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Ceet - Centre d'études de l'emploi et du travail

« Le Descartes »
29, promenade Michel Simon
93166 Noisy-Le-Grand CEDEX
Téléphone : (33) 01 45 92 68 00
Télécopie : (33) 01 49 31 02 44
www.cee-recherche.fr

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NATHALIE GREENAN
nathalie.greenan@lecnam.net
Cnam, Lirsa, CEET, TEPP

MAJDA SEGHIR
majda.seghir@lecnam.net
Cnam, Lirsa, CEET, TEPP

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Measuring Vulnerability to Adverse Working Conditions: Evidence from European Countries[1]

Nathalie Greenan, Majda Seghir

Abstract

Workforce vulnerability has recently come to the forefront in European policy debate as countries searched for the potential engine of inclusive growth with an aim of protecting workers against adverse working conditions.

This paper presents a methodology to measure vulnerability at the workplace relying on a definition of vulnerable workers as carrying the burden of working under the threat of adverse physical and psychosocial working conditions. Vulnerability is thus a forward-looking concept that allows identifying workers that are the most exposed to work resource deprivations and more generally to ill-being at the workplace. Using a pseudo-panel derived from repeated cross-sectional data, second-order moments can be used to identify and estimate the variance of shocks on working conditions and, therefore, the probability of being exposed to adverse working conditions in the future. Estimates from the last editions of the European Working Conditions Survey (EWCS) provide a vulnerability measure both at the cohort level and at the aggregate one allowing for comparisons across European countries.

Keywords: *vulnerability, adverse working conditions, pseudo-panel, European countries.*

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MESURER LA VULNÉRABILITÉ À LA DÉGRADATION DES CONDITIONS DE TRAVAIL DANS LES PAYS EUROPÉENS

RÉSUMÉ

Conformément aux objectifs européens d'une croissance et d'un marché du travail plus inclusifs, la question de la vulnérabilité des travailleurs occupe un pan essentiel de la politique économique et sociale européenne.

Ce travail s'insère ainsi dans une réflexion visant à définir et à mesurer les différentes formes de vulnérabilité qui peuvent survenir et se développer dans le travail en Europe. Nous proposons un cadre conceptuel et méthodologique où la vulnérabilité est définie comme le degré d'exposition des travailleurs à des risques cumulés sur le lieu de travail, ayant des effets néfastes pour le bien-être et la santé. À cette fin, un indicateur de mauvaises conditions de travail est proposé : il agrège des facteurs relatifs aussi bien à l'environnement – qu'il soit physique ou social – qu'au contenu et à l'organisation du travail (forte intensité du travail, faible complexité, horaires atypiques). Cet indicateur synthétique est ensuite utilisé pour calculer la probabilité pour un travailleur d'être exposé à une dégradation de ses conditions de travail. C'est cette probabilité qui mesure la vulnérabilité aux conditions de travail dégradées.

Notre mesure est construite à partir des données provenant des cinq dernières éditions de l'enquête européenne sur les conditions de travail (EWCS). S'appuyant sur les techniques d'estimation en pseudo-panel, nos résultats montrent de grandes disparités de la vulnérabilité des travailleurs occupés au sein des quinze pays fondateurs de l'Union européenne. Les travailleurs de trois pays, la Grèce, l'Espagne et la France, apparaissent comme les plus exposés à la dégradation de leurs conditions de travail. Dans le cas particulier de la France, nos résultats montrent une dégradation lente mais persistante des conditions de travail, engendrant ainsi une vulnérabilité face aux risques liés au travail supérieure à la médiane européenne. Les pays nordiques, à l'exception de la Finlande, ainsi qu'une grande majorité des pays d'Europe centrale se distinguent par de meilleures conditions de travail et par une moindre vulnérabilité de leurs travailleurs.

Des facteurs démographiques, tels l'âge et le genre, constituent également des sources de variation du niveau de vulnérabilité. Les femmes sont ainsi plus vulnérables que les hommes, toutefois cette tendance n'est pas commune à tous les pays : en France et en Irlande, le risque de dégradation des conditions de travail est plus prononcé pour les hommes que pour les femmes. De même, l'évolution et la distribution de la vulnérabilité varient considérablement par tranche d'âges : elle est, en moyenne, plus élevée pour les plus jeunes (moins de 25ans) et les plus âgés (plus de 55ans).

Des disparités sont encore à noter par type d'emploi : les travailleurs indépendants et ceux pourvus de contrats de travail à durée déterminée sont plus exposés au risque de mauvaises conditions de travail. De même, les travailleurs non ou faiblement qualifiés, travaillant dans le secteur privé au sein de petites entreprises sont en moyenne plus vulnérables à la dégradation de leurs conditions de travail.

Mots-clefs : vulnérabilité, mauvaises conditions de travail, pseudo-panel, pays européens.

INTRODUCTION

The issue of vulnerability has gained prominence among social scientists and policy-makers because of its potential impact on individual well-being and economic performance especially after the global financial crisis. Notwithstanding this surge of interest, the concept of vulnerability in labour economics is somehow vague and often used interchangeably with precariousness (Burgess et al., 2013; Pollert and Charlwood, 2009). Even if the two concepts are linked, they are not identical. Precarious work implies work features that are already established as risky for employees. Non-standard work arrangements or atypical contracts and jobs with risk of redundancy are examples of precarious work (Fudge and Owens, 2006). The welfare loss resulting from precariousness is therefore certain. Comparatively, vulnerability implies a risk that has not yet materialised and which is by extension not directly observable. The difference between the two concepts has many implications in terms of assessment methodologies, policy evaluation and implementation of preventive policies.

The purpose of this paper is to identify and to analyse employees' vulnerability at the workplace across European countries. As a first contribution, this paper proposes a conceptual framework to analyse vulnerability at the workplace drawing on previous works from the economic development literature. **We define vulnerability as the existence and the extent of risks at the workplace; the danger of adverse working conditions that may threaten the worker's well-being.** Risks may emanate from the different work components and their accumulation further exacerbates the employee vulnerability. We assume that vulnerability is not restricted to some category of employees (e.g. disabled workers, migrant workers, young or older workers, women) as it is usually the case in the literature. Nor is it limited to some work-related dimensions (e.g. work arrangement, wage) or job characteristics' (working in the formal or informal sector, industry versus services). It extends to every employee in all sorts of jobs. Filling thus our purpose of identifying vulnerable employees and knowing that vulnerability is not directly observable, we opt for an identification methodology that relies on prediction and probability computation to assess the risks facing employees and by extension the extent of their risk exposition.

As the concept of vulnerability focuses on downside risks, the first step of our work consists in listing the different risks that may jeopardise employees' well-being at the workplace. Accordingly, and using the last five editions of the European Working Condition Survey (EWCS), five work-related dimensions are selected relying on previous findings in the literature (Green et al., 2013; Greenan et al., 2013): adverse physical environment, workplace violence or adverse social climate, atypical working schedules, high work intensity and low work complexity. **Relying on these five components, we construct a composite indicator of cumulative adverse working conditions which will be our aggregate measure of threatening risks at the workplace and which represents the second contribution of this paper.**

The third contribution of this paper is methodological. In fact, the vulnerability assessment raises a certain number of methodological issues that this paper endeavours to solve as follows. First, the concept of vulnerability is related to risks that are characterised by an unknown probability of realisation. All employees face multiple risks and preventive actions are desirable before their materialisation. An ex-ante assessment of vulnerability is then crucial for risk management. Based on a probabilistic approach, our vulnerability measure at the workplace is provided by the likelihood that an employee has a level of cumulative

adverse working conditions above a predefined threshold. This methodology allows identifying employees at risks – vulnerable – and taking actions to mitigate the risk-generated loss. An illustration of risk-mitigation action in the context of growing risks at the workplace is given by the demand-control model (Karasek, 1979) which emphasises high decision latitude when job demands are high. Nonetheless, identifying the risks that may threaten employees' well-being and make workers vulnerable is a pre-required step to implement preventive policies.

The remainder of this paper is structured as follows. The first section sets out the conceptualisation of vulnerability at the workplace. The following section presents the data used as well as the pseudo-panel approach followed to measure vulnerability. The third section presents the results before concluding in the last section.

1. RISK AND VULNERABILITY AT THE WORKPLACE: CONCEPT AND MEASUREMENT

1.1. Widening the concept of vulnerability to adverse working conditions

A common thread to vulnerability definitions in social sciences appears to be that vulnerability relates to a "sense of insecurity, of potential harm people must feel wary of-something bad may happen and spell ruin" (Dercon, 2006). For instance, vulnerability as defined by Chambers (1989) refers "to exposure to contingencies and stress which is defencelessness, meaning a lack of means to cope without damaging loss" [p.1]. The World development report 2000/01 defines vulnerability as the likelihood that a shock will result in a decline in well-being. Along with these definitions and applied to the specific context of employment, the TUC[2] commission defines vulnerable employment as "precarious work that places people at risk of continuous poverty and injustices resulting in imbalance of power in the employer-worker relationship". The concept of vulnerability is then used by different practitioners and the definition used as well as its assessment methodology depends on the overarching conceptual framework chosen. However, and regardless of the investigation area, the concept of vulnerability always refers to a risk chain comprising the following components: a) risk or risky events, b) options for managing risk, or the risk responses and, c) outcome in terms of welfare loss (Alwang et al., 2001).

A strong element in the literature on vulnerability comes from international economics and more precisely from development economics. This is mainly done from the perspective of poverty and applied to developing countries (Hoddinott and Quisumbing, 2008; Ligon and Schechter, 2003). Two perspectives are usually adopted: a forward looking approach and a backward looking one. The backward looking approach favours the ex-post assessment of the extent to which a negative shock caused a welfare loss when the forward looking approach focuses on the ex-ante assessment of a future welfare loss. Accordingly, an ex-ante measure requires the probability computation of a future welfare loss conventionally defined as a fall below a given benchmark. Usually, the vulnerability is assessed relying on metric money measures (e.g. income, wage or consumption) because such measures are easily compared both across individuals and across countries. However, the rising concern about multidimensional deprivations in the poverty literature widened the measure of vulnerability

[2] The Trade Union Congress in the United Kingdom (TUC) set up a Commission on Vulnerable employment. The definition provided of employment vulnerability is taken from the resulting report.

to other tangible and intangible assets in order to identify vulnerable households or individuals both in developed and developing areas.

Working life contributes strongly to most people's well-being. It takes a large part of their time and profoundly models their life experience. Despite great improvement in the quality of jobs during the last decades, especially in industrialised economies, new threats and risks have emerged and accompanied economic structural changes. Along with the question of earnings and its inherent risks of poverty and inequality, the last decades come with new risks at the workplace such as work intensification, job insecurity or mental strain, leading to the introduction of the concept of vulnerability in the labour studies literature. We can identify three strands within this literature that conceptualise vulnerability in terms of job-related risks.

First, the employment vulnerability definition and measure provided by the ILO (International Labour Organization) which is work-contract centred. Vulnerable workers operate in relatively precarious circumstances, namely as family workers or self-employed. These two categories of workers are less likely to have formal work arrangements, access to benefits or social protection programs and are more at risk to economic cycles. This definition suffers from many limitations: some salaried workers might also carry high economic risk and some self-employed workers might be quite well off and not vulnerable at all. It could be relevant however in assessing employment vulnerability in developing countries. In line with this definition but considering other aspects of work contract, another literature characterises some subpopulations as vulnerable when they are more likely to have precarious employment arrangements such as migrants or women (Costello & Freedland, 2014; Sargeant & Giovannone, 2011). A serious shortcoming of this definition of employment vulnerability is the tendency to treat vulnerability as a label fixed on a particular population and on particular employment contract characteristics.

Second and in a different vein, the employment vulnerability literature identifies low wages and non-unionism as threats to worker's well-being. The downside risk workers face is thus poverty and lack of protection rights. The poverty risk materialises, for instance, when the earned income is below some predefined threshold: one third of the median hourly wage (Hudson, 2006) or the median hourly earnings (Pollert and Charlwood, 2009). Hence low pay can be taken as an indicator of vulnerability. Goos et al. (2009) show that changes in the labour market in the last 25 years spurred a polarisation of jobs, with an increase in both the number and proportion of low paid jobs, which indicates by extension an increase in the number of vulnerable workers. However, all workers are not equally vulnerable and especially non-unionised workers are more exposed. Indeed, unions can protect from employment vulnerability by raising their members' awareness of employment rights and providing them with the resources to claim them (Pollert and Charlwood, 2009).

Concurrently to these arguments, Bewley and Forth (2010) highlight the distribution of power between employers and employees as determinant of employment vulnerability. Patterns of dependence which increase the bargaining power of employers can thus be expected to increase the risk of adverse treatment and increase employees' vulnerability, whilst patterns of dependence which increase the bargaining power of employees is expected to reduce their vulnerability. The hypothesis of power lack as determinant of employment vulnerability contrasts with a more general framework based on risk and capacity, which constitutes a third approach of employment vulnerability. O'Regan et al. (2005) and Taylor (2008) define vulnerable workers as those with higher risk of exposure and lower protection capacities. The risk content can encompass all the dimensions related to job quality, namely the work contract characteristics, the working conditions or the work itself.

While there are some attempts to conceptualise vulnerable employment, empirical evidence concentrate on a small number of risks with an ex-post approach of vulnerability assessment. To our best knowledge, Bazillier et al. (2016) are the first to construct an employment vulnerability index relying on several dimensions of work, eight in total, namely: type of employment contract, type of labour relations, establishment size, type of organisation, supervising responsibilities, capacity to decide how the daily work is performed, capacity to influence decisions about activities of the organisation and type of occupation. Nonetheless, this index suffers from being an ex-post assessment of employees' vulnerability as well as from omitting several dimensions related to working conditions and to job content.

Overall, in the literature there are several employment vulnerability measures, all focus on different and relevant aspects of work-related risks. However, it is possible to assess employment vulnerability, looking at all the risks that workers may face. Borrowing from the development literature, this paper relies on an ex-ante approach to anticipate workers that are likely to face adverse working conditions in the future, conditional on individual and work related characteristics. The ex-ante vulnerability assessment allows identifying employees at risk in advance and thus is an information source for policies targeting.

1.2. Measuring vulnerability to adverse working conditions

In this paper, we define vulnerability as the existence and the extent of risks at the workplace; the danger of adverse working conditions that may threaten the worker's well-being. Though complementary to previous works on employment vulnerability, our approach is different. It is an attempt to encompass the multidimensional aspects of job quality and the various associated risks that may jeopardise employees' well-being.

Relying on a risk-based definition of vulnerability, the aim is to identify workers at risk of adverse working conditions in the future based on their current standing, so that it is an ex-ante, forward looking measure. Accordingly, employee vulnerability is quantified by considering the probability to face adverse working conditions in the future that is having predicted adverse working conditions above a predefined threshold, conditional on both the jobs' and employees' characteristics.

The probability can be stated as follows:

$$v_{it} = \Pr(I_{i,t+1} > z_t) \qquad (1)$$

where $I_{i,t+1}$ is the value of adverse working conditions at time $t+1$ for employee i and z_t is the threshold of a socially acceptable level of exposure to adverse working conditions. The issue with this measure is that $I_{i,t+1}$ is not observable, so this approach requires making predictions about the employees' future exposure. To obtain an estimate of the future state of adverse working conditions, we begin by specifying their determinants and allowing predicted changes in these various determinants to condition the future expectations of adverse working conditions. Accordingly, the first step consists of estimating the following equation:

$$I_{i,t} = \beta X_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \qquad (2)$$

where $X_{i,t}$ represents a bundle of employee as well as job characteristics, α_i is unobservable individual-specific factors, δ_t captures the time fixed effect and $\varepsilon_{i,t}$ is a time-varying idiosyncratic disturbance which captures unobservable shocks. The objective from the estimation of this equation is not the estimation of the marginal effects per se, but rather using the marginal effects to create an estimate of the expected level of exposure to adverse working conditions at period $t+1$. If shocks are unanticipated perturbations, then it seems

reasonable to assume that the mean of these shocks is zero leading thus to the underlying assumption that $\varepsilon_{i,t}$ is a zero mean disturbance term. The expected exposure to adverse working conditions are thus given by $E\left[I_{i,t+1}\right] = \hat{\beta}X_{it} + \hat{\alpha}_i + \hat{\delta}_{t+1}$.

From (Equation 1), employees' vulnerability to adverse working conditions depends, not just on their expected (i.e. mean) exposure looking forward, but also on its variability (i.e. variance, from an inter-temporal perspective). Therefore, to go from an estimate of adverse working conditions to a measure of employees' vulnerability, we need to estimate the variance of their future exposure to adverse working conditions. Within the context of cross-sectional data, the disturbance term is interpreted as the intertemporal variance of exposure to adverse working conditions. Viewed from this perspective, the assumption that the variance of exposure to adverse working conditions is the same for all employees (i.e. the underlying assumption of homoscedasticity) seems quite restrictive. Further, unlike in other setting where failure to take into account heteroscedasticity results in a loss of efficiency but need not bias the main parameters of interest, here, the standard deviation of the disturbance term enters directly in generating an estimate of vulnerability. A biased estimate of this parameter will lead to biased estimate of vulnerability (Chaudhuri, 2003). When data is longitudinal, we can use the estimate of expected working conditions to derive an estimate of the employee's variance of working conditions computed as the average squared deviation of observed working conditions from expected ones: $Var\left[I_{i,t}|X_{i,t}, \hat{\beta}, \hat{\alpha}_i, \hat{\delta}_t\right] = \hat{\sigma}_{I_i}^2$. The variance of working conditions thus takes into accounts both the employee and the job characteristics.

Once the moments of the distribution of exposure to adverse working conditions are estimated, the following step consists in determining the exposure threshold above which an individual is considered vulnerable. As it is difficult to establish an absolute reference or benchmark for adverse working conditions, we opt in this study for a relative definition of vulnerability, meaning that the threshold of adverse working conditions is established as the EU-15 median of adverse working conditions per survey edition. Such a choice puts the focus on convergence between European countries towards a common benchmark.

With these two moments of the distribution of adverse working conditions distribution estimated, we can provide a measure of vulnerability, approximated by the probability to have a level of adverse working conditions above the threshold z_t:

$$\phi\left[\frac{lnz_t - E\left[I_{i,t+1}|X_{i,t}, \hat{\beta}, \hat{\alpha}_i, \delta_t\right]}{\sqrt{Var\left[I_{i,t}|X_{i,t}, \hat{\beta}, \hat{\alpha}_i, \delta_t\right]}}\right] \quad (3)$$

where ϕ is the normal cumulative distribution function.

2. DATA AND EMPIRICAL FRAMEWORK

The assessment of vulnerability to adverse working conditions is a tree-stages procedure. The first stage identifies actual characteristics that are associated with adverse working conditions. In a second stage, a composite indicator of adverse working conditions is constructed. Then, the third stage computes probabilities of being exposed to adverse working conditions. The empirical methodology results in an estimate of a value of the adverse working conditions threshold, used to construct the probabilities associated with vulnerability.

2.1. Data sources

In these stages, we rely on the five latest editions of the European Working Conditions Survey (EWCS)[3]: 1995, 2000, 2005, 2010 and 2015 to identify workers facing adverse working conditions in 15 European countries. This survey is carried at home (i.e. outside the workplace) and is questionnaire-based. The population target is the working population, aged 15 years and over and living in each of the Member States. The target number of interviews is 1,000 in all countries, except for Luxembourg (target 500)[4]. After deleting missing or incomplete observations, the remaining samples per edition have the following sizes: 12,539 workers for 1995, 17,998 for 2000, 12,266 for 2005, 17,776 and 17,798 for 2010 and 2015 respectively.

In this paper and in order to allow for time comparison, we include only countries that were surveyed on a regular basis since 1995, namely: Austria, Belgium, Denmark, Germany, Greece, Italy, Luxembourg, Spain, France, Ireland, the Netherlands, Portugal, the United Kingdom, Finland and Sweden. For issues of sample size in the development of our methodology, we have aggregated Belgium with Luxembourg. As a result, EU-15 is decomposed into 14 national entities and the acronym "Blu" refers to Belgium and Luxembourg.

2.2. Designing an Adverse Working Conditions Index (AWCI)

Relying on the five editions of EWCS, the first step is to design an adverse working conditions index.

2.2.1. The AWCI sub-components

Ideally, an adverse working conditions index (AWCI) should measure the cumulative risk exposure at the workplace. In designing our AWCI, we retained the components that reflected the main risks that could occur at the workplace and that were measured in the same way throughout the five editions of the survey. The AWCI compiles five sub-indices that capture different threats to employees' well-being and health, namely: adverse physical environment, workplace violence or adverse social climate, atypical working schedules, high work intensity and low work complexity. The choice of these structuring dimensions reflects a number of considerations. On the one hand, all these dimensions are identified by the empirical literature as central issues that affect workers' welfare (Green et al., 2013; Greenan et al., 2013). On the other hand, data limitations inevitably curtailed the choice of sub-indices. The EWCS offers a broad coverage of risks related to working conditions; however, the survey focus differs from one edition to the other. Therefore, purpose of time and country comparison limits the number of dimensions that could be considered in our composite

[3] The EWCS is performed by the European Foundation for the Improvement of Living and Working conditions (Eurofound) to gather information about working conditions, quality of work and employment in order to contribute to the planning and design of policies aiming at the improvement of living and working conditions in Europe.

[4] Detail on the methodology and characteristics of the EWCS can be found at the Eurofound's website: https://www.eurofound.europa.eu/

indicator. Notwithstanding data constraints, the AWCI takes into account several aspects of adverse working conditions that are organised as follows[5]:

- Adverse physical working environment indicator: as workplace nuisances, environmental hazards and poor postures are well-identified sources of risk at the workplace and by extension of workers' vulnerability. This indicator includes the following 9 questions: exposition to vibrations from used tools, loud noise, low and high temperatures, breathing in smoke or fumes, exposition to dangerous substances, painful position, carrying or moving heavy loads and doing repetitive movement. In the economic literature these job disamenities have a negative impact on employees' welfare and thus they should be associated with a wage premium. They also generate occupational health and safety risks. The wage-risk trade-off has been used to compute the statistical value of risks to life and health (Viscusi, 1993).
- Adverse social climate or workplace violence indicator (6 questions): It is represented by perceived cases of discrimination such as those related to age, sexual orientations, ethnicity, disability, nationality or exposition to unwanted sexual attention. The meta-analysis by Pascoe & Richman (2009) show that perceived discrimination has a significant negative effect on mental and physical health as it both produces significantly higher stress responses and interacts with either the participation in unhealthy behaviours or the non-participation in healthy ones.
- Atypical working schedules indicator (4 questions): It is based on information about night work, Sunday or Saturday work and shift work. These atypical working schedules are showed to be detrimental to the well-being and work-life balance of workers and their families (Fagan et al., 2012). There is also evidence that they impair health through three channels: disturbed body clock, shortened and disturbed sleep and disturbed family and social life (Tucker and Folkard, 2012).
- High work intensity indicator (8 questions): It may be conceptualised as comprising an intensive perspective (e.g. short repetitive tasks of less than 10 minutes, working at very high speed or to tight deadlines) combined with a work pressure component (e.g. pace of work dependent on the work done by the colleagues or by external people, pace of work dependent on numerical production targets or on machine, pace of work dependent on the direct control of boss). Work intensity is a measurement of the effort engaged by the worker to perform his task. From an economic standpoint, it generates a disutility which is compensated by the wage. If we refer to the psychosocial model developed by Karasek (1979) work intensity is a component of job demands, the other main component being role conflict. High job demands are sources of job stress, but their relationship with job satisfaction and well-being is ambiguous. Using nationally representative data for Britain in 2001, 2006 and 2012, Green et al. (2016) find however that high work intensity is associated with low job-related well-being. Furthermore, work intensification accounts significantly to the fall in job-related well-being observed through the great recession, and all the more so when it is not accompanied by rises in task discretion or organisational participation in decision-making.
- Low work-complexity indicator (10 questions): It includes items related to the characteristics of tasks, how they are performed and the associated learning process. Low work complexity entails low task discretion (no possibility to choose or change the order of tasks or the methods of work), low skill use (simple and monotonous tasks, no quality standards nor self-assessments of quality) and low skill development (no job rotation, no support from colleagues, no on the job learning). Low work-complexity limits job

[5] A detailed description of the questions used is provided in the Appendix A1.

opportunities, skills development and may be detrimental to employee's cognitive and emotional functioning (Frese, 1982). Work complexity shares many common features with job control as defined in the Job Demand-Control model (Karasek, 1979). Combined with high job demands, low job control lead to high strain jobs associated with low job satisfaction and well-being and detrimental health effects. In a more recent paper, Karasek argues that absolute low control in social organisations can contribute to the development of chronic disease through the deregulation of highly integrated physiological systems (Karasek, 2008). Indeed, decision latitude is a major resource for developing strategies to maintain the stability of internal physiological processes in the turbulent context of globalised economies.

2.2.2. Methodological choices to aggregate the components of the AWCI

Our composite indicator captures exposure to cumulative risks engendered by workplace organisation and practices. The construction of a composite indicator usually yields a number of methodological issues. There is no single way of composition and each method has his pros and cons as summarised in the OECD handbook (2008). The structuring steps are nevertheless the same and can be grouped in three stages: normalisation, weighting and aggregation.

First of all, and in order to construct a composite indicator of adverse working conditions, the individual answers from the EWCS are recoded to respect the following rule: the higher the value, the most adverse the working conditions. The lower grade corresponds therefore to the best working conditions while the higher grade is synonym of adverse working conditions. The different elements (variables, indicators or dimensions) have then to be brought to a unified scale to allow for a meaningful summation and to permit composition. In this paper, normalisation to a 0-1 range is adopted with 0 corresponding to the most favourable working conditions while 1 refers to the most adverse working conditions.

Once the individual answers are normalised, a weighting scheme should be adopted to determine the relative importance of the different items in the sub-indices on the one hand and the weights of the sub-indices in the composite indicator on the other hand. The issue of weighting is arguably one of the most difficult aspects of constructing a composite indicator and the literature offers several weighting procedures such as statistical methods, participatory methods or normative methods (see Decancq and Lugo [2013] for a detailed presentation of the different weighing approaches). However, there is no consensus regarding the reliability of one method over the others and the choice of the weighting methodology is often related to the purpose of the indicator. In our case, the objective of the AWCI indicator is to capture the cumulative risk exposure at the workplace. The issue then is what weight to attach to adverse physical environment vis-à-vis the adverse social climate or how much weight should be placed on atypical working schedules and on high work intensity. Weighting requires a system of valuation of the different risks threatening workers' well-being that is difficult to define because the risk perception differs among workers and over time. Therefore, an unequal weighting of the different components of the composite indicator may bias results as the individual preferences and by extension the answers depends on the individual context (Tangian, 2007). Consequently, we choose an equal weighing procedure to aggregate the five sub-components in AWCI.

For the aggregation of the variables into each sub-index, two different strategies are used. The first strategy is again an equal weighing procedure where the variables are simply summed up. The advantage of this procedure is its simplicity, making it easily reproducible. The drawback is that the questions in the EWCS have not been designed in relation to a

scientifically validated scale. Indeed, it would be very difficult to find a general agreement among the various users of the survey, coming from different institutional and academic background. We thus use a data-driven method, a principal component analysis to capture each type of risk, considering that it is a latent variable which cannot be directly observed but which can be approached through a set of partly redundant variables. Each sub-index results from the factors of a principal component analysis including the associated set of variables. We retain the first factor for adverse physical conditions, adverse social climate, atypical working schemes and low work complexity. It represents respectively 42%, 34%, 49% and 42% of total variance and it is built on the opposition between high and low levels of each variable entering the index, with a weight depending on the correlations between variables. For the high work intensity index, we use the first two factors, representing respectively 28% and 14% of total variance. The first factor represents high intensity driven by technical constraints when the second factor represents high intensity driven by market forces[6].The high intensity index sums up the two factors once standardised. We use this second composite indicator in robustness checks. It is referred to as (AWCIpca) throughout the paper.

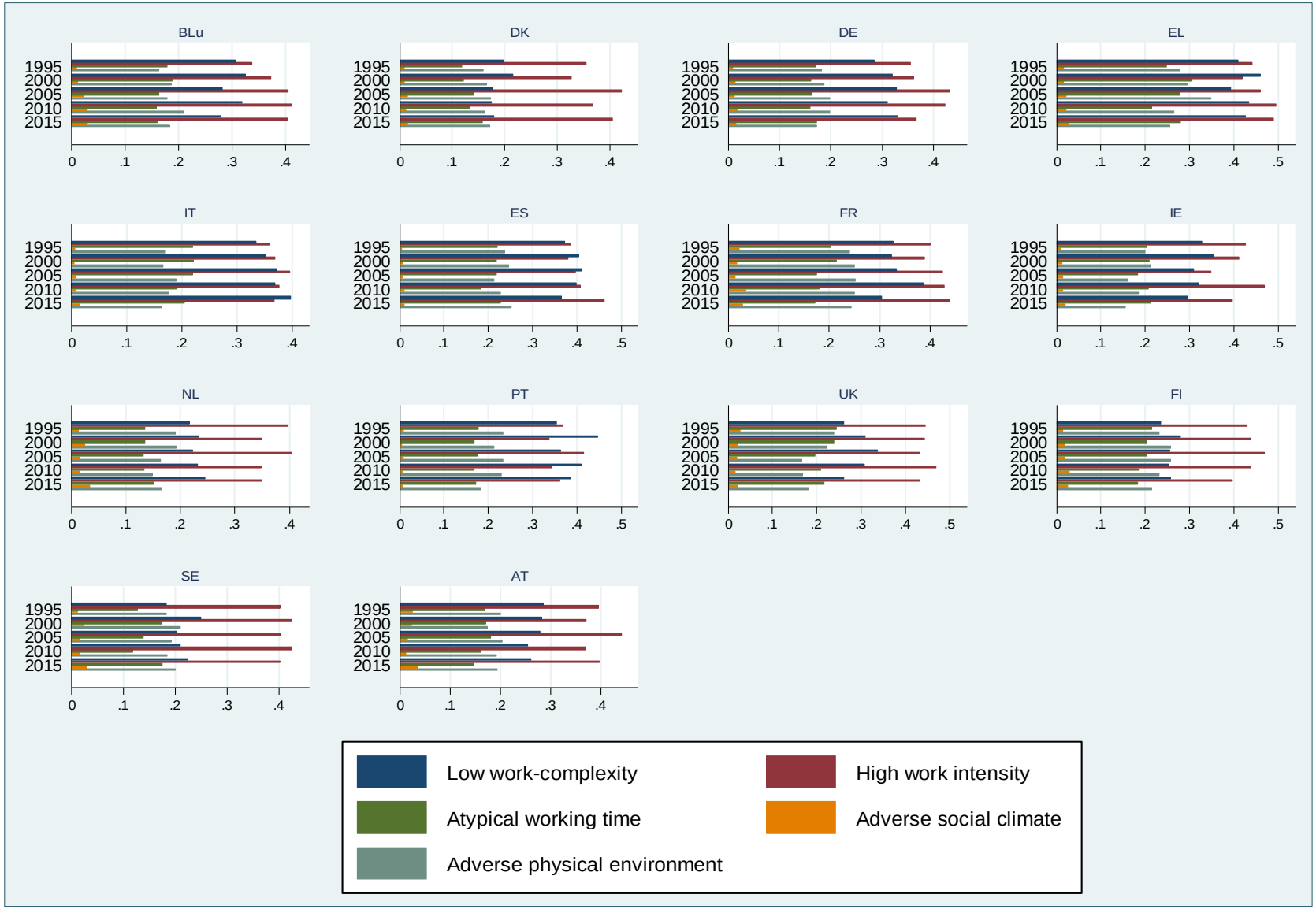
Figure 1 illustrates the time evolution, per country, of the mean value of each of the five sub-indices used in computing the AWCI indicator namely: low-work complexity, atypical working schedules, adverse physical environment and social climate and high work intensity. At first sight, we can note that a common threatening risk in almost all the countries is high work intensity. While the time trend is upward since the 90's with the highest value recorded in 2010 for Belgium and in 2015 for both France and Spain, we observe a cyclical pattern for some countries with rises and falls in the level of work intensity. Such pattern is clearly observed in Denmark, Greece, Ireland, the Netherlands, Portugal or Austria. Along with high work intensity, the second major workplace risk is low work-complexity. Regarding this component, two groups of countries stand out: countries with very low level of work complexity such as Spain, Greece and Italy and countries with varying and relatively high levels of work complexity like Germany, France, the United Kingdom and Portugal. The distribution of the remaining risks seems more homogeneous across countries and over time. For instance, and surprisingly, the quality of the physical working environment has not improved much since 1995. Similarly, the prevalence of atypical working hours among workers is somehow identical from one year to the other and across European countries. Finally, and even if the adverse social climate represents a very marginal risk in comparison with the other risks, Figure 1 shows an increasing perception of social discrimination in some countries such as France, Finland, Sweden, Austria, the Netherlands, Belgium, Luxembourg and Greece.

Turning to the AWCI, Table 1 reports some descriptive statistics per survey year and country[7]. The global trend shows an increase in 2000 compared with 1995 and another, smaller increase in 2010 compared with 2005. This suggests a development of workers' vulnerability in economic booms as well as in recessions. However, if we look at country averages, we find an increase in average vulnerability in almost all countries in 2000, but this is not the case in 2010 as average vulnerability increases in four national entities only: Belgium & Luxembourg, France, Ireland and the United Kingdom. In every country, the AWCI shows a normal distribution, more or less skewed to the right depending on the year and the country considered (see Figure A1 in Appendix A3).

[6] This result on the two independent sources of work intensity is also found by Greenan et al. (2013).

[7] Table A1 in the Appendix A3 reports desriptive statistics of the AWCI (pca) per survey year and country.

Figure 1. Average sub-indices per country and per survey edition



Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT), Germany (DE), Belgium &Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK)

Table 1. Descriptive statistics of AWCI per survey edition and country

	1995		2000		2005		2010		2015	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
BLu	1.003	0.475	1.086	0.471	1.053	0.477	1.131	0.484	1.057	0.464
DK	0.844	0.421	0.840	0.396	0.933	0.425	0.853	0.420	0.932	0.400
DE	1.007	0.498	1.041	0.484	1.133	0.495	1.110	0.484	1.059	0.474
EL	1.399	0.531	1.494	0.493	1.503	0.558	1.431	0.553	1.483	0.478
IT	1.091	0.442	1.118	0.448	1.188	0.463	1.124	0.436	1.152	0.468
ES	1.223	0.492	1.255	0.480	1.249	0.486	1.234	0.475	1.323	0.514
FR	1.192	0.515	1.192	0.502	1.201	0.497	1.281	0.564	1.186	0.514
IE	1.167	0.475	1.204	0.488	1.020	0.459	1.199	0.490	1.081	0.481
NL	0.957	0.458	0.936	0.446	0.943	0.431	0.883	0.410	0.949	0.451
PT	1.148	0.480	1.174	0.458	1.202	0.460	1.163	0.465	1.115	0.422
UK	1.219	0.505	1.237	0.519	1.154	0.479	1.170	0.502	1.114	0.481
FI	1.123	0.473	1.200	0.473	1.209	0.471	1.145	0.466	1.082	0.458
SE	0.914	0.453	1.083	0.448	0.957	0.403	0.958	0.402	1.032	0.461
AT	1.076	0.487	1.023	0.510	1.122	0.531	0.989	0.481	1.037	0.514
All	1.083	0.497	1.136	0.497	1.128	0.495	1.134	0.502	1.126	0.494

Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT) , Germany (DE), Belgium & Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK)

2.3. Determinants of adverse working conditions

Relying on the set of employee information available in the European Working Conditions Survey, the determinants of adverse working conditions that we are able to approach are a combination of socio-demographic background, employment contract and firm characteristics. Table 2 presents some descriptive statistics of the main variables used for the whole sample and by country. About two thirds of EU-15 workers live with a partner or are main contributor to the household income. There are few disparities regarding these variables across countries. Family responsibilities are less equally distributed: more workers have no children under the age of 15 in Germany, Austria, Italy and Spain when workers in Belgium, Denmark, France and Ireland are more often parents of young children. A majority of EU-15 workers are salaried (85.2%), but there are large disparities across countries. In particular, self-employment is widespread in Greece (29.8%), Italy (25.2%), Spain (17.5%) and Ireland (16.8%). Similarly, the unlimited contract is the most common employment arrangement with a proportion of 68% across Europe. However, some countries such as Greece, Spain, Portugal, Ireland and Italy record shares of permanent contract which are far below the European average (41.4%, 53%, 57.5%, 58.9% and 59% respectively).

Table 2. Descriptive statistics of adverse working conditions determinants

In %	BLu	DK	DE	EL	IT	ES	FR	IE	NL	PT	UK	FI	SE	AT	ALL
***Living with a partner*:**															
Yes	68.1	73.8	64.5	64.9	63.2	62.2	63.6	63.1	69.0	69.7	67.4	65.5	66.9	62.5	66.0
Main breadwinner:															
Yes	67.8	65.1	71.1	64.9	60.4	68.7	69.4	68.0	64.2	63.8	65.6	72.3	69.6	68.5	67.3
Number of children under 15:															
None	59.4	58.8	71.7	64.0	69.2	68.3	58.6	57.7	63.2	61	62.3	60.4	64.2	65	63.1
One child	19.2	18.9	16.8	18	18.3	19.0	20.3	16.4	14.1	25.1	17.1	18.9	16	18.2	18.4
2 children	16.0	17.6	9.7	14.7	10.8	10.9	15.8	15.3	16.6	11.5	15.7	14.2	14.9	13.5	14.0
3 children	4.21	4.4	1.6	2.5	1.5	1.5	4.2	7.7	4.9	1.9	1.7	5.1	4	2.8	3.5
4 or more children	1.1	0.6	0.2	0.7	0.2	0.2	1.0	3.0	1.2	0.5	1.1	1.3	1.0	0.5	0.9
Employment status:															
Self-employed	11.3	5.5	8.3	29.8	25.2	17.5	10.1	16.8	9.5	21.1	10.3	12.3	6.7	11.7	13.5
Employees	87.0	93.2	90.7	69.5	73.0	81.5	87.7	82.1	89.2	77.5	89.0	86.1	92.5	86.6	85.2
Other	1.7	1.3	1.0	0.7	1.8	1.1	2.2	1.0	1.4	1.4	0.7	1.5	0.7	1.7	1.3
Employment contract :															
Unlimited permanent contract	75.8	78.1	77.3	41.4	59.0	53.0	71.6	58.9	72.4	57.5	73.2	69.3	80.0	74.6	68.3
Fixed-term contract	6.4	7.3	8.9	6.1	7.0	20.3	10.6	7.4	11.8	10.8	6.9	12.3	7.6	5.1	9.3
Temporary employment agency contract	2.3	1.4	0.9	1.9	1.6	2.2	2.2	2.8	2.1	1.6	1.9	0.6	2.4	0.8	1.8
Apprenticeship or other training scheme	0.6	1.7	1.7	0.6	1.6	0.7	0.8	1.1	0.5	0.9	0.5	0.7	0.2	1.2	0.9
Other	1.8	5.2	2.4	19.6	4.6	6.1	2.7	11.5	2.6	6.5	5.9	2.7	2.1	4.2	5.0
Occupation:															
Legislators, senior officials & managers	7.9	7.6	4.8	9.1	4.9	6.1	5.9	9.9	10.1	7.5	11.4	6.5	8.8	7.7	7.6
Professionals	19.1	21.3	7.4	13.8	12.4	11.3	11.7	16.3	18.3	9.1	15.5	14.6	21.5	6.9	14.3
Technicians & associate professionals	14.4	20.6	17.2	6.2	17.2	9.9	17.3	10.4	17.0	6.1	11.7	17.8	19.9	16.2	14.5
Clerks	15.5	9.9	15.4	11.5	17.1	15.1	12.8	11.1	14.8	11.4	11.5	10.5	11.5	15.1	13.4
Service workers and shop, market sales workers	14.8	14.6	19.8	17.0	15.0	17.8	18.5	17.6	14.2	15.7	19.0	15.6	15.3	20.1	16.8
Skilled agricultural & fishery workers	1.0	0.6	1.5	9.4	1.5	2.8	2.3	5.1	0.9	4.8	1.2	4.2	0.8	2.3	2.5
Craft & related trades workers	10.4	11.7	17.1	16.7	14.8	14.8	12.4	10.8	9.6	17.8	10.6	13.4	8.5	14.3	12.9
Plant and machine operators & assemblers	5.3	5.5	6.9	7.0	6.1	5.4	5.7	8.1	5.8	10.1	7.6	8.2	7.0	5.6	6.6
Elementary occupations	11.1	7.7	9.5	8.1	10.4	16.4	13.0	10.1	8.7	16.5	11.2	8.6	6.1	11.3	10.9
Armed forces	0.5	0.5	0.4	1.2	0.5	0.3	0.5	0.6	0.4	1.0	0.2	0.6	0.7	0.5	0.5
Company ownership:															
Public sector	28.3	38.5	17.5	18.8	23.9	17.2	24.9	28.0	21.1	19.8	31.6	36.1	41.6	21.1	26.1
Business sector	70.0	60.8	81.5	65.8	74.4	80.8	73.0	65.7	75.9	77.0	65.9	62.5	57.3	76.9	71.1
Other	1.7	0.7	1.0	15.4	1.6	2.1	2.1	6.3	3.0	3.2	2.5	1.4	1.0	2.0	2.8
Workplace size:															
1 employee	7.1	3.6	3.5	17.3	15.6	14.5	11.4	10.9	5.7	15.9	6.7	8.4	4.5	7.6	9.1
2-9 employees	22.3	15.6	28.3	39.2	31.6	33.3	27.0	27.0	16.2	32.0	17.0	27.2	17.6	29.5	25.4
10-49 employees	26.9	31.3	29.9	23.4	21.4	23.5	22.8	26.8	25.6	23.8	26.8	30.5	32.0	26.5	26.6
50-499 employees	29.1	31.2	25.1	14.2	18.7	18.8	25.7	23.1	33.7	20.8	28.4	22.1	28.2	23.0	25.1
500 or more employees	14.6	18.3	13.2	5.9	12.7	10.0	13.2	12.3	18.7	7.5	21.1	11.8	17.8	13.3	13.9
Sector:															
Agriculture, hunting, forestry and fishing	3.6	6.5	10.0	13.5	8.3	8.4	5.5	10.4	7.9	11.1	4.7	9.9	6.1	8.4	7.7
Industry	16.9	20.8	23.1	21.6	22.1	19.5	18.3	21.5	19.8	26.9	19.0	29.4	18.7	24.1	21.0
Services (excluding public administration)	49.2	36.0	40.7	43.6	43.4	44.2	45.8	42.5	38.7	36.0	43.6	35.4	35.5	42.1	42.1
Public administration and defence	9.5	11.1	9.4	7.8	9.9	6.9	9.2	7.5	9.6	9.5	11.3	5.9	13.1	7.8	9.2
Other services	20.7	25.6	16.8	13.5	16.3	21.0	21.1	18.1	24.0	16.4	21.3	19.4	26.7	17.5	20.0

Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT), Germany (DE), Belgium & Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK).

Company ownership varies significantly from one country to the other, showing large disparities in the size of the public sector which is much smaller in the Mediterranean than in the Nordic countries. The distribution of occupations is quite homogeneous across European countries, except for highly skilled occupations, skilled agricultural & fishery workers and elementary occupations that are unequally represented. The distribution of the economic sectors differs widely from one country to another except for the service sector which is the prevailing sector in EU-15 (42.1%) as well as for each country. The establishment size is classified into five categories according to the number of employees. The share of employees working in establishments with one employee or in establishments with more than 500 employees is small in comparison with other categories (9.1% and 13.9% respectively for EU-15). Micro-companies (2-9 employees) and small companies (10-49 employees) represents nearly 57% of the sample of employees in Greece, while medium-sized companies (50-499 employees) is the most underrepresented size group. Large companies (more than 500 employees) are predominant in the United Kingdom (21.1%), the Netherlands (18.7%) and Denmark (18.3%) when they are and scarce in Greece (5.9%) and Portugal (7.5%).

Other natural and well-identified determinants of working conditions in the literature include union representation. Adverse working conditions and vulnerabilities arise when the workers are not aware of their employment rights and when they lack the resources to defend them. Information on the presence of unions would be very useful to explain the levels of adverse working conditions but unfortunately, such data is only available in the 2015 edition of the survey. A question on involvement in political/trade union activities outside work could be a proxy, but as it was introduced in the survey in 2000, we lack this information for 1995. Similarly, data on wages and education (even if the occupational status may be viewed as a good proxy of the educational attainment), though provided in some editions, suffer from a lot of missing values.

2.4. The pseudo-panel

Tackling the issue of work-related vulnerabilities as well as their time evolution requires longitudinal data that are seldom available within the context of working conditions surveys. Although repeated cross-sectional data have the obvious drawback of not tracking the same individuals over time, they have some advantages such as less attrition and non-response problems in comparison with panel data (Ridder & Moffitt, 2007). Nonetheless, repeated cross-sectional surveys may offer an alternative that allow exploring time variations by using pseudo-panel techniques, as pioneered by Deaton (1985). Pseudo-panel consists of grouping individuals into cohorts that we are able to follow over time making use of all the cross-sectional information available at a point in time. To obtain consistent estimators, from a pseudo-panel, grouping variables should not present missing values for any individual in the sample, should be time invariant and exogenous (Verbeek, 2008). The number of cohorts should be large enough to avoid measurement error problems and similarly the size of each cohort has to be large.

In this paper, the used grouping variables[8] consist of gender, country and birth year in ten year spans[9]. After grouping, 140 cohorts are constituted and may be tracked over the five

[8] Further details about the pseudo-panel construction are provided in the Appendix A2.

[9] The grouping variable is often based on the date of birth (resulting in age cohorts), however defining cohorts over more than one dimensions is also possible as Duval-Hernandez and Orraca (2009) who use birth year, gender and educational attainment or Arestoff and Djemai (2016) who use birth year and country.

used editions of the EWCS. Table 3 reports the average number of individuals per country-cohort. The size of each cohort is sufficiently large to avoid sample size problems with an average of 167 individuals per cohort.

Table 3. Structure of the pseudo-panel: number of individual per country-cohort

Country	Number of cells	Mean	Min	Max
BLu	50	225	24	671
DK	50	93	28	182
DE	50	141	43	260
EL	50	81	15	234
IT	50	99	14	220
ES	50	129	32	424
FR	50	139	21	421
IE	50	91	18	218
NL	50	97	19	213
PT	50	91	16	168
UK	50	112	39	193
FI	50	91	10	168
SE	50	91	8	169
AT	50	84	27	195
All	700	167	8	671

The individual observations of the selected variables are averaged over cohorts leading to an equation expressed in terms of cohort weighted means (i.e. taking into account survey weights), which then becomes the units of observation in the pseudo-panel. Equation (2) becomes:

$$\bar{I}_{c,t} = \beta \bar{X}_{c,t} + \alpha_c + \delta_t + \bar{\epsilon}_{c,t} \qquad (4)$$

where $\bar{I}_{c,t}$ is the averaged adverse working conditions index of cohort c at time t, α_c represents the cohort fixed effects, δ_t captures the time effect and $\bar{X}_{c,t}$ are the mean[10] of both employee and job characteristics in each cohort. Hence, the pseudo-panel allows following cohorts over time through the mean of intra-cohort observations.

3. ESTIMATION AND ANALYSIS OF VULNERABILITY

3.1. Vulnerability estimates

Our estimates of vulnerability to adverse working conditions follow the different steps recalled in the methodology section. Accordingly, we begin by estimating the expected mean and variance of adverse working conditions relying on Equation (4). Then in a second step

[10] A weighting adjustment is made in the computation of each cohort mean.

the vulnerability measure is obtained by computing the likelihood of an expected level of the adverse working conditions index being above a predefined threshold (Equation (3)).

Table 4 presents the results from the weighted least-squares estimation in the pseudo-panel data. Columns 1-2 display the result of the estimation of Equation (4) where the dependent variable is the logarithm of our indicator of adverse working conditions. In order to check the result sensitivity to the methodology used to construct this indicator, we report in column 1 the results obtained from the AWCI indicator and in column 2 the results from the AWCIpca indicator. Overall, results are convergent regardless of how the indicator is designed. The remaining of the paper is based on the use of the AWCI indicator.

First, being the main contributor to the household's income increases the risk of adverse working conditions since such workers are more reliant on their jobs and may bear more risks than workers without such responsibility. Having two children also increases risk exposure compared with workers who are not parent. However, the relationship of AWCI with the number of children is non-linear. Exposure to adverse working conditions is the lowest for workers with three children and the highest for workers with two children. Risk exposure is comparable when workers have no children, one child or four or more children. When these variables are taken into account, marital status has no influence on the AWCI. If we now turn to the employment contract characteristics, we see that self-employed are less exposed to adverse working conditions compared with employees, but the estimated coefficient is non-significant. Furthermore, employees under fixed-term contracts are more exposed to adverse working conditions than employees under permanent contract, but individuals in apprenticeship or training situation bear the lowest risks. We do not find any significant relationship between tenure and exposure to adverse working conditions. Considering the occupational status armed forces bear the highest risk of exposure to cumulative workplace risk, followed by skilled blue collar workers (craft and related trade workers and plant and machine operators and assembly workers). Elementary occupations and service workers and sellers have the same level of exposure as legislator, senior officials and managers, when clerks, technicians and professionals are less exposed. Finally, company ownership and sector have an influence on AWCI, but the relationship with workplace size is non-significant. More precisely, workers from service activities in the business sector are more exposed than public sector employees or employees in the manufacturing industry.

Table 4. Fixed effect model of the Adverse Working Conditions Index

Variables	AWCI(1)		AWCIpca(2)	
Age	-0.0231	(0.019)	0.0010	(0.019)
Age-squared	0.0127	(0.018)	-0.0074	(0.018)
Living with a partner	-0.0081	(0.046)	-0.0319	(0.045)
Main breadwinner	0.1149***	(0.040)	0.1132***	(0.039)
Number of children under 15, reference None				
One child	-0.0272	(0.054)	-0.0708	(0.053)
2 children	0.1308*	(0.076)	0.1267*	(0.074)
3 children	-0.3423**	(0.160)	-0.3436**	(0.158)
4 or more children	-0.0864	(0.277)	-0.0596	(0.272)
Employment status, reference Employed				
Self-employed	-0.1521	(0.156)	-0.1296	(0.153)
Other	-0.0986	(0.118)	-0.1367	(0.116)

Employment contract, reference Unlimited employment contract				
Fixed-term contract	0.1680***	(0.054)	0.1005*	(0.053)
Temporary employment agency contract	-0.0084	(0.102)	-0.0859	(0.101)
Apprenticeship or other training	-0.3969***	(0.144)	-0.3142**	(0.142)
Other	-0.2026***	(0.051)	-0.1240**	(0.050)
Tenure	0.0024	(0.002)	0.0013	(0.002)
Occupation, reference Legislators, senior officials & managers				
Professionals	-0.3001***	(0.082)	-0.3133***	(0.081)
Technicians and associate professionals	-0.2584***	(0.082)	-0.2594***	(0.081)
Clerks	-0.1327	(0.091)	-0.2034**	(0.089)
Service workers/shop and market sellers	0.0406	(0.080)	0.0010	(0.078)
Skilled agricultural and fishery worker	0.1530	(0.116)	0.1612	(0.114)
Craft and related trade workers	0.2228**	(0.089)	0.1565*	(0.087)
Plant and machine operators and assembly workers	0.3058***	(0.098)	0.1990**	(0.096)
Elementary occupations	0.0256	(0.084)	-0.0058	(0.083)
Armed forces	0.9424***	(0.247)	0.7829***	(0.243)
Company ownership, reference Private				
Public	-0.1625***	(0.049)	-0.1369***	(0.048)
Other	0.1408**	(0.064)	0.0609	(0.063)
Workplace size, reference 50-499 employees				
1 employee	0.0532	(0.070)	0.0370	(0.068)
2-9 employees	-0.0346	(0.050)	-0.0357	(0.049)
50-499 employees	0.0107	(0.047)	0.0243	(0.046)
500 or more employees	0.0827	(0.053)	0.0906*	(0.052)
Sector, reference Industry				
Agriculture, hunting, forestry and fishing	0.0230	(0.063)	0.0463	(0.062)
Services (excluding public administration)	0.0917**	(0.042)	0.1450***	(0.041)
Public administration and defence; compulsory social sector	0.1033*	(0.057)	0.1295**	(0.056)
Other services	0.1213**	(0.049)	0.1634***	(0.049)
Year fixed effect	YES		YES	
Cohort fixed effect	YES		YES	
R2(Within)	0,34		0,31	
Number of cohort	700		700	
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

As our interest lies in the measurement of vulnerability, the estimation of the conditional distribution of adverse working conditions is of primary importance since both the predicted value and the variance of working conditions enter in the vulnerability measure. Nonetheless, using pseudo-panel allows dealing with some shortcomings linked to repeated cross section data such as not taking into account fixed effect and the difficulty to obtain unbiased estimates of the variance-covariance matrix. However, it also yields a number of econometric issues that we overcome as follows. First, since five observations are available for each cohort

(corresponding to the five used editions of EWCS), the cohort aggregates are considered as error-ridden measurements of the true cohort population. Verbeek and Nijman (1993) propose an estimator[11] which does not suffer from inconsistency due to a small number of time periods and which is based on a parametric specification of the measurement error and its correlation with the variable of interest. Second, using the average of individual observations per cohort presents another caveat that is the varying number of individuals from one cohort to another as well as the varying size of cohorts from one edition to another. These size changes are likely to create heteroscedasticity, yielding biased standard errors. To overcome heteroscedasticity within the context of pseudo-panel, we follow the usual procedure that consists of weighting the observations with cohort's size.

Based on the methodology outlined above, we construct estimates of cohort vulnerability to adverse working conditions. As we are dealing with cohorts of employees created by birth-year, gender and country, our threshold of exposure to adverse working conditions, used to compute vulnerability probability in Equation (3), is given by the median of observed adverse working conditions in EU-15 by gender and age group. Accordingly, observed cumulative exposure to workplace risks for each cohort is compared to the median of their counterparts at EU-15 level in the corresponding year.

3.2. Vulnerability analysis by cohort's characteristics

The approach taken up to estimate vulnerability relies on cohorts of employees as unit of analysis. As reminder, each cohort is constructed by country, gender and by birth year. Table 5 reports the average probabilities of vulnerability as well as their standard deviations per country and per survey edition while Figure 2 ranks the average vulnerability of European countries per survey editions. These results denote a great divergence of the level of work-related risks across European countries as the vulnerability measure stems from a comparison with the median level of adverse working conditions in EU-15 by gender and for each age group. Overall, several general trends can be detected. First, for almost all countries, vulnerability increased from 1995 to 2000 before declining until 2010. In 2015, we observe a general increase of the level of vulnerability except in countries such as Finland where the average vulnerability has on the contrary decreased. Second, we find that Greece has the highest average level of vulnerability in all the survey editions, denoting a great divergence from the European median. Denmark and the Netherlands, on the contrary have the lowest level of vulnerability denoting a working environment, on average, less risky than the European median level. Finally, we identify a class of countries with higher and constant average level of vulnerability in comparison with overall average value of vulnerability in each survey edition. For instance, the average vulnerability in 1995 is 0.40. Three countries are far above this average, namely Greece (0.58), Spain (0.51) and France (0.48). The most striking observation when considering this set of countries is the high and constant level of vulnerability both in comparison with the average vulnerability of each survey edition and in comparison with the average vulnerability in other countries. Portugal, Italy, the UK and Finland are the next closest group of country, the UK and Finland being characterised, like Spain in the first group, by larger time variations.

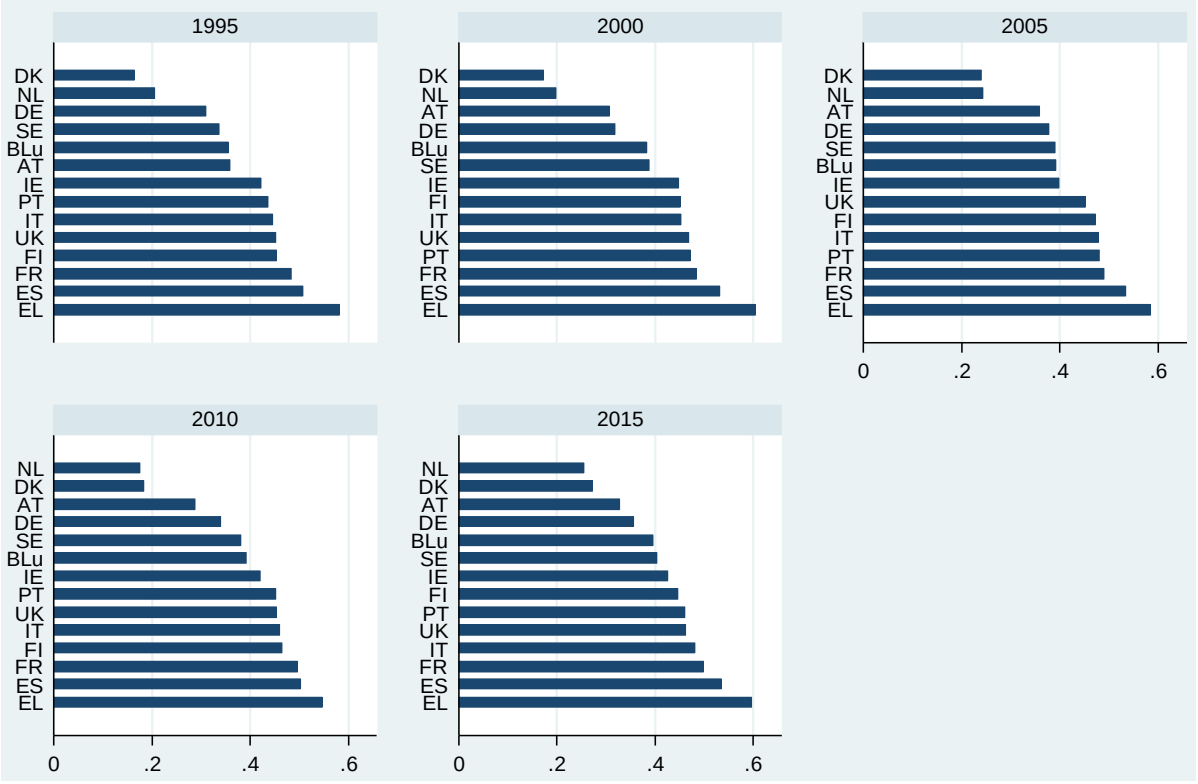
[11] In fact and as outlined by Deaton (1985), the sample-based averages of the cohort means are estimates of the unobserved population cohort means with measurement error. It is then necessary to correct the within estimator for measurement errors which tend to zero if the number of individual per cohorts tends to infinity. Verbeek and Nijman (1993) propose a modified estimator of Deaton to achieve consistency when the number of individuals per cohort is small and/or the number of time periods is small.

Table 5. Average vulnerability per country and per survey edition

	1995		2000		2005		2010		2015	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
BLu	0,36	0,04	0,38	0,04	0,39	0,06	0,39	0,02	0,40	0,04
DK	0,16	0,11	0,17	0,11	0,24	0,09	0,19	0,10	0,27	0,08
DE	0,31	0,06	0,32	0,06	0,38	0,05	0,34	0,06	0,36	0,08
EL	0,58	0,02	0,60	0,04	0,59	0,03	0,55	0,03	0,60	0,02
IT	0,45	0,02	0,45	0,03	0,48	0,01	0,46	0,02	0,48	0,03
ES	0,51	0,03	0,53	0,03	0,53	0,03	0,50	0,03	0,54	0,02
FR	0,48	0,02	0,48	0,02	0,49	0,03	0,50	0,03	0,50	0,02
IE	0,42	0,03	0,45	0,04	0,40	0,04	0,42	0,04	0,43	0,03
NL	0,21	0,08	0,20	0,07	0,24	0,07	0,18	0,08	0,26	0,08
PT	0,44	0,04	0,47	0,05	0,48	0,06	0,45	0,05	0,46	0,07
UK	0,45	0,02	0,47	0,04	0,45	0,02	0,45	0,03	0,46	0,04
FI	0,45	0,04	0,45	0,03	0,47	0,05	0,47	0,06	0,45	0,08
SE	0,34	0,11	0,39	0,06	0,39	0,05	0,38	0,07	0,40	0,07
AT	0,36	0,08	0,31	0,09	0,36	0,09	0,29	0,09	0,33	0,06
All	0.40	0.12	0.41	0.13	0.42	0.11	0.40	0.12	0.42	0.11

Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT), Germany (DE), Belgium & Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK)

Figure 2. Average vulnerability per country and per survey edition

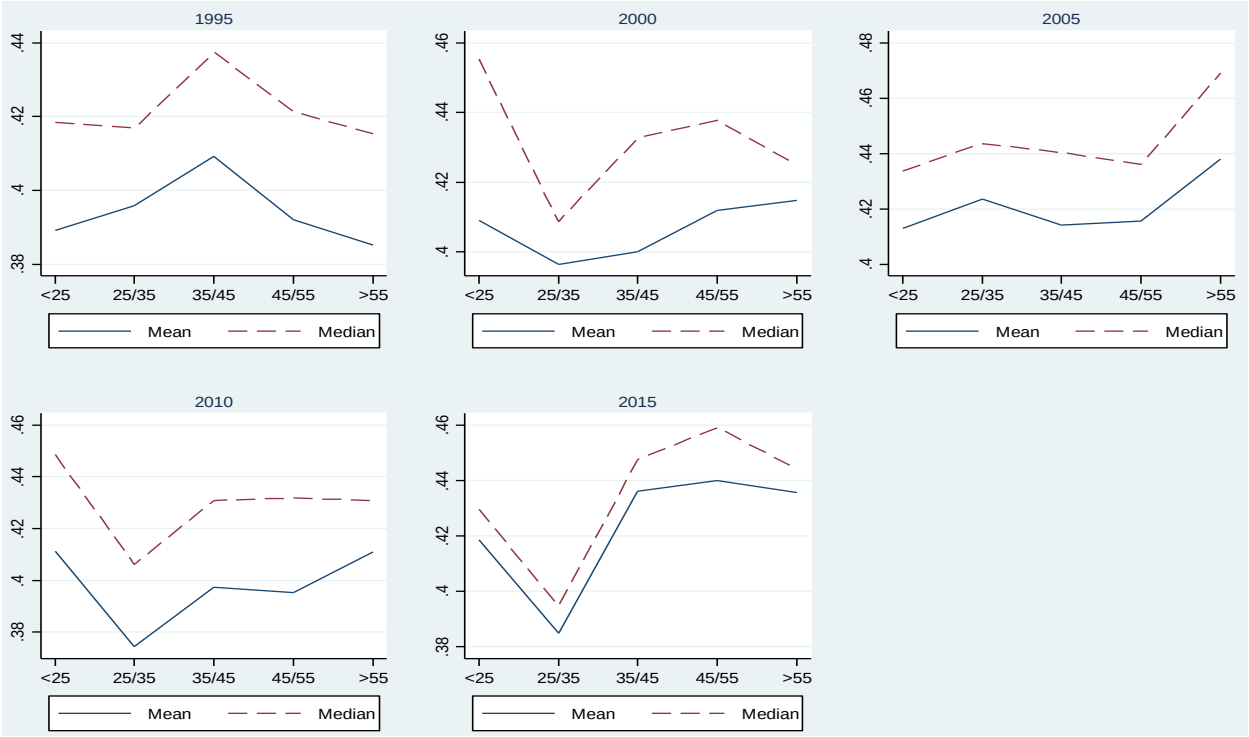


Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT), Germany (DE), Belgium & Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK)

These differences could reflect the disparities between countries in terms of sectoral structuring as well as in terms of work and employment practices. Indeed, such factors could contribute to reducing or widening differences in working environments and work-related risks across European countries. Institutional differences are also often pointed out as potential drivers of working conditions divergence across European States (Esping-Andersen, 1990; Gallie, 2007). Nonetheless, the traditional grouping of countries in this literature does not fully work out in the context of our study. If it applies for countries such as Denmark, Sweden, Greece or Spain, specific patterns are found for other countries such as Finland, Italy or Portugal. In terms of vulnerability to adverse working conditions, Finland appears to be an exception in the social democratic regime known for protecting the quality of jobs. Comparatively to other Southern European countries, Italy and Portugal record a lower average vulnerability to adverse working conditions than Spain, Greece or France.

Two employee characteristics that have been extensively investigated as enhancing risks at the workplace are gender and age. Beginning with the age effect, Figure 3[12] depicts the mean and the median value of vulnerability per age category in each survey edition. Our results highlight that ageing has an exacerbating effect on the average vulnerability since 2000: the average vulnerability of older-age cohorts is higher relatively to younger and middle age ones. In 1995, the age profile of vulnerability had an inverted U shape: it rises up to 35/45 where it reached a peak of 0.41 and then it declines. In 2000 vulnerability is higher for younger and older cohorts, changing the age profile to a U shape, which remains in 2005, with a decrease in the vulnerability of the youngest age cohort. From 2010, the age profile becomes an increasing one after 25/35 and in 2015 the increase in vulnerability for the middle age and older cohorts is notable: the previous peak of 0.41 is exceeded from age 35/45 and remains high up to retirement age.

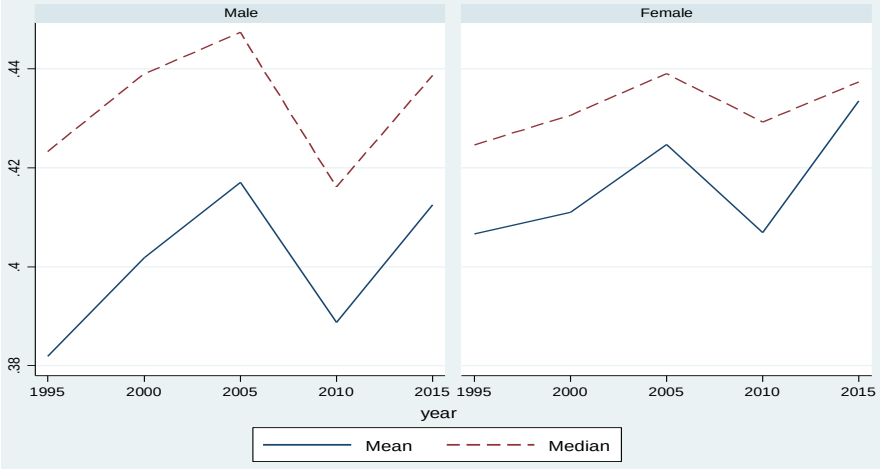
Figure 3. Average vulnerability per age category



[12] Figure A2 in the Appendix plots the average vulnerability per age and per survey edition for each country.

Turning to the distribution of vulnerability by gender, Figure 4 compares time evolution between men and women. On average, women are more vulnerable to adverse working conditions than men in all survey editions. However, the median probabilities of vulnerability are almost identical for men and women, varying between 0.42 and 0.44. The time trends are also similar with a surge of vulnerability from 1995 to 2005 and from 2010 to 2015. Nonetheless, the overall increase is much greater for men than for women.

Figure 4. Average vulnerability by gender



3.3. Who is vulnerable to adverse working conditions?

Stakeholders and public authorities may wish to specifically target vulnerable employees, so it is important to be able to identify the characteristics that condition or are symptomatic of vulnerability. To this end, we provide in Table 6 the sample characteristics of cohorts that are classified as vulnerable versus those that are not classified as such. A cohort is considered as vulnerable when its likelihood of exceeding the EU-15 average is greater than 0.50 which corresponds to an equal chance of facing adverse working conditions. The first part of Table 6 gives the resulting share of vulnerable and non-vulnerable cohorts in each survey edition. We observe that this share has increased from 14.3% in 1995 to 24.3% in 2015. This growth has been rapid between 1995 and 2000 and again between 2010 and 2015. Relying on an independent samples *t-test*[13], we compare the means and medians of vulnerability determinants for both vulnerable and non-vulnerable groups assuming an unequal variance between the two groups. Employment contract conditions make a clear difference in terms of vulnerability. For instance, on average, 67% of employees have a permanent contract in the non-vulnerable group, when this figure reaches 52% only in the vulnerable group. Conversely and unsurprisingly, fixed-term contract is more often associated with vulnerability as the significant mean difference between the two groups of cohorts illustrates it: on average 13% of workers in vulnerable cohorts work on a fixed contract versus 10% in non-vulnerable ones. These first results are in line with the results we found when analysing the determinants of our adverse working conditions indicator. We had also found that self-

[13] We perform parametric tests of significance to determine whether there is a statistically significant difference between the means of the two samples of vulnerable and non-vulnerable cohorts.

employed were less exposed to adverse working conditions than employees, although the result was not statistically significant.

Table 6. Share and characteristics of vulnerable groups versus non-vulnerable groups, threshold of 0.50

	Non-vulnerable	Vulnerable	Pmean
1995	85.7	14.3	-
2000	78.6	21.4	-
2005	77.9	22.1	-
2010	80.0	20.0	-
2015	75.7	24.3	-
Living with a partner	0,64	0,60	0,17
Main breadwinner	0,61	0,59	0,35
Employment status			
Self-employed	0,12	**0,20**	0,00
Employed	**0,86**	0,79	0,00
Employment contract			
Unlimited employment contract	**0,67**	0,52	0,00
Fixed-term contract	0,10	**0,13**	0,00
Temporary employment agency contract	0,02	0,02	0,37
Apprenticeship or other training	0,02	0,01	0,17
Tenure	10,16	10,75	0,41
Occupation			
Legislators, senior officials & manager	**0,08**	0,07	0,02
Professionals	**0,16**	0,12	0,00
Technicians and associate professionals	**0,15**	0,10	0,00
Clerks	**0,13**	0,11	0,04
Service workers/shop and market sellers	0,16	**0,19**	0,02
Skilled agricultural and fishery worker	0,02	**0,07**	0,00
Craft and related trade workers	0,12	**0,14**	0,03
Plant and machine operators and assembly workers	0,07	0,08	0,34
Elementary occupations	0,10	**0,12**	0,02
Armed forces	0,01	0,01	0,19
Company ownership			
Public	**0,26**	0,20	0,00
Private	0,72	**0,75**	0,03
Workplace size			
1 employee	0,07	**0,13**	0,00
2-9 employees	0,24	**0,33**	0,00
10-49 employees	**0,28**	0,25	0,02
50-499 employees	**0,26**	0,21	0,00
500 or more employees	**0,15**	0,09	0,00
Sector			
Agriculture, hunting, forestry and fishing	0,09	0,12	0,08
Industry	0,24	0,22	0,15
Services (excluding public administration)	0,39	0,41	0,27
Public administration and defense; compulsory social sector	**0,10**	0,08	0,05

Vulnerable cohorts are however more often self-employed (20%) than non-vulnerable cohorts (12%). An interpretation for this difference is that if the working conditions of self-employed are less adverse on average, they are also more uncertain and the likelihood that exposure to adverse working conditions will fall below the European average is not negligible. Occupation is another critical determinant of both the type of working conditions and vulnerability. Non-vulnerable cohorts have significant higher shares of higher occupational status groups such as managers, professionals and technicians and lower shares of lower occupational status groups than vulnerable cohorts. However, within the middling and unskilled occupations, the groups that are the most exposed to adverse working conditions are not the most vulnerable except for craft and trade related workers. Armed force, plant and machine operators and assembly workers are evenly distributed between the vulnerable and non-vulnerable cohorts. Skilled agriculture and fishery workers, service and sales workers and elementary occupation, whose exposure to adverse working conditions is intermediate, are more represented in vulnerable cohorts (respectively 7%, 19% and 12%) than in non-vulnerable ones (respectively 2%, 16% and 10%). Finally, employer characteristics play a clear role. Exposure to adverse working conditions and vulnerability relate in a similar way to company ownership: public sector employees are less exposed than private sector ones to adverse working conditions and they are less vulnerable on average. Sector is a strong determinant of exposure to adverse working conditions when workplace size has no significant impact. We find the opposite result in terms of vulnerability. Small size workplaces represent a significantly higher share of vulnerable cohorts: on average, 46% of workers in vulnerable cohorts are affiliated to workplaces with less than 10 employees, whereas this figure amounts to 31% in non-vulnerable cohorts. Conversely on average 15% of workers in non-vulnerable cohorts belong to workplaces with 500 and more employees when this is the case for only 9% of workers in vulnerable cohorts. This indicates an uncertain evolution of working conditions in small workplaces with a significant likelihood of facing more adverse working conditions in the future.

3.4. Varying the threshold of vulnerability

Setting the threshold of vulnerability at 0.50 to determine vulnerable groups implies a very low level of security: individuals in vulnerable cohorts are as likely to experience as not to experience adverse working conditions. In this section, we set instead this threshold at 0.33 implying that vulnerable cohorts are those that have one-in-three chances of facing adverse working conditions which exceeds the European average. This allows us to apprehend changes in the proportion of vulnerable cohorts as well as in the vulnerable group characteristics' according to the choice of threshold.

Table 7 shows that the percentage of vulnerable cohorts with a threshold of 0.33 is more than twice the proportion of vulnerable cohorts with a threshold of 0.50. In 1995, 77.1% of cohorts have a one-in-three chances to face risky working environments while they were 14.3% when considering a vulnerability threshold of 0.50. The same pattern can be observed for each survey year. However, the share of vulnerable cohort is more stable and has a different pattern of evolution than when the 0.50 vulnerability threshold is chosen: the main increase in between 2000 and 2005 where it reaches 80.7% and then it decreases to 78.6% in 2010 and 77.9% in 2015. The interest of changing the vulnerability threshold also lies in assessing the profile of vulnerable cohorts. To this end, we report in Table 7 as in the previous section the mean characteristics of vulnerable cohorts versus non-vulnerable cohorts when the threshold of vulnerability is set at 0.33.

Table 7. Share and characteristics of vulnerable groups versus non-vulnerable groups, threshold of 0.33

	Non-vulnerable	Vulnerable	Pmean
1995	22.9	77.1	-
2000	22.9	77.1	-
2005	19.3	80.7	-
2010	21.4	78.6	-
Living with a partner	0,63	0,63	0,98
Main breadwinner	0,59	0,61	0,42
Employment status			
Self-employed	0,07	**0,15**	0,00
Employed	**0,91**	0,83	0,00
Employment contract			
Unlimited employment contract	**0,72**	0,62	0,00
Fixed-term contract	0,11	0,11	0,74
Temporary employment agency contract	0,02	0,02	0,07
Apprenticeship or other training	**0,03**	0,01	0,00
Tenure	8,90	**10,66**	0,00
Occupation			
Legislators, senior officials & manager	0,07	**0,08**	0,01
Professionals	**0,18**	0,14	0,00
Technicians and associate professionals	**0,18**	0,13	0,00
Clerks	0,13	0,12	0,62
Service workers/shop and market sellers	0,16	0,17	0,52
Skilled agricultural and fishery worker	0,01	**0,04**	0,00
Craft and related trade workers	0,11	0,13	0,21
Plant and machine operators and assembly workers	0,06	**0,07**	0,03
Elementary occupations	0,09	**0,11**	0,01
Armed forces	0,00	0,01	0,38
Company ownership			
Public	0,25	0,25	0,89
Private	0,73	0,72	0,44
Workplace size			
1 employee	0,04	**0,09**	0,00
2-9 employees	0,22	**0,27**	0,00
10-49 employees	0,28	0,27	0,18
50-499 employees	**0,29**	0,23	0,00
500 or more employees	**0,16**	0,13	0,00
Sector			
Agriculture, hunting, forestry and fishing	0,08	0,10	0,07
Industry	0,23	0,24	0,58
Services (excluding public administration)	0,40	0,39	0,82
Public administration and defense; compulsory social sector	0,11	0,09	0,22

Overall the vulnerable cohorts' characteristics are similar when considering both vulnerability thresholds. Nonetheless, some features turn insignificant when the threshold is set at 0.33. While holding an unlimited employment contract is always synonym to less vulnerability, holding instead a fixed-term contract denotes further vulnerability only when the threshold is set at 0.50 as the mean proportion of employees with this type of contract is not significantly different between vulnerable and non-vulnerable groups when the threshold is set at 0.33. Conversely, average tenure of employees in vulnerable cohorts turns significantly higher than in non-vulnerable ones, when this difference was non-significant in Table 6. Differences are also worth noting regarding the occupational status of employees when the threshold of vulnerability is set at 0.33. First the differences between vulnerable and non-vulnerable cohorts is no more significant for both service and craft workers. Second, regarding the higher occupations and with respect to our one on three chances to be vulnerable, the mean percentage of legislators & managers is now significantly higher in the vulnerable group: 8% instead of the 7% obtained when the threshold is set at 0.5. Turning to the employer characteristics, the results are convergent with Table 6.

CONCLUSION

This paper has used the five last editions of the European Working Condition Survey to identify and to analyse vulnerability to cumulative adverse working conditions at the workplace. **Vulnerability is defined in this work as the likelihood that an employee has a level of adverse working conditions above some predefined threshold**. We focus on 15 countries (Austria, Belgium, Denmark, Germany, Greece, Italy, Luxembourg, Spain, France, Ireland, the Netherlands, Portugal, the United Kingdom, Finland and Sweden) that were surveyed on regular basis since 1995. Relying on pseudo-panel techniques, we estimate the vulnerability of cohorts of employees grouped by birth-year, gender and country. Our results highlight disparities of vulnerability levels across European countries. **Three classes of countries are identified: countries with very low level of vulnerability, countries with varying level of vulnerability over time and finally countries with persistent high level of vulnerability**. This classification is somehow surprising as it does not completely fit with the usual categorisation set by employment regimes theory with respect to similarities and dissimilarities of job quality and worker protection between European countries.

Indeed, Nordic countries tend to have strict employment protection laws, more influential trade unions and high union membership ensuring thus very low levels of workforce vulnerability (Eurofound, 2015; Gallie, 2007). This assertion is convergent with our results except for Finland which records very high levels of vulnerability. Similarly, Ireland and the United Kingdom that are known for having a liberal regime with less employment protection have on average a close and a high level of vulnerability in comparison with the European average. Further, vulnerability in southern countries, such as Spain, Italy and Greece, may be expected to be higher and alike as employment policies are weaker in these countries and they have lower level of trade union power. Instead, our results highlight great divergences between these countries with **Greece and Spain recording the highest levels of vulnerability** while the average vulnerability in Italy and Portugal is closer to the average in Ireland than in Spain. Finally, **the level of vulnerability in France is close to the highest ones, registered in Greece and Spain**. The relationship between employment regimes and vulnerability to adverse working conditions thus deserves more attention to explain differences between European countries.

At the individual level, our results suggest differences of vulnerability levels according to job characteristics': employees with fixed-term contracts in private-owned small-sized establishment or self-employed are more likely to be vulnerable. Similarly, high-skilled manuals and elementary occupations entail a higher concentration of vulnerable employees. **Women seem to be less exposed to work-related vulnerabilities than men**, except in Finland. In fact, the gender gap is tightening or widening depending on the year and the country considered but remains overall small. Regarding the age effect on vulnerability, our results highlight **increasing vulnerability for both middle-aged and older employees**.

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APPENDIX

A.1 Variables included in the AWCI

a1.1 Adverse physical environment (9 questions, yes answers):

- Are you exposed at work to?
- Vibrations from hand tools, machinery, etc.
- Noise so loud that you would have to raise your voice to talk to people
- High temperatures that make you perspire even when not working
- Low temperatures whether indoors or outdoors
- Breathing in smoke, fumes, powder or dust, etc.
- Handling or being in direct contact with dangerous substances such as chemical, infectious materials, etc.

- Does your main job involve?
- Painful or tiring positions
- Carrying or moving heavy loads
- Repetitive or arm movements

a1.2 Adverse social climate (6 questions, yes answers):

- Over the past 12 months, have you or have you not, subject to?
- Sexual discrimination
- Unwanted sexual attention
- Age discrimination
- Ethnic discrimination
- Disability discrimination
- Nationality discrimination

a1.3 Atypical working time (4 questions, positive answers):

- Normally, how many times a month do you work?
- At night, for at least 2 hours between 10.00 pm and 05.00 am
- On Sundays
- On Saturdays

- Do you work shifts?

a1.4 High work intensity (8 questions, yes answers):

- Does your job involve?
- Short repetitive tasks of less than 10 min?
- Working at very high speed
- Working at tight deadlines

- On the whole, is your pace of work dependent, or not on?
- The work done by the colleagues
- Direct demands from people such as customers, passengers, pupils, patients, etc.
- Numerical production target
- Automatic speed of machine or movement of a product
- The direct control of your boss

a1.5 Low work complexity (9 questions, no answers):

- Generally, does your main paid job involve?
- Meeting precise quality standard
- Assessing yourself the quality of your own work
- Solving unforeseen problems
- Complex tasks
- Rotating tasks between you and your colleagues
- Learning new things

- Are you able to choose or change?
- Order of tasks
- Methods of work

- You can get assistance from your colleagues if you ask for it?

A.2 Pseudo-panel construction

The grouping variables for cohort data are country, gender and year of birth. Considering the year of birth, instead of taking the declared age in each survey, we create a new variable, equal to the difference between the survey year and declared age. This solves the problems of interviewed employees in different year but reporting the same age: for instance, a 25 years old employee interviewed in the last edition of 2010 would not have the same working conditions as a 25 years old employee interviewed in 1995 (all other things being equal). With the pseudo panel and in order to allow for relevant comparison of working conditions over time, each cohort should be associated with only one birth year interval. The cohorts are defined then for the birth year from 1927 to 1994 using surveys from 1995 through 2010. The averages for each birth year are generated by country and by gender.

A.3 Further results

Table A1. Descriptive statistics of AWCI(pca) per survey edition and country

	1995		2000		2005		2010		2015	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
BLu	1.033	0.452	1.112	0.466	1.083	0.474	1.135	0.480	1.075	0.457
DK	0.936	0.403	0.931	0.395	1.029	0.405	0.941	0.404	1.012	0.377
DE	1.088	0.477	1.113	0.468	1.203	0.480	1.178	0.471	1.121	0.465
EL	1.382	0.529	1.510	0.511	1.548	0.570	1.438	0.563	1.514	0.478
IT	1.077	0.412	1.149	0.430	1.211	0.452	1.142	0.434	1.168	0.464
ES	1.181	0.483	1.199	0.477	1.255	0.491	1.214	0.474	1.297	0.508
FR	1.172	0.515	1.202	0.494	1.185	0.497	1.277	0.544	1.159	0.513
IE	1.157	0.453	1.215	0.465	1.068	0.447	1.214	0.484	1.116	0.476
NL	1.016	0.436	1.036	0.429	1.010	0.418	0.967	0.397	1.021	0.445
PT	1.157	0.480	1.167	0.451	1.141	0.450	1.115	0.456	1.111	0.423
UK	1.232	0.486	1.248	0.499	1.157	0.483	1.147	0.479	1.144	0.471
FI	1.179	0.455	1.244	0.457	1.250	0.455	1.178	0.445	1.111	0.434
SE	1.011	0.436	1.183	0.438	1.073	0.398	1.031	0.391	1.122	0.442
AT	1.191	0.458	1.113	0.490	1.189	0.504	1.062	0.469	1.076	0.486
All	1.119	0.473	1.173	0.480	1.165	0.484	1.154	0.486	1.150	0.480

Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT) , Germany (DE), Belgium &Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK).

Figure A1. Kernel density of AWCI using EWCS 1995, 2000, 2005, 2010, 2015

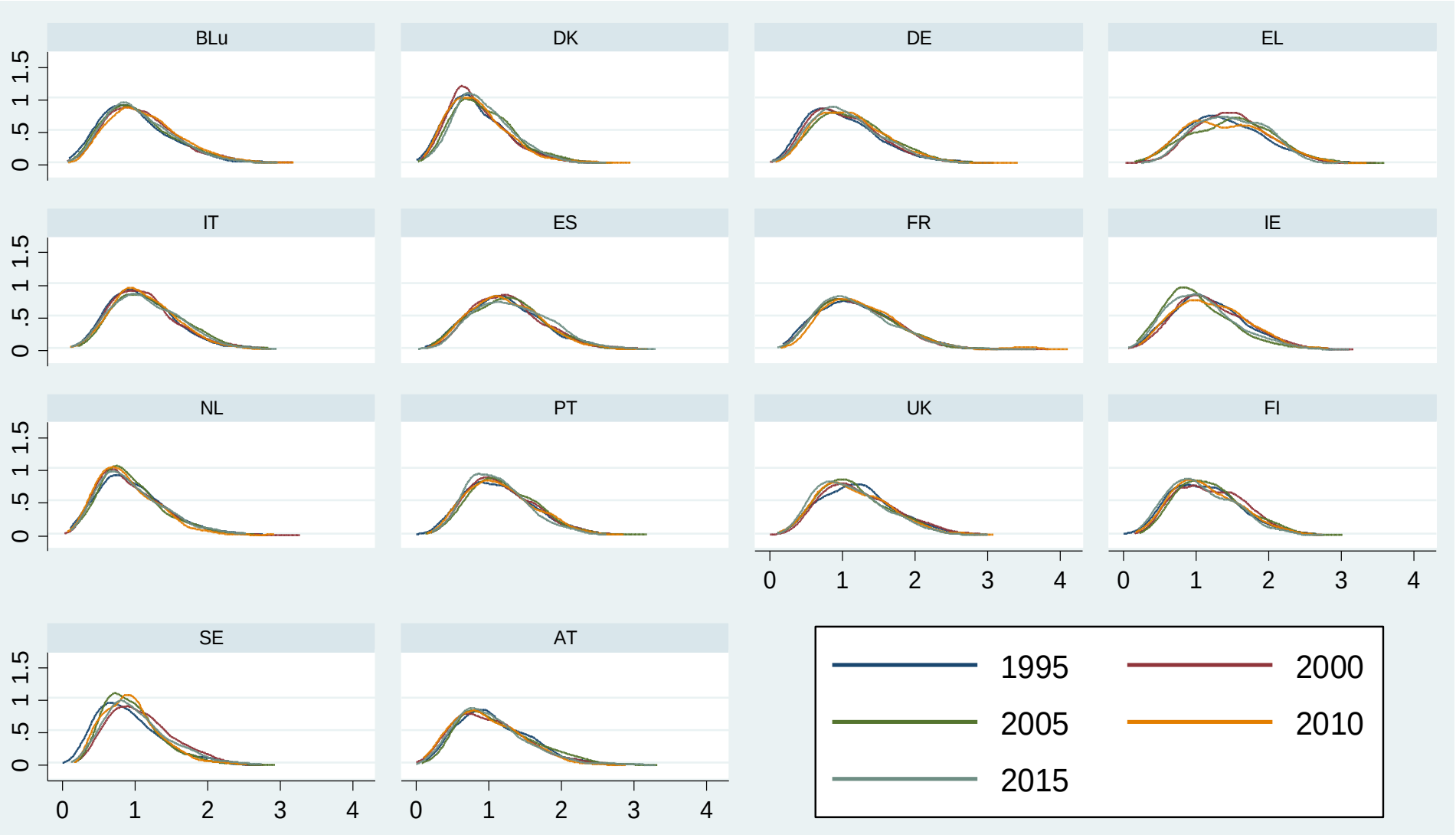

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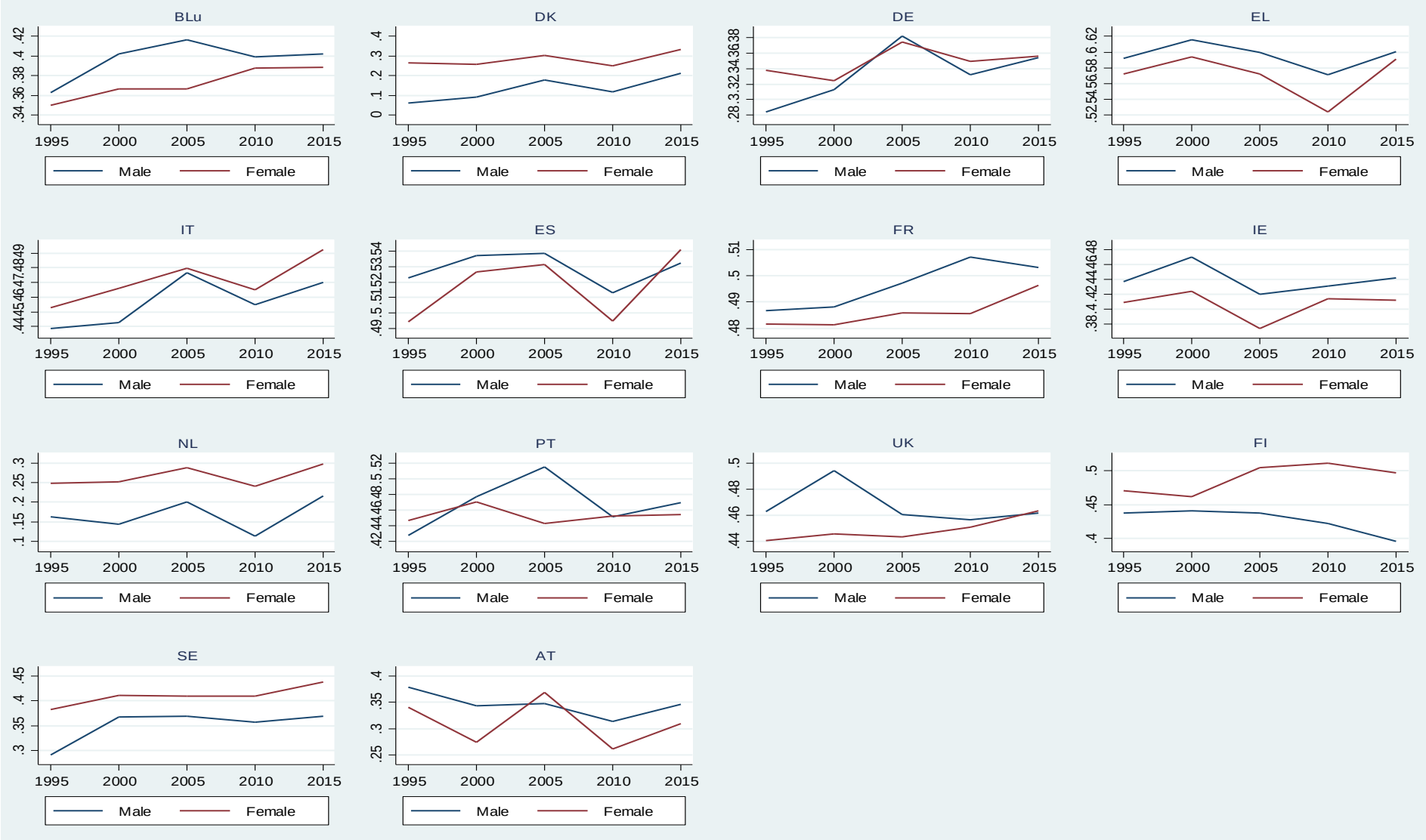
Figure A2. Average vulnerability per age-group and by survey year for each country

Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT), Germany (DE), Belgium & Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK).

Figure A3. Average vulnerability per gender and by survey year for each country



Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France (Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT), Germany (DE), Belgium & Luxembourg (BLu), Netherland (NL), Sweden (SE), Denmark (DK).

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