulnerability, wages, exercise of rights, unpredictable working times. Drawing on EWCS-2015, MI of the second-order factor model was tested in a sample of 31,340 formal employees by means of (a) multi-group confirmatory factor analyses, and (b) the substantive exploration of EPRES-E mean scores in each country. The results demonstrate that threshold invariance holds for the first-order structure (dimensions) of 22 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, UK), but only metric invariance is attained by the second-order structure. The latter is supported by the exploration of mean scores, where we found that different score patterns in each dimension lead to similar overall EPRES-E scores, suggesting that PE is configured by different sources within the six dimensions in each country according to their broader socio-political trajectories. We conclude that, although EPRES-E can be used for comparative purposes in 22 European countries, the scores of each dimension must be reported alongside the overall EPRES-E score.

Keywords Precarious employment · Europe · Measurement invariance · Multi-group confirmatory factor analysis · Comparative research

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1 Introduction

Post-industrial societies have experienced a set of pivotal processes in recent decades, including the globalization of their economies, far-reaching technological innovations prompting the so-called fourth industrial revolution, the development of neoliberal macroeconomic policies, periodic economic downturns and demographic changes. Among other consequences, these have triggered a structural transformation of labor markets. Broadly, the unprecedented post-WWII socioeconomic order that gave rise to the Standard Employment Relationship (SER) - permanent full-time employment with social protection and benefits (Bosch 2004) - is gearing towards a more flexible and individualized paradigm where collective bargaining schemes and social protection networks provided by welfare states are progressively being retrenched (Arnold and Bongiovi 2013; Kalleberg 2018). As a result, social, academic and political actors have drawn attention to the precarization of employment and the potential impact it may have on critical aspects such the health and wellbeing of workers (Benach et al. 2013). However, little effective progress has been made in articulating precarious employment (PE) in public policy. A fundamental obstacle to doing so has been the lack of an internationally shared definition and operationalization of PE, engendering conceptual confusion and impeding proper monitoring of the phenomenon within and across countries, which would sensitively inform both researchers and policy-makers. Hence, developing a theoretically sound measure of PE that transcends the singularities of territories is essential if decent and sustainable labor markets are to be introduced locally, nationally and globally (Benach et al. 2012).

In this article, we add to this strand of research by examining the extent to which the Employment Precariousness Scale for Europe (EPRES-E), a multidimensional and theory-based instrument to measure PE that has been empirically validated in Spain (Padrosa et al. 2020), can be used for comparative research in 35 European countries. Specifically, we explore the degree of measurement invariance (MI) for EPRES-E to determine whether the underlying concept (i.e. PE) is measured the same way in the studied countries. This is both crucial in obtaining results that are meaningfully comparable across territories, and a key challenge to understanding further how the precariousness of employment arrangements is made manifest in each national context.

The structure of the article is as follows. In the next section, we scrutinize current discussions of the conceptualization and operationalization of PE internationally, and the challenges to conducting comparative research in this field, reporting the gaps in the literature that justify our approach from a theoretical and a methodological point of view. Then we present our data along with a detailed commentary on the statistical analyses we use. Thereafter, the results are described and interpreted, revealing the potential reasons for invariance or non-invariance of EPRES-E in each country. Lastly, we conclude with some observations on the implications of these findings for further research and policy-making.

2 Background

As briefly stated above, delineating what defines PE is an open source of debate among scholars in a variety of disciplines, as well as international institutions. To begin with, a distinction should be made between the three main sets of features that characterize jobs: the nature of the job tasks and their associated working conditions, employment conditions, and employment relations (Benach et al. 2013). The former include the physical and

psychosocial aspects of employment; employment conditions denote the circumstances in which a person is engaged in a job or occupation; and employment relations refer to the power relations between employers and employees, both as collective and as individual actors. Because a detrimental employment experience can stem from any of these sources, some authors incorporate aspects of all three in their theorizations (e.g. Livanos and Papadopoulos 2019). Nonetheless, the precariousness of employment arrangements emanates from the broader configuration of employment relationships that shape the extent to which workers are immersed in their jobs, regardless of their precise content (Benach et al. 2016; Bodin et al. 2020). Indeed, as PE taps a concept that goes deeper than job-specific working conditions, its conceptualization should focus on employment conditions and relations. Accordingly, departing from the definition proposed by Rodgers (1989), a dominant strand of research treats PE as a combination of the adverse characteristics of the employment relationship that differ from those manifested in the SER; mainly, employment insecurity, low or inadequate wages, and reduced social protection and workplace rights (see Kreshpaj et al. 2020 for a review). As such, PE is commonly theorized as representing a continuum, with the SER lying at the upper end and the most de-standardized jobs at the lower end. However, it has been argued that this approach obscures the asymmetry of interpersonal power relations between employers and employees (Amable 2006; Korpi 2006; Benach et al. 2013), a crucial aspect of the experience of PE that might be present even in the SER (Julià et al. 2017). Additionally, an increasing number of commentators have politically and culturally criticized the idealization of the SER-like career-long contract with standardized working schedules and bound to a specific workplace. They rather advocate for (worker-led) flexible working times, part-time employment or remote working as ways of emancipating workers from this disciplined and production-based model of the organization of work and life, which is sustained by the premises of Fordist accumulation regimes (Weeks 2011; Fleming 2014). On account of these standpoints, it can be concluded that not only is there a wide range of definitions of PE, some of them are even contradictory. Nonetheless, a couple attributes of the concept are globally acknowledged: first, its objective nature, since subjective perceptions and expectations might relate to circumstances other than the employment relationship (ILO 2012); and second, its multidimensionality, in the sense that multiple aspects of the employment relationship, which do not need to occur simultaneously, combine in providing the overall experience of PE (Campbell and Burgess 2018). The latter is particularly important in order to comprehend the vast array of nuances that make different employment situations precarious, and to identify the sources of this precariousness in each situation. This in turn is essential if effective tailored policies to minimize PE are to be designed. Therefore, the challenge in defining and measuring PE lays in determining the dimensions that frame it, and whether these dimensions apply equally to different populations.

Another key issue underlying the absence of a consensus in conceptualizating PE is the socio-historical, economic, political and cultural particularities of the territories in which people experience their jobs. To elaborate, employment arrangements are embedded in the wider intersection between welfare states, labor markets and family models, which in turn are dynamically shaped by changing power relations between the main political and economic actors in society, namely institutions and political parties, unions, corporations and civil-society organizations (Esping-Andersen 1990; Hall and Soskice 2001; Benach et al. 2016). Consequently, the mechanisms by which these intersections unfold into different types of employment arrangements are context-specific and determine what is considered precarious in each territorial reality (Duell 2004; Muñoz-Bustillo et al. 2009). An example are zero-hour contracts, which are heavily restricted in Germany and

the Netherlands but whose use is growing in liberal countries such the UK (Farina et al. 2019). On the other hand, Denmark and Greece have a similar share of fixed-term contracts (OECD 2020), but the former's flexicurity model provides temporary workers with levels of social protection, career prospects and working conditions that resemble those of their permanent counterparts, while this is quite the opposite in Greece (Frade et al. 2004). For this reason, contextualized theoretical frameworks of PE that allow comparative research are rather scarce, let alone their methodological operationalization and empirical validation. Indeed, the majority of studies or reports that adopt a cross-national perspective rely on one-dimensional indicators such as temporary employment, perceived job insecurity or low salaries, which oversimplify both the all-embracing aspects that contour PE (Benach et al. 2013) and the contrasting experiences that such workers may face in each country (Frade et al. 2004; Muñoz-Bustillo et al. 2009). This is a huge obstacle to achieving understanding of the phenomenon and of the implications that different policies and institutional frameworks might have for its deployment. Therefore, not only is a multidimensional and objective measure of PE that incorporates the different national contexts substantially needed, but also is the empirical assessment of its comparability in order to draw meaningful conclusions internationally.

EPRES-E was developed to fill this gap in the literature (Padrosa et al. 2020). This measure consists of an adaptation of the Employment Precariousness Scale (EPRES) construct in the sixth wave of the European Working Conditions Survey (EWCS-2015). The original version of EPRES takes the form of a multidimensional scale that encompasses the following six dimensions: temporariness (contract duration), disempowerment (level of negotiation of the employment conditions), vulnerability (defenselessness against workplace authoritarianism), low wages, workplace rights, and the capacity to exercise them. These dimensions are both theoretically and methodologically sound, as they stem from a long-term interdisciplinary research project that involved, in the first place, an extensive literature review, followed by interviews with 12 key informants (who were experts in various fields such sociology, labor economy or social epidemiology) and, finally, six focus-group discussions with temporary and permanent workers, and trade union representatives (Amable 2006; Vives et al. 2010). The EPRES instrument is also unique in being empirically validated for use in countries with substantially different labor markets and institutional contexts, namely Spain (Vives et al. 2010, 2015), Chile (Vives et al. 2017), Sweden (Jonsson et al. 2019) and is currently being tested in Belgium and Finland. Despite all these assets, the use of EPRES in comparative research is not straightforward since, to achieve this purpose, primary data that is cross-nationally homogenized ought to be fielded. In this scenario, the EWCS stands out as a great source of information given that it is conducted periodically, permitting the availability of data over time and the study of trends at an aggregate level. Moreover, it covers a large number of countries, thus providing a unique opportunity to perform Europe-wide comparative analyses. Therefore, the adaptation of a theoretically strong PE construct (i.e. EPRES) in a powerful international survey (i.e. EWCS) has potential as an insightful solution for the assessment of the phenomenon across countries. Accordingly, EPRES-E was first developed using the EWCS-2015 subsample from Spain in order to ensure that the representativeness of the original construct, which had been engendered in the Spanish context, prevailed. Due to the closed nature of the questionnaire, the rights dimension was omitted because of the unavailability of items (see Padrosa et al. 2020 for further details), but a social component designed to capture the lack of control of precarious workers over their own time was incorporated (Cano 2004; Porthé et al. 2010). All said, EPRES-E's dimensions are: (a) temporariness; (b) disempowerment; (c) low wages; (d) exercise of rights; (e) vulnerability; and (f) unpredictability of working

times (uni-directionally led by employers). The instrument demonstrated good psychometric properties, construct validity and internal consistency reliability in the EWCS-2015 Spanish subsample (Padrosa et al. 2020). Taking this into account, and given the aforementioned absence of theoretical support to employing PE measures across territories without further cautiousness, the obvious next step in measuring PE from a comparative perspective is to empirically examine MI of EPRES-E in the 35 European countries covered by the EWCS-2015.

3 Methods

3.1 Data and Study Population

Data used for the analyses were derived from the sixth wave of the EWCS, a cross-sectional European survey conducted quinquennially that is representative of the population in employment residing in private households in the countries covered. In this specific wave, which was fielded in 2015, the European Union (EU's) 27 Member States, the 5 EU-candidate countries (i.e. Albania, Republic of North Macedonia, Montenegro, Serbia and Turkey), Norway, Switzerland and the UK were included. The overall response rate was 42.5%, ranging from 10.9% in Sweden to 78% in Albania (Eurofound 2017). A total of 43,850 individuals aged 15 and over (except for Bulgaria, Norway, Spain and the UK where individuals were aged 16 or over due to the minimum legal working age being higher in these countries) were interviewed. For the purposes of this study, however, respondents in self-employment ($n=9245$), without an employment contract ($n=2478$), serving in the armed forces ($n=149$) or with unknown or non-eligible ages - i.e. 65 or over - ($n=638$) were excluded. Thus, the final sample under analysis consisted of 31,340 individuals.

3.2 Measures

The main variable was EPRES-E, which was operationalized by 13 proxy indicators sorted in the 6 dimensions described in the foregoing. That is, two items in "temporariness", two in "disempowerment", two in "wages", two in "exercise of rights", two in "vulnerability", and three in "unpredictability of working times". All 13 items were measured using frequency or ordinal scales, recoded so that higher values correspond to more precarious situations (Supplementary Material 1). A more detailed description of these indicators can be found in Table 1. Dimension scores were simple averages of the items transformed into 0–100 scales, while the overarching EPRES-E score was the arithmetic mean of the six dimension scores (Supplementary Material 1).

Other variables used to describe the sample were sex (women, men), age (9-year age groups), place of birth (country of residence or other), occupational social class (non-manual, manual), educational attainment according to the International Standard Classification of Education 2011 (high, medium, low), and country of residence.

3.3 Statistical Analyses

EPRES-E comparability across countries was tested by means of multi-group confirmatory factor analysis (MGCFA) (Chen 2008; Kim and Yoon 2011). The EPRES-E-tested model was composed of the 6 latent dimensions as first-order factors that were, in turn, reflected

Table 1 Operationalization of the Employment Precariousness Scale for Europe (EPRES-E)

	Indicator	Operationalisation	Response options
Temporariness	Duration of current contract	Combination of: (a) what type of contract do you have; (b) what is the duration of your current contract?	0. Permanent contract 1. Temporary contract, short duration 2. Temporary contract, long duration
	Tenure	How many years have you been in your company or organization?	0. More than 5 years 1. 3 to 5 years 2. 1 to 3 years 3. Less than 1 year
Disempowerment	Trade unions	Does a trade union, works council or a similar committee representing employees exist at your organization?	0. Yes 1. No 2. Don't know
	Meetings	Does a regular meeting in which employees can express their views about what is happening in the organization exist at your organization?	0. Yes 1. No 2. Don't know
Vulnerability	Respect of boss	Your immediate boss respects you as a person	0. Strongly agree 1. Tend to agree 2. Neither agree nor disagree 3. Tend to disagree 4. Strongly disagree
	Fair treatment	You are treated fairly at your workplace	0. Always 1. Most of the time 2. Sometimes 3. Rarely or never

Table 1 (continued)

	Indicator	Operationalisation	Response options
Exercise of rights	Break when you need it	You can take a break when you wish	0. Always 1. Most of the time 2. Sometimes 3. Rarely 4. Never
	Hours off for personal matters	Would you say that for you arranging to take an hour or two off during working hours to take care of personal or family matters is…	0. Very easy 1. Fairly easy 2. Fairly difficult 3. Very difficult
Unpredictability of working times	Schedule unpredictability	Do changes to your working time arrangements occur regularly? If yes, how long before are you informed about these changes?	0. No 1. Yes, several weeks in advance 2. Yes, several days in advance 3. Yes, the day before 4. Yes, the same day
	Work at short notice	How often have you been requested to come into work at short notice?	0. Never 1. Less often 2. Several times a month 3. Several times a week or daily
	Working times regularity	Combination of: do you work (a) the same number of hours every day; (b) the same number of days every week; (c) the same number of hours every week; (d) fixed starting and finishing times?	0. Very high (yes on all) 1. High (no on at least one) 2. Medium (no on at least two) 3. Low (no on at least three) 4. Very low (no on all)

Table 1 (continued)

	Indicator	Operationalisation	Response options
Wages	Net earnings per month	Net monthly earnings from your main paid job	0. High earnings (above the median) 1. Medium-low earnings (between low earnings and the median) 3. Low earnings (less than 0.6 of the median population)
	Net earnings per hour	Net hourly earnings from your main paid job	0. High earnings (above the median) 1. Medium-low earnings (between low earnings and the median) 3. Low earnings (less than 0.6 of the median population)

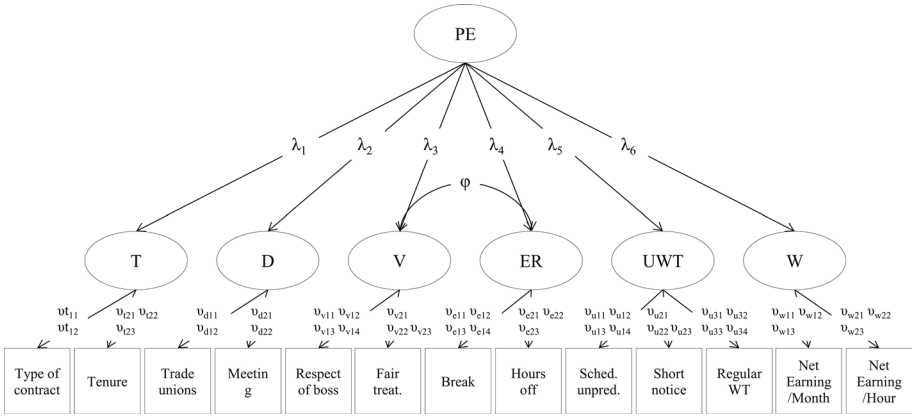

Fig. 1 Factor structure of EPRES-E (European Working Conditions Survey 2015). *EPRES-E* Employment Precariousness Scale for Europe, *PE* Precarious Employment, *T* Temporariness, *D* Disempowerment, *V* Vulnerability, *ER* Exercise of rights, *UWT* Uncertain Working Times, *W* Wages, *Fair treat* fair treatment, *Sched. unpred.* schedule unpredictability, *WT* working times, λ factor loading, φ factor covariance, υ threshold

by the overarching PE construct, which was modeled as a second-order factor (Fig. 1). According to this configuration, to identify the covariance structure part of the model one factor loading for each first- and second-order factor was fixed to 1, since this is considered to be the best way to attain identification in MI models (Rudnev et al. 2018). Besides, because of the ordinal nature of the observed variables, the MGCFAs were run with the mean- and variance-adjusted weighted least squares estimator (WLSMV) and polychoric correlations (Beauducel and Herzberg 2006).

As regards the assessment of MI, briefly, the basis of the MGCFA approach consists of investigating the invariance of the relations between underlying latent constructs and observed variables by imposing constraints on the measurement parameters of the model for every specified group, and then comparing the model to more or less restricted ones (Davidov et al. 2014): the stricter the parameter equality constraints, the higher the degree of invariance (Meredith 1993; Steenkamp and Baumgartner 1998). Furthermore, to establish MI in second-order factor models, this must first be accomplished by the first-order factors (Rudnev et al. 2018). For this reason, we examined EPRES-E's MI in five steps following a bottom-up approach (Fig. 2). First of all, configural invariance of the overall (first- and second-order factors) model was tested for all 35 countries. This level of invariance is met when the factor structures, and thus the latent constructs, are equal in all groups. That is, when people in the different groups respond to the items with the same construct in mind (Chen 2008). The output of this model was explored in detail to check for negative latent variances, low omega reliability coefficients - i.e. an estimator of the homogeneity of the items that takes into account the structure of the model (Raykov 2001) - or other sources of misspecification in any of the studied countries. Individual CFAs were then run for countries displaying these characteristics, if any, to further determine whether the EPRES-E construct was applicable to that territorial context. If the individual model fitted the data poorly (see below), that specific country was excluded from the analyses. Subsequently, configural invariance of the remaining countries was addressed, followed by metric invariance of the first-order factors. In this case, invariance requires factor loadings between observed and latent variables to be equal, meaning that a unit increase on

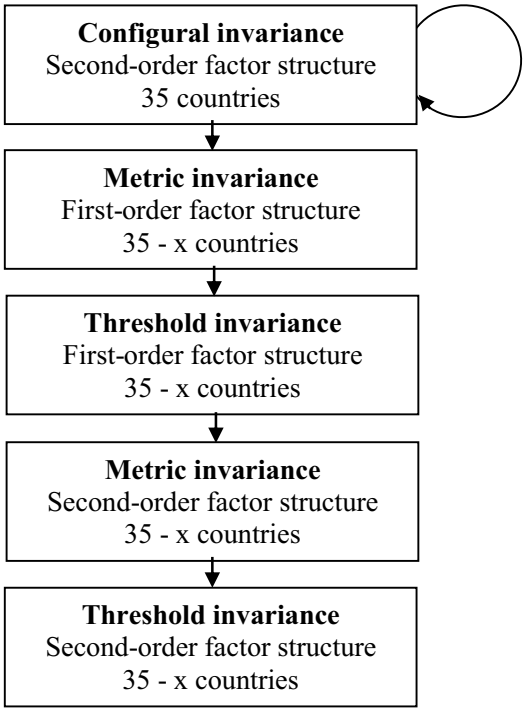

Fig. 2 Flowchart of multi-group confirmatory factor models analysed to test measurement invariance. *CFA* Confirmatory Factor Analysis

the measurement scale (i.e. latent variable) has the same implications in each group. In a fourth step, we examined threshold (or scalar) invariance of the first-order factors (Millsap and Yun-Tein 2004; Pendergast et al. 2017). This indicates whether mean differences in the latent variables are tied in with the same shifts between the response options of the ordinal observed variables, making the raw scores of the latent variable comparable or non-comparable. Finally, the same procedure, namely threshold invariance, was performed in the second-order factor model. All the steps were conducted conditionally on the basis of the results of the preceding one. Note that residual invariance is the last and strictest level of MI, which is attained when residual variances - i.e. the sum of uniqueness and measurement error variances - are equal as well. However, examination of this degree of invariance in the context of ordinal data is limited, and there is disagreement in the literature over its requirement to uphold latent mean comparability (Vandenberg and Lance 2000) given that residuals are not part of the latent variable. Hence, it was not tested in this article.

Nor is there a consensus among scholars regarding which strategy is best at discerning whether the above equality constraints are violated (Vandenberg and Lance 2000; Chen et al. 2005). In this study, we evaluated the following models' goodness-of-fit indices according to their proposed cut-off values for acceptance (Hooper et al. 2008; Kline 2010): the chi-squared test (χ^2) and the associated degrees of freedom and p value (the smaller the value of the statistic, the better the fit), the comparative fit index (CFI) (>0.90), the Tucker-Lewis index (TLI) (>0.90), and the root mean square error of approximation (RMSEA),

along with its 90% confidence interval (CI) (<0.080 with the upper bound of its confidence interval < 0.100). Nonetheless, this practice relies on the rather uncertain assumption that invariance constraints have a sufficient impact on the global fit of the model to make it transcend the cut-off value of acceptability (Davidov et al. 2014). Therefore, we combined this strategy with the assessment of the difference between these indices in the nested and increasingly constrained models (Cheung and Rensvold 2002; Chen 2007). Based on simulation studies, Chen (2007) formulated cut-off values for these differences in CFI and RMSEA (<−0.010 and <0.015, respectively), but when it comes to large-group comparisons, these criteria are unsuitable (Rutkowski and Svetina 2014). Accordingly, they were only adopted to test for threshold invariance, while a more sensible cut-off of 0.030 for ΔRMSEA and of 0.020 for ΔCFA were adopted to test for metric invariance (Rutkowski and Svetina 2014). Finally, as Brown (2015) emphasizes, the logic of comparisons does not necessarily have to be based on choosing the best-fitting model, but on selecting the most parsimonious one that still fits well, so these cut-off values were used more as a reference than as a strict condition in deciding whether to accept or reject the models.

In a final stage of the analysis, the EPRES-E mean scores and those of its dimensions were explored in each of the countries included in order to scrutinize the proposed EPRES-E structure in a more substantive manner. Note that, as stated above, we applied equal weights to every component of EPRES-E to compute these scores, regardless of the loadings retrieved from MGCFAs. This was because the weights obtained from MGCFAs might be unsuitable for other samples. Considering that one of the strengths (and aims) of using the EWCS data is to be able to measure and compare PE in further cross-sectional samples, this data-driven weighting technique would represent a serious drawback. Accordingly, in the absence of a methodological gold standard in the allocation of more specific weights, equal weighting is recommended as the most cautious option (Nardo et al. 2008). Nevertheless, this issue should be explored in more detail when other data containing EPRES-E are available.

4 Results

Characteristics of the sample are shown in Table 2. In sum, 52.23% of the sample were women, half were middle-aged - i.e. 36 to 55 years old -, 91.04% were born in the country where they were residing, 28.58% had a manual job, and 14.20% had a low educational attainment.

As for the models examined (Table 3), no solution was found for Model 1, which included configural constraints among the 35 studied countries. After further exploring the output of the model (not shown), we observed that up to 13 countries either displayed a negative variance for the dimension “temporariness” (Cyprus), a low omega reliability coefficient (Latvia, Malta, Montenegro, Hungary, Estonia, Czech Republic, Bulgaria, Romania, Republic of North Macedonia, Serbia and Turkey) or non-computable results (Albania). Besides, the model displayed a fit below the acceptable level when run individually for these countries (not shown). Therefore, Model 2 was conducted without them, resulting this time in a good fit (χ^2 [df] = 7097.326 [1276], p value < 0.001; CFI = 0.945; TLI = 0.926; RMSEA (90% CI) = 0.074 (0.072–0.075)). This indicates that the latent second-ordered structure was measured by the same items in the remaining 22 countries. Consequently, the following models were only performed for this set of countries. Model 3 produced an even better fit (χ^2 [df] = 3611.558 [1247], p value < 0.001; CFI = 0.978;

Table 2 Sample description (European Working Conditions Survey, 2015)

		N	(%)
Sex	Women	16,365	52.23
	Men	14,969	47.77
Age	15 to 25	2815	8.98
	26 to 35	7306	23.31
	36 to 45	8394	26.78
	46 to 55	8447	26.95
	56 to 64	4378	13.97
Place of birth	Country of residence	28,383	91.04
	Other	2793	8.96
Occupational social class	Non-manual	22,320	71.42
	Manual	8932	28.58
Educational attainment	High	11,139	35.66
	Medium	15,660	50.13
	Low	4437	14.20
Country	Austria	781	2.49
	Belgium	2097	6.69
	Bulgaria	790	2.52
	Croatia	782	2.50
	Cyprus	455	1.45
	Czech Republic	772	2.46
	Denmark	871	2.78
	Estonia	803	2.56
	Finland	743	2.37
	France	1295	4.13
	Germany	1717	5.48
	Greece	443	1.41
	Hungary	776	2.48
	Ireland	692	2.21
	Italy	816	2.60
	Latvia	736	2.35
	Lithuania	827	2.64
	Luxembourg	866	2.76
	Malta	640	2.04
	Netherlands	816	2.60
	Poland	832	2.65

Table 2 (continued)

		N	(%)
	Portugal	613	1.96
	Romania	804	2.57
	Slovakia	830	2.65
	Slovenia	1298	4.14
	Spain	2444	7.80
	Sweden	888	2.83
	United Kingdom	1265	4.04
	Montenegro	601	1.92
	Republic of North Macedonia	610	1.95
	Serbia	584	1.86
	Turkey	805	2.57
	Norway	885	2.82
	Switzerland	814	2.60
	Albania	349	1.11

TLI = 0.969; RMSEA (90% CI) = 0.048 (0.046–0.049)), so the first-order factors (i.e. the dimensions) could be regarded as metrically invariant across countries. In the case of Model 4, with threshold invariance for the first-order factors, it presented a good fit (χ^2 [df] = 8304.920 [1646], p value < 0.001; CFI = 0.937; TLI = 0.934; RMSEA (90% CI) = 0.069 (0.068–0.071)), but in comparison with the previous model, ΔCFA exceeded the cut-off value of −0.030. Nevertheless, given both the good overall fit and the ΔRMSEA being really close to the proposed cut-off value (0.021), we assumed threshold invariance (albeit borderline) for the dimensions in the 22 examined countries. Accordingly, we analyzed Models 5 and 6, which tested for metric and threshold invariance of the second-order factor respectively. Regarding the former, both its good fit (χ^2 [df] = 9007.871 [1528], p value < 0.001; CFI = 0.929; TLI = 0.921; RMSEA (90% CI) = 0.076 (0.075–0.078)) and the absence of any significant deterioration of CFI and RMSEA indicated that metric invariance holds for the EPRES-E construct as a whole. That is, the underlying multidimensional PE construct had the same meaning in all the studied countries. This was not the case for Model 6, where a poor overall fit to the data (χ^2 [df] = 13,821.964 [1906], p value < 0.001; CFI = 0.887; TLI = 0.899; RMSEA (90% CI) = 0.086 (0.085–0.088)) and a reduction in the CFI higher than −0.030 were obtained.

In light of these results, threshold invariance of the first-order factor model and metric invariance of the second-order factor model could be assumed. Therefore, only the means of the dimensions should be compared across the 22 countries according to MI standards. However, we also delved into the means of EPRES-E for each country to interpret the above-mentioned findings more intuitively (Table 4). As observed, an interesting finding was that countries showing similar EPRES-E scores showed different dimension score

Table 3 Goodness-of-fit indices from multi-group confirmatory factor analyses of EPRES-E (European Working Conditions Survey, 2015)

	χ^2 [df]	CFI	ΔCFI	TLI	ΔTLI	RMSEA (90% CI)	ΔRMSEA
1. Configural invariance[a]	*Solution not found*						
2. Configural invariance[b]	7097.326 [1276]*	0.945	–	0.926	–	0.074 (0.072–0.075)	–
3. Metric invariance of the first-order factors[b]	3611.558 [1247]*	0.978	0.033	0.969	0.043	0.048 (0.046–0.049)	−0.026
4. Threshold invariance of the first-order factors[b]	8304.920 [1646]*	0.937	−0.041	0.934	−0.035	0.069 (0.068–0.071)	0.021
5. Metric invariance of the first- and second-order factors[b]	9007.871 [1528]*	0.929	−0.008	0.921	−0.013	0.076 (0.075–0.078)	0.007
6. Threshold invariance of the first- and second-order factors[b]	13,821.964 [1906]*	0.887	−0.042	0.899	−0.022	0.086 (0.085–0.088)	0.010

EPRES-E Employment Precariousness Scale for Europe, *df* degrees of freedom, *CFI* Comparative Fit Index, *TLI* Tucker-Lewis Index, *RMSEA* Root Mean Square Error of Approximation, *CI* Confidence Interval

*Significant at $p < 0.001$

[a]35 countries included

[b]22 countries included

patterns. For instance, the Nordic countries displayed the lowest overall scores (24.09 Finland, 24.48 Sweden, 26.26 Denmark, and 27.24 Norway), alongside Luxembourg (25.73) and the Netherlands (27.12). This is potentially underpinned by their shared social-democratic tradition (or evolution towards it in the case of the Netherlands (Swank 2000)), characterized by high labor market standards, collective bargaining schemes, and sensible social protection benefits not overwhelmingly based on employment contributions (Esping-Andersen 1990). Nonetheless, it appears that each country endorses this social and economic system through particular labor market dynamics, leading to different dimension scores: the flexicurity Danish and Dutch model resulted in a higher degree of "temporariness" (23.82 Denmark and 24.45 Netherlands in contrast to 18.33 Finland, 22.22 Sweden and 22.93 Norway), whereas the Rehn-Meidner Swedish model (based on the strong involvement of social partners through collective bargaining) derived into an exceptionally low degree of "disempowerment" (10.81 against 15.61 Denmark, 15.98 Norway and 16.71 Finland). Contrastingly, Norway showed the poorest score in "wages" (58.67), followed by Germany (52.18). Considering how the indicator was constructed (includeing monthly and hourly wages in order to encompass both the overall wage-income that workers receive to live on, and the relative amount they receive for their human capital) we argue that this might relate to their high share of part-time employees (OECD 2020), most of whom were potentially low paid (Pfau-Effinger and Reimer 2019). On the other side of the balance, we found mostly Central- and Eastern-European countries displaying the worst EPRES-E scores (33.93 Poland, 32.93 Slovakia, 31.54 Croatia, and 31.03 Slovenia) but, again, differences in the source of these poor scores were detected. In this case they are probably related to variations in their transition to market capitalism and in the adjustments they undertook to enter the EU (along with some previous differences) that led to noticeable divergences between them in terms of labor market (Rys 2001). Whereas Slovenia's welfare state development, degree of social partnership, and public expenditure levels very much resemble those of many old EU member states (Fenger 2007), Poland went through up to three waves of neoliberal labor market reforms and privatization of public companies since the 1990s, entailing extensive use of temporary employment contracts, the creeping deregulation and decentralization of the social security system, and a collapse in trade union density (Czarzasty and Mrozowicki 2014; Maciejewska et al. 2016). This empirically translates into poor(est) scores in "temporariness" (29.97 versus 21.74 Slovakia, 21.45 Croatia and 16.64 Slovenia) and "disempowerment" (35.36 versus 28.74 Croatia, 28.69 Slovakia and 22.64 Slovenia). Furthermore, even though the strictness of employment protection legislation and the strength of social dialogue appeared to be higher in some of these countries, such as Slovenia or Slovakia (Farkas 2017), as captured by the dimensions "temporariness" and "disempowerment", their levels of unequal power relations demonstrated by the dimensions "vulnerability" (30.72 Slovakia against 26.02 Poland, 24.13 Croatia and 20.34 Slovenia) and "exercise of rights" (55.28 Slovakia and 55.00 Slovenia against 52.76 Croatia and 48.27 Poland) were prominently high, which might be linked to differences between legislated and actual practices in the workplace (Kovtun et al. 2014).

Another striking case is Germany, which displayed the third poorest EPRES-E score (32.06) despite its good performance in traditional labor market indicators, e.g. unemployment rates, temporary employment (OECD 2020). Concretely, as mentioned before, the country presented really high scores in "wages" and "exercise of rights" (53.61). We argue that this might be related to the rise of unprotected and low-paid (part-time) jobs generated as a consequence of the Hartz reforms - i.e. a set of policy measures aimed at improving employment services and policy measures, activating the unemployed and fostering

Table 4 Means of EPRES-E and its dimensions by country (European Working Conditions Survey, 2015)

	T	D	V	ER	UWT	W	EPRES-E
Austria	20.33	24.23	15.16	45.03	25.10	50.00	29.84
Belgium	20.61	20.88	19.25	44.73	18.62	45.81	27.95
Croatia	21.45	28.74	24.13	52.76	20.81	38.69	31.54
Denmark	23.82	15.61	15.16	36.49	27.99	39.47	26.26
Finland	18.33	16.71	17.20	33.75	23.76	35.33	24.09
France	21.38	20.42	21.85	42.44	21.30	42.64	27.83
Germany	21.14	25.15	18.36	53.61	22.76	52.18	32.06
Greece	22.31	30.11	20.31	57.34	16.52	38.11	31.33
Ireland	19.16	22.79	17.54	42.28	20.99	45.33	27.73
Italy	18.27	27.14	23.82	48.91	14.88	41.86	27.86
Lithuania	19.80	34.80	24.99	47.16	19.00	26.67	28.53
Luxembourg	16.97	22.23	18.28	40.47	18.85	37.21	25.73
Netherlands	24.45	22.55	14.41	38.09	22.20	42.51	27.12
Norway	22.93	15.98	11.94	32.75	23.12	58.67	27.24
Poland	29.97	35.36	26.02	48.27	19.96	46.56	33.93
Portugal	19.36	36.13	14.67	48.42	17.02	36.04	28.80
Slovakia	21.74	28.69	30.72	55.28	24.41	39.89	32.93
Slovenia	16.64	22.64	20.34	55.00	19.75	51.23	31.03
Spain	29.25	28.23	17.75	45.70	16.71	41.65	30.08
Sweden	22.22	10.81	16.60	36.75	24.92	37.50	24.48
Switzerland	20.20	30.66	17.50	49.03	23.97	33.25	29.36
UK	22.86	23.28	20.01	41.58	21.91	43.41	28.43

EPRES-E Employment Precariousness Scale for Europe, *T* Temporariness, *D* Disempowerment, *V* Vulnerability, *ER* Exercise of Rights, *UWT* Unpredictable Working Times, *W* Wages, brighter colors correspond to higher means

employment demand by deregulating the labor market (Jacobi and Kluve 2006) - and the popularization of the so-called minijobs (Pfau-Effinger and Reimer 2019).

To end with other disruptive dimension scores that sum up rather similar EPRES-E scores, we discuss the neighboring countries of Portugal (28.80) and Spain (30.08). Even though commonalities in their respective labor market structures and socio-political models have been extensively reported (e.g. Hall and Soskice 2001), in Spain PE appeared to stem from "temporariness" (29.25 in contrast to 19.36 in Portugal), while in Portugal it was more an issue of "disempowerment" (36.13 in contrast to 28.23 in Spain). Unsurprisingly, Spain's case matches the country's traditionally high share of temporary employment (OECD 2020), which was exacerbated after the major labor market reform enacted in 2012 that introduced new ways of temporarily employing workers (Livanos and Papadopoulos 2019). Portugal, on the other hand, saw its collective bargaining schemes particularly affected by the structural reforms sought by the Troika in the aftermath of the Great Recession (Cruces et al. 2015). Although this was also experienced by other EU member states facing similar situations (e.g. Spain, Greece, Ireland), the changes in Portugal represented rather the continuation of a process that was already in motion, resulting in almost a million workers not being covered by a collective agreement since 2010 (Távora and González 2016).

5 Discussion and Conclusions

The purpose of this article was to examine MI of EPRES-E, an instrument to measure PE that consists of an adaptation of the EPRES construct in the EWCS in 35 European countries. The main rationale for this approach was the need to come up with a multidimensional and objective instrument that is able to measure PE in a meaningful manner beyond territorial singularities. This is essential both to obtain the full (or a more complete) picture of the phenomenon in Europe and to conduct comparative research providing researchers and policy-makers with sensible information about each country's reality, and allowing lessons to be learned from this. However, given the vast heterogeneity of the Eurozone in terms of labor market regulations and institutions, industrial relations and welfare state regimes (Korpi 1983; Esping-Andersen 1990; Hall and Soskice 2001), which decisively determine the ever-changing nature of (precarious) employment arrangements in each country (Duell 2004; Benach et al. 2016), MI of the proposed instrument ought to be empirically assessed. To our knowledge, this is the first study to do this using a multidimensional approach with a sound theoretical basis. Consequently, the article makes an insightful contribution to a pivotal gap in the literature.

Accounting for the second-order factor structure of EPRES-E with its first-order dimensions (i.e. temporariness, disempowerment, vulnerability, exercise of rights, unpredictability of working times, and wages), our results indicate that metric invariance of the overall instrument holds for 22 out of the 35 studied countries - i.e. Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the UK. Threshold invariance could only be assumed for the dimensions, though. In more operational terms, while the raw scores of the dimensions proved to be suitable for comparative research across these countries, this was not the case for the overall EPRES-E score, which only reached a degree of invariance that allows the comparison of its covariances and unstandardized regression coefficients.

Strictly speaking, this should prevent us from comparing the overall EPRES-E raw scores (Chen et al. 2005). Nevertheless, it should be noted that from a methodological perspective and in the realm of higher-order factor models the latent nature of first-order factors (i.e. the dimensions), as opposed to observed variables, sets up structural rather than measurement relationships with the second-order latent factor (i.e. the EPRES-E). Correspondingly, the relative importance of each dimension may vary in the studied countries without changing the essence of the PE concept they are tackling, which is not the case for first-order factor models and the observed variables composing them (Van de Vijver and Leung 1997; Rudnev et al. 2018). Instead, this variation of the structural parameters in the second-order EPRES-E factor points out the divergence in terms of content and connotations of the underlying concept across groups, an interesting finding in itself (Rudnev et al. 2018). As such, MGCFAs suggest that the contouring of PE emanates from different sources within the six dimensions in each country. This aligns with the results derived from the exploration of the mean scores outlined above, where different patterns of dimension mean scores led to similar EPRES-E mean scores. Therefore, we can conclude that the country-specific contexts that articulate different legal and institutional frameworks for work and employment (e.g. macro-level policies, labor market reforms, social dialogue schemes and welfare state regimes) stand out as key factors in the configuration of PE.

From a substantive point of view, these findings provide empirical reasons for approaching PE from a multidimensional perspective, especially when performing comparative

research, since they make visible the fact that different dimensions have different magnitudes in each country. Accordingly, focusing only on one of them might trigger misleading conclusions. A highly illustrative example of this is the case of Germany, which was found to be the third worst performing country in terms of its overall EPRES-E score, despite it usually being portrayed as one of the most successful countries regarding unemployment rates or temporary employment (e.g. ILO 2019). On the other hand, the results stemming from this study also constitute a step forward towards validating EPRES-E. That is, the dimension scores fruitfully captured the situation that labor markets in the analyzed countries where experimenting at the time, as we have described in the previous section. Therefore, this narrative reinforces the use of EPRES-E in 22 European countries for comparative purposes if they are displayed in conjunction with the scores of each dimension.

Centering the attention on the 13 European countries where the construct does not hold - i.e. Albania, Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Malta, Montenegro, Republic of North Macedonia, Romania, Serbia and Turkey - further research should specifically delve into their labor market structure in order understand in a more comprehensive manner how employment precariousness is shaped there. A potential interpretation for their non-invariance lies in the institutional framework of these countries, which is characterized by their delayed transition from almost half a century of communist rule to market capitalism, making these labor markets substantially different from those of the older EU member states. Accordingly, their welfare states and social protection networks present a lagged development, a marked dual structure between public and private sectors, and a vastly expanded informal sector (Fenger 2007). Indeed, the share of informal salaried workers in these countries is substantially higher compared to the 22 countries to which the EPRES-E is applicable (Supplementary Material 2). This widens the array of forms that PE can take, which go beyond the dimensions captured in EPRES-E. To elaborate, PE measurement instruments tailored for these countries ought to encompass other aspects such the range of social risks that workers have covered and whether they are compulsorily or voluntarily entitled to such insurance schemes, the absence of a formal contract, or its irregularities in terms of the detailed number of working hours (Farkas 2017). Finally, note that the instrument does indeed work for some post-communist countries - i.e. Croatia, Lithuania, Poland, Slovakia and Slovenia - but these countries happen to be the ones sharing a higher number of confluent points with occidental European countries (Fenger 2007; Bohle and Greskovits 2012; Farkas 2017). This prompts the conclusion that EPRES-E is only applicable to western post-industrial societies, suggesting that the theoretical construct on which the instrument is grounded is limited in its ability to encapsulate the realities that stem from other socio-political trajectories. Future studies should still address whether EPRES-E is suitable for groups of workers in these countries that resemble their occidental counterparts, such those working in the public sector (Fenger 2007), in order to boost the scope of the instrument.

This study has some limitations that need to be acknowledged. First, the secondary nature of the survey prevents us from tackling specific issues, detailed in the foregoing, which would enhance our capacity to measure PE in a higher number of countries. Nevertheless, the advantages gained by using this source of information are enormously superior to this drawback in the sense that the EWCS puts out homogenized information from a substantial sample in almost all European countries every five years. This permits not only the study of PE in further waves of the survey, which will allow the monitoring of a social phenomenon that is increasingly attracting international concern, but also the unique opportunity to do so on a Europe-wide scale. Second, EPRES-E is restricted to formal employees and does not tap other forms of employment that might also show signs

of precariousness (e.g. self-employment, informal salaried employment, informal entrepreneurs,) (Benach et al. 2013; Ruiz 2018). Approaching these forms of employment would be greatly relevant for a set of countries where they are highly prevalent; mainly, those in Southern, Central and Eastern Europe (Supplementary Material 2). However, the precariousness of these forms of employment encompasses a wide set of aspects in addition to or different from those captured in both the EPRES and the EPRES-E constructs, and some of them (as mentioned earlier in this section) are not included in the EWCS, such the social protection rights to which workers are entitled (Gevaert et al. 2018; Ruiz 2018; ILO 2020). Future research should therefore explore how to tackle these features in the EWCS as well.

Nevertheless, EPRES-E demonstrates both theoretical and empirical properties of invariance that provide support for its use in up to 22 European countries. This is unprecedented in the field of PE research, particularly from a multidimensional perspective. Hence this article constitutes a significant contribution to assessing the comparability of PE in Europe, which is fundamental to deepening our understanding of the phenomenon and to working towards establishing more decent and sustainable labor markets at an internationally in an era framed by globalization. At the same time, it also stresses the importance of directing further efforts towards the incorporation of questions related to employment conditions and relations in more frequent or longitudinal international surveys such as the Labor Force Survey (LFS) or the European Union Survey of Income and Living Conditions (EU-SILC), as well as conserving the EPRES-E items in further waves of the EWCS.

Our findings are also informative for the future conceptualization and operationalization of PE from a cross-national perspective. On the one hand, they enable the inference that the precariousness of employment arrangements is unequally contoured by a number of sources that in turn emerge from the broader socio-historical, political and cultural particularities of countries. On the other hand, more conceptual and practical work is needed to identify what additional (or different) aspects delineate PE in societies other than western post-industrial.

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Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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