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JOB QUALITY AND VULNERABILITY-AT-WORK INDICATORS IN EUROPE

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Abstract

In the harsh new world of global competition and in the face of new wave of technological innovation, the world of work seems to undertake continuous changes. Further, structural transformations of the economy induced and extended by economic crisis as well as demographic and labour market changes imply the emergence of new forms of employment. However, there are also risks involved, in particular an increase of more precarious jobs and of inequality within and across countries that jeopardise the individual well-being. Against this backdrop, this report is put forth to highlight the global changes of job quality and work-related vulnerabilities in European countries, developing methods to identify the most at-risk employees, and also providing improvement guides of job quality. To this end, the first chapter presents a job-centred methodology aiming to combine the multiples dimensions of jobs into reduced number of job types. The output is a taxonomy of job types that opens room for job quality evaluation and improvement. The second chapter provides an employee-centred method to measure vulnerability to adverse working environment. The main outcome is a vulnerability measure comparable across European countries and a warning system of employees at risk. Finally, the third chapter provides an assessment of the possibility of an international standard for scale construction using ECWS 2010.

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European policy-oriented research can and must deliver useful contributions to tackle the Europe 2020 challenges of Inclusive Growth. Key tools in this social sciences research are all types of data earning statistics, administrative social data, labour market data, surveys on quality of live or working conditions, policy indicators. The project aims to integrate and optimise these existing European data infrastructures and accompanying expertise.

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1. Introduction

Since the turn of the century, there has been growing recognition that the pace of structural changes in most of the modern economies is threatening the standard employment relationship and is changing the social patterns. A combination of factors, such as the increased globalisation of economic activity, the widespread adoption of new technologies induced by the emergence of the knowledge society, the prevalence of service industries over manufacturing as well as the flexibilisation of labour market practices have contributed to the development of new forms of work organisation as well as to the emergence of new health and safety risks for workers.

Against this background, the European Union places an emphasis on fostering inclusive labour markets by ensuring a more sustainable working environment and promoting employment, with positive effects on participation in the labour market and on company productivity. To advance towards these objectives, a range of policy initiatives has been launched such as the European Employment Strategy, the Lisbon Strategy and more recently the European 2020 inclusive growth strategy with the common priority of more and better quality jobs. Further, the Commission's 2010 Agenda for new skills and jobs supports the improvement of job quality and productivity by arguing in favour of skills development. The improvement of working conditions can ensure a longer working life as well as a higher level of individual well-being.

In accordance with the European Commission's objective of more inclusive labour market, this report is put forth to address the issue of job quality and work-related vulnerabilities in European countries. More precisely and as part of the European InGRID research infrastructure project, this study is commissioned with the aim of:

- characterising vulnerable groups of employees to poor working conditions and occupational safety and health issues
- developing methods to facilitate the identification of these vulnerable groups in future European surveys

Indeed, occupational health and safety is one of the oldest and most advanced social policy areas of the European Union. The Council Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work established minimum occupational safety and health requirements and stated that 'particularly sensitive risk groups must be protected against the dangers which specifically affect them'. This framework directive was followed by a range of 'daughter Directives' that set out the principles of the Framework Directives with regards to specific hazards at work (*e.g.* exposure to dangerous substances), single tasks (*e.g.* risk factors for musculoskeletal disorders in manual handling of loads), different workplaces of high risks (*e.g.* temporary work sites, extractive industries).[1]

In this study, we propose two different but complementary approaches to define and to identify vulnerable groups to poor working conditions and OSH issues across European countries. The first approach sets out a typology of jobs relying on various relevant aspects of working conditions. The outcome is an improvement guide for each job type. Using a methodology developed to study vulnerability to multiple deprivations, the second approach proposes a measurement frame for assessing

1 cf https://oshwiki.eu/wiki/General_principles_of_EU_OSH_legislation for the complete list of daughter Directives.

vulnerability to adverse working conditions. Such a framework would be part of a warning system to identify employees at risk in workplaces. Both approaches relies on the most reliant source of information regarding working conditions in European countries, namely the European Working condition Survey (EWCS) performed by Eurofound.

Research approach & Structure of the report

This report is based on the joint work done by HIVA-KU Leuven and the CNAM-CEET regarding the issue of vulnerability to poor working conditions and OSH issues in European countries. It brings together two deliverables for task 21.4 of WP21:

The first chapter starts from the job types' methodology proposed by Holman (2012) to capture and better understand the complex and multidimensional nature of job quality. A typology of seven job types is made relying on the latest data of the EWCS (2010 and 2015) and using a broad set of job characteristics such as complexity, autonomy, voice and wage. In the second part, the relation between the job types and subjective workers' outcomes (such as job satisfaction, perceived work related health problems, feeling of job insecurity, etc.) is examined and trade-offs between the job characteristics impacting workers' outcomes are discussed.

The second chapter applies a methodology originally developed to study vulnerability to poverty to measure vulnerability at the workplace. Vulnerable workers are defined 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. The proposed methodology allows tracking cohorts of employees from 1995 until 2015, comparing the level of vulnerability across European countries and identifying the characteristics of vulnerable groups.

The third and final chapter assesses the possibility of an international standard for scale construction with the fifth European Working Conditions Survey (EWCS) data. As both previous chapters rely on this survey to tackle issues related to job quality and quality of working lives, the reliability of used data and scales are of primary importance. This chapter takes it a step further in discussing methological issues related to the construction of one internationally applied scale for measuring job quality and its various aspects. Harmonisation of data on item level and on scale level are key to this.

2. It takes more than one measure: capturing the multidimensionality of job quality with job types and multiple job quality outcomes

Prepared by ***Lise Szekér, Ine Smits & Guy Van Gyes***

Employees spend a significant part of their lives at their job (Munoz de Bustillo, Fernandez-Macias, Esteve, & Anton, 2011). Consequently, work and the time at work have an important impact on their well-being. For those in employment, the quality of their job is important and also an essential consideration in the decision to engage or to stay engaged in employment. Research showed that (having) work is an important aspect of both one's personal and social life (Layard, 2004 in Munoz de Bustillo *et al.*, 2011; Dolan, Pasgood & White, 2008 in Munoz de Bustillo *et al.*, 2011). In addition, the increasing retirement age all across Europe raises questions on the sustainability of jobs. Employees will have to work longer, but do their jobs allow or enable them to work longer? Or will the low quality of jobs hamper employees to work until retirement age? Therefore a good understanding of job quality and the job characteristics and outcomes associated with it is and will be an important topic of interest.

Job quality, however, is not an easy concept to define, which makes it even more complex to adequately measure it. Job quality is multidimensional and there is a wide range of influencing job characteristics. Furthermore, most jobs are not straightforwardly good jobs or bad jobs. Each job consists of a specific set of positive and negative characteristics, which together determine the quality of the job (Ecorys & IDEA, 2009).

Despite the long and extensive research tradition on job quality, Europe still lacks consensus on how exactly to define and measure job quality, and what a good (European) job quality indicator can be. Important characteristics of a good European indicator have been put forward and several overviews are made of recent European job quality indicators. However, until today, none of the existing indicators seems to fully fulfil all the requirements to become the general European job quality indicator (Leschke & Watt, 2008; Leschke, Watt, & Finn, 2012; Munoz de Bustillo *et al.*, 2011).

Following Holman (2012), statistical methods for clustering data to determine job types become a more frequently used attempt to understand and capture the multidimensionality of job quality. Each job type is composed of good and bad job characteristics, but is not directly linked with fixed job titles. This approach is useful because there might be different types of job quality, depending on the specific combination of job characteristics that are indicative of high or low job quality. This job quality can be evaluated with job quality outcomes, such as well-being (physical and psychological) and positive attitudes, for example job satisfaction (Green, 2006 in Holman, 2012; Vandenbrande *et al.*, 2012). According to this job types approach to measure job quality, Vandenbrande *et al.* (2012) performed similar analyses to estimate the Belgian labour market situation (on 5th wave EWCS data) and Eurofound (2016) recently reported five job types based on findings from the 6th wave of EWCS data.

Moreover, this study will build on the work of Lamberts *et al.* (2016), who estimated job types for the Belgian labour market based on 5th and 6th EWCS data. Similarly, the analyses presented in this paper will use the latest data of the European Working Conditions Survey (5th and 6th wave EWCS) - executed in 2010 and 2015 - and try to look for consistency in job types between 2010 and 2015. The job quality of the job types will be evaluated using a broad set of job quality outcomes.

2.1 Literature review

2.1.1 Job quality

Researchers agree about the complex and multidimensional nature of job quality, and the difficulties to capture it in a conclusive but specific definition. However, until now, no consensus is found about the specific definition and conceptualisation. Holman (2012) defines job quality as *'the extent to which a job has work and employment-related factors that foster beneficial outcomes for the employee, particularly psychological well-being, physical well-being and positive attitudes such as job satisfaction.' (Green, 2006 in Holman, 2012).* This definition implies that job quality depends on 'objective' characteristics of the job itself and the employment conditions in which this job has to be done. It also suggests some positive outcomes that are indicative for high job quality, such as well-being and job satisfaction (Green & Mostafa, 2012; Holman, 2012).

Throughout the extensive research legacy on job quality, researchers came forth with a large set of conceptualisations. Three contemporary models that focus on the link between sets of job characteristics and job quality served as a starting point for the construction of job types that will be discussed below.

In their model Holman and McClelland (2011) distinguish three areas of job quality, covered by five dimensions and a set of sub dimensions. The first area is work quality, covered by the dimension *work organisation*, with the sub dimensions *job demands* and *job resources*. The second area, employment quality, includes the dimensions of *wages and payment system* and of *security and flexibility*. The third area focuses on empowerment quality and covers both the *skills and development* dimension and the dimension *of engagement and representation* (Holman, 2012).

In the framework of Green and Mostafa (Eurofound, 2012) job quality is based on four blocks or dimensions. Two dimensions cover extrinsic job features: *earnings* (*e.g.* level and fairness of wages) and *prospects* (*e.g.* career opportunities, job security, and employability). The two other dimensions cover more intrinsic job features: *intrinsic job quality* (*e.g.* skill use, discretion, work intensity) and *working time quality* (*e.g.* work-life balance, working time arrangements).

A third approach to job quality, which shows large overlap with the previous models, is the Belgian 'Four A's' model, which is recently expanded to the 'Five A's' model. This model distinguishes between five main dimensions of job quality: *work organisation* (*e.g.* teamwork)*, job content* (*e.g.* workload and autonomy), *working conditions* (*e.g.* pressure and risks), *employment conditions* (*e.g.* contract type, wages, and career opportunities), and *social relations* (*e.g.* social support and voice) (Flohimont *et al.*, 2013). These categories are merely thematic differentiations and not strongly based on empirical coherence and can be simplified into three dimensions that capture the majority of the literature involved: *Work*, *Employment* and *Social relations* (WES-model) (Lamberts *et al.*, 2016).

There is a large overlap between these frameworks and the dimensions identified. In this paper we will follow the latter WES-model with only three dimensions, which combines the insights from these earlier models and provides sufficient simplicity. The dimension *Work* combines the aspects of job content, working conditions and work organisation. That is because the distinction made in most models such as the 'Five A's' model ignore the idea that these job characteristics are often interrelated; the physical or psychological risks (traditionally seen as working conditions) an employee encounters are not independent of the performed task (job content) and its organisation (work organisation). For example, a sales man cannot accomplish its selling targets (job content) without getting in contact with customers, which is a possible source of stress and psycho-social risks (working conditions). In addition, these risks can be monitored by an appropriate work organisation. Because of the overlap between the three previously distinct dimensions, this WES-model combines them into only one component (Lamberts *et al.*, 2016).

The remaining dimensions *Employment* and *Social relations* resemble more the components of the previous described models, such as the 'Five A's' model. *Employment* is about job characteristics that

are mostly fixed within formal employment agreements and that interfere most directly with the private life of employees, such as wages, working time, flexibility and training. *Social relations* imply the context of social relations and interactions, social dialogue and representation at work, this can be via formal institutions as well as in an informal way (Lamberts *et al.*, 2016).

2.1.2 Job types

Job types are a way of grouping workers into different profiles, that each consist of a set of job characteristics. Using job types, a coherent picture is given of the kind of jobs that workers have, which enables us to evaluate the quality of these jobs and to investigate the outcomes for the worker.

Holman (2012) points out the importance of job types for policymakers and other stakeholders. Job types enable to get a detailed view of the variation in job quality over time, across and within countries, as well as for other relevant comparisons across groups (gender, age groups, sectors, etc.). A better understanding of the complexity and multidimensionality of job quality can help policymakers to target their policies more accurately. In addition, job types can be a method to estimate the overall or total quality of a job to see if there is a variety of types of high-quality jobs and low-quality jobs, following from different job quality indicators.

Another advantage of the use of job types in analyses on job quality, is that it allows to take into account the multidimensionality of job quality and the interactions between job characteristics. By pooling multiple aspects into one job type, it becomes possible to comprehend the evaluation of job quality and to construct an organised comparison.

2.1.2.1 The six job types of Holman (2012)

Holman (2012) developed a taxonomy of six job types, using a broad set of job quality indicators based on his classification of job quality dimensions (Holman & McClelland, 2011). In the two-step cluster analysis on the data of the 4th EWCS (executed in 2005) of the EU-27 countries, the six-cluster model was the best solution.

The *active jobs* are characterised by high levels of job resources. Also pay, skill and developmental factors, job security and working time flexibility are of a moderate to high level. Some of the job demands are also high (job complexity and cognitive demand), while others, such as workload are lower than average. The *saturated jobs* have high levels of almost all job characteristics. In comparison with active jobs, job demands are much higher, especially workload, atypical working hours and longer hours, and interaction demands. The *team-based jobs* typically have high levels of team work and team autonomy, job resources and job complexity, as well as high job security. Other job demands are more moderate, as well as pay and skill and development factors. In addition, working time flexibility is very low. *Passive-independent jobs* combine low job resources with low job demands. Also skills, training and development factors and working time flexibility are low, with often standard hours. Pay is slightly lower than average and security is high. The combination of non-permanent contracts and low security is typical for *insecure jobs*. Further they have low levels of pay and job resources, as well as little development opportunities and limited working time flexibility. Job demands are rather low to moderate. Finally, the *high-strain jobs* are confronted with high levels of workload and other job demands, in combination with low job resources (especially job discretion). While security is high, pay and skill and development factors are below the average. Further non-standard working hours and shift work are not unusual (Holman, 2012).

2.1.2.2 The seven job types of Vandenbrande *et al.* (2013) in Belgium

Vandenbrande *et al.* (2012) constructed a typology of jobs in the Belgian labour market, using the data of the 5th EWCS (executed in 2010) and with the JWES-model as a starting point. This model is derived from the Belgian 'Four A's' model and distinguishes between four dimensions of job quality: job content (J) (*e.g.* workload and autonomy), working conditions (W) (*e.g.* pressure and risks),

employment conditions (E) (*e.g.* contract type, wages, and career opportunities), and social relations (S) (*e.g.* social support and voice) (Vandenbrande *et al.*, 2012). They developed a framework of 22 job quality indicators or characteristics, based on literature review and factor analysis. Next, they investigated the impact of work on several job quality outcome indicators to assess the quality of work. After dichotomising all job quality indicators, a cluster analysis was executed on the dataset, resulting in a solution with seven different clusters.

The first cluster is called *saturated work*. These employees have high scores on almost all job characteristics, with limited risks, favourable working conditions and high autonomy, but also high flexibility. The second cluster, the *full-time balance work* group, has similar scores, which are in all cases a little bit lower that in the saturated jobs. Further, they have less flexibility regarding their workplace, work schedule, etc. *Work with limited career prospects* is the label of the third cluster, due to the small amount of full-time workers in this cluster, and the high levels of temporary contracts. Further, these workers receive low pay and have no training or career opportunities. On the other hand, job resources are moderate to high and job demands are limited. The fourth cluster*, work with flexible and unusual hours,* is - as stated in the name - characterised by high flexibility and limited working time autonomy, often with unusual working hours. Employees of the *emotionally demanding work* cluster, have jobs with high emotional pressures and team work on complex issues. They feel little or not supported by their co-workers and management and experience high levels of job demands, together with bad working conditions (low pay, no full-time work, unusual working hours, etc.). The *heavy repetitive work* cluster consists of jobs with a high level of repetitive tasks and high risks, combined with limited autonomy and say. However, full-time contracts, fixed workplaces and stable work schedules are also characteristic. The last cluster is called *indecent work*. This cluster scores badly on almost every job quality indicator, with high risks and repetitive tasks, no say or autonomy, low wages and no career prospects. These workers often have part-time temporary contracts and limited representation. However, on the more positive side, these workers do not suffer from emotional pressure and have a fixed work schedule (Vandenbrande *et al.*, 2012).

2.1.2.3 The six jobs types of Lamberts *et al.* (2016) in Belgium

In 2016, another Belgian analysis used the 5th and 6th wave of the EWCS data to study job quality on the national labour market. As part of a larger report on job quality in Belgium, Lamberts and colleagues (2016) constructed 22 indicators of job characteristics (*task autonomy, autonomous teamwork, task complexity, speed pressure, emotional demands, repetitive tasks, fixed workplace, risks, permanent contract, full-time work, earnings, additional fees, atypical working hours, working time flexibility, planning autonomy, career opportunities, training, participation, representation, supportive management, social support, adverse social behaviour*) and performed a latent profile analysis to create job types. These job types were also linked to the following job outcomes, looking at the relation between the job characteristics and the health and well-being of workers: *job satisfaction, capability to work until the age of 60, absenteeism, presentism, job security, labour market security, general health, physical health, mental health, estimated impact of work on health,* and *psychological well-being*.

Six job types were found: *saturated work, balanced work, supported work, work with limited development opportunities and support, heavy repetitive and flexible work,* and *low-quality work*. The first cluster (12% of the respondents) is characterised by a lot of autonomy and teamwork, as well as complex tasks, full-time work, lots of career opportunities, a high score on participation and a positive social context with strong social support, and limited exposure to risks. On the other hand, these workers report a considerable work pressure, rather large emotional demands, and flexible working time arrangements. Secondly, the cluster of *balanced work* (22%) scores more moderate on almost all 22 indicators. A lot of autonomy, teamwork and complexity are compensated by moderate to low work pressure and emotional demands. The cluster of *supported work* (17%) stands out in its amount of part-time workers, followed by a lower score on earnings and additional fees. Further, these workers report much autonomous teamwork, a positive social climate and much social support, little emotional demands,

very low work pressure, and limited task complexity and task autonomy. The fourth cluster, *work with limited development opportunities and support* (22%), is also marked by a lot of part-time work and thus low wages, but an important difference is the lack of teamwork, social support, participation and representation. Workers report little working time flexibility and emotional demands, but limited career opportunities and a lot of repetitive tasks. Fifth, workers in the cluster of *heavy repetitive and flexible work* (18%) often have a permanent full-time contract and enjoy a high wage. Other remarkable characteristics of this cluster are a lot of career and training opportunities, well-organised representation, and high scores on working time flexibility, work pressure, and emotional demands. The last cluster comprises only 9% of the Belgian employees, who are employed in so-called *low-quality work*. Even though these workers enjoy a fixed workplace and little emotional demands, this work is characterised by low scores on task complexity, task autonomy, earnings, representation and training opportunities, and high scores on repetitive work, risks, work pressure and working time flexibility.

Also the evolution of these job types between 2010 and 2015 is described in the report. The most remarkable evolutions in this regard are the decrease of *heavy repetitive work* and the increase of *saturated work* (Lamberts, *et al.*, 2016).

2.1.2.4 The five job types of Eurofound (2016)

Using the most recent EWCS data (6th wave, 2015) from the EU-28, Eurofound assessed a latent class analysis to find job types across Europe. First, seven indices were created based on their proven positive or negative impact on the health and well-being of workers (Eurofound, 2016); *physical environment* (physical risks at the workplace), *work intensity* (work demands such as high speed, tight deadlines, emotional demands), *working time quality* (long working hours, possibility for breaks, atypical working time, working time arrangements, flexibility), *social environment* (supportive social relationships as well as adverse social behaviour), *skills and discretion* (opportunities for learning and training), *prospects* (career advancements as well as the likelihood of losing the job), and *earnings* (monthly income) were constructed using multiple indicators per dimension. Also, the following covariates were introduced in the model as predictors of the cluster variable: *sex, age, sector (NACE rev. 2), occupation (ISCO-08), country, workplace size, education,* and *employment status*. Because missing values are excluded on a case wise basis, thus each respondent lacking at least one answer, the total amount of respondents (employees as well as self-employed) included is 26,648.

This analysis showed that five clusters can be identified: *high flying jobs, smooth running jobs, active manual jobs, jobs under pressure, poor quality jobs*. The first cluster (*high flying jobs*) gathers jobs with the highest scores on most of the indicators – this is about 22% of the workers. These jobs score remarkably higher on skills and discretion, as well as on prospects and on earnings. Workers report complex jobs providing the possibility to implement their own ideas in the organisation of the work, with a lot of career opportunities and job security, as well as more on-the-job training. On the other hand, these workers also experience a higher work intensity and lower working time quality – but still these downsides are less striking than is the case for the last three clusters. The cluster of *smooth running jobs* includes about 25% of the workers and thus is the largest group. Even though the prospects in these jobs are average and the level of earnings and skills and discretion is slightly lower than in the other clusters, these workers report a low work intensity and a high working time quality. The most important characteristics of this group are the good and safe physical and social environment and the observation that most of these workers have part-time jobs and work less than 48 hours per week. The third cluster is defined as *active manual jobs*, comprising about 22% of the workers, and is characterised by the highest score on exposure to risks at the workplace. Workers report the worst physical environment, but this is somewhat compensated for by a positive social environment. Scores on the other job quality indicators are average. The *jobs under pressure* contain the smallest percentage of the workers (13%) and stand out by their very negative social environment and the highest work intensity (due to a high level of emotional demands, tight deadlines and working at high speed). The highest number of abuse and harassment is indicated here and in addition, little support is provided by the

managers or colleagues. Even though earning and skills and discretion are high - second to the *high flying workers* - a low working time quality is reported. Finally, the *poor quality jobs* comprise 19% of the European workers and shows low scores on all job quality indicators. Earnings, prospects, and skills and discretion are the lowest of all clusters, working time quality scores on average, and work intensity is only slightly better than in the clusters of *under pressure* and *active manual jobs* (Eurofound, 2016).

2.1.2.5 Comparison between the job types

There are large similarities between the research and the methodology of Holman (2012) and Vandenbrande *et al.* (2012), both creating a typology of job types, using cluster analysis. This is different from the latent class analysis approach used by Lamberts *et al.* (2016) and Eurofound (2016). Even though the results show some continuity as some clusters seem to have a certain overlap, other pertinent differences between the scope and method ask for caution when comparing the results, making it impossible to look at the results from a trend perspective.

First of all, the scope of the researchers is different. Holman (2012) looks at job quality in the EU-27 countries, with data from the 4th European Working Conditions Survey (EWCS) data from 2005, before the financial crisis, while Vandenbrande *et al.* (2012) and Lamberts *et al.* (2016) focus specifically on the Belgian labour market, with EWSC data gathered respectively during the financial crisis in 2010 and afterwards in 2015, and finally, Eurofound (2016) present results based on EWCS data from EU-28 countries collected in 2015, after the financial crisis. Most importantly, there are large differences between the items included in the 4th, 5th and 6th EWCS and subsequently between the job quality indicators constructed with these items. Since these job quality indicators are the basic input for the cluster analyses, this will certainly have influenced the outcomes. In addition, Holman (2012) used scales of job quality indicators, while Vandenbrande *et al.* (2012) dichotomised their indicators. Since Lamberts *et al.* (2016) and Eurofound (2016) used a latent class analysis, continuous variables as well as ordinal variables could be included. Nevertheless, from a more generalist perspective on jobs and job types, it still can be informative to look for similarities between the job types found in the four analyses.

Two clusters are more or less the same in the four studies, although their labels sometimes differ. The *saturated work* clusters of Holman (2012), Vandenbrande *et al.* (2012) and Lamberts *et al.* (2016) show large mutual similarities as well as resemblance with the *high flying jobs* stipulated by Eurofound (2016). Likewise, the cluster that Vandenbrande *et al.* (2012) call *indecent work* matches with Holman's *insecure jobs*, with the *low-quality jobs* of Lamberts *et al.* (2016) and with the *poor quality jobs* in Eurofound (2016). In short, all analyses show a cluster with high scores on (almost) all job quality indicators and a cluster with (almost) all low scores.

In-between the types with the highest and the lowest scores, the distribution among clusters is more variated. A fourth cluster found by Vandenbrande *et al.* (2012) resembles a cluster Holman (2012) has defined. The *emotionally demanding work cluster* (Vandenbrande *et al.*, 2012) only partially corresponds to Holman's *team-based work* cluster. They are both characterised by high levels of emotional demands and team work combined with relative high autonomy and complexity. But we can identify some important differences: employees in *team-based work* experience much higher levels of support, more often have full time contracts and less unusual working hours than those in the *emotionally demanding work cluster*. Their work consists less of repetitive work. Also, *emotionally demanding work* can be recognised in the cluster of *jobs under pressure*. Both have to work with people and report strong emotional demands and a negative social environment (following the definition of Eurofound's analysis (2016): adverse social behaviour such as abuse and harassment). On the positive side, they have more than average training opportunities.

Also, similarities can be found between the *active jobs* (Holman, 2012), the *full-time balanced work* (Vandenbrande *et al.*, 2012) and the *balanced work* (Lamberts *et al.*, 2016).

Other similarities in clusters can be found between the groups identified by Vandenbrande *et al.* (2012), Lamberts *et al.* (2016) and Eurofound (2016). First, *work with limited career prospects* shows some

resemblances with the *supported work* and the *smooth running jobs*; all have limited access to training or career opportunities and receive low wages, but score rather to very positive on the other criteria. The main differences between the typologies lay in differences in the indicators examined. Next to that, *heavy repetitive work, heavy repetitive and flexible work* and *active manual jobs* all encounter the highest level of physical risks at the workplace. The earnings in these job classifications are average to good, but the workers experience almost no training opportunities. *Heavy repetitive work* and *active manual jobs* also have a rather positive social environment, because of the lack of work with people, which is not the case for the *heavy repetitive and flexible work*.

The remaining two clusters identified by Holman (2012) - *passive-independent jobs* and *high-strain jobs* - are too different from the clusters found in other research. Some similarities can be seen between the clusters, but they clearly pool different job types. This can be caused by a different methodology and different indicators implemented in the analysis, or by the changed labour market situation after the financial crisis.

Also the *work with flexible and unusual hours* (Vandenbrande *et al.*, 2012) and the *work with limited development opportunities and framing* (Lamberts *et al.*, 2016) cannot be linked to a cluster described in the other analyses. This could be because of the more specific Belgian scope or because of different indicators in the analysis of Eurofound (2016).

In this paper we will try to replicate the study of Lamberts *et al.* (2016) using the two most recent waves of the EWCS (of 2010 and 2015). Further we will compare the typology resulting from our data with the typologies described, looking for indications of consistency in job types. An evolution of the job types between 2010 and 2015 will be described and the clusters will be linked to job outcomes as an indication of the job quality in these groups.

Table 2.1 Overview of similarities between job types in different analyses

Holman (2012)	Vandenbrande *et al.* (2012)	Lamberts *et al.* (2016)	Eurofound (2016)
Saturated jobs	Saturated jobs	Saturated jobs	High flying jobs
Insecure jobs	Indecent work	Low quality jobs	Poor quality jobs
Team-based jobs	Emotionally demanding work		Jobs under pressure
Active jobs	Full-time balanced work	Balanced work	
	Work with limited career prospects	Supported work	Smooth running jobs
	Heavy repetitive work	Heavy repetitive and flexible work	Active manual jobs
Passive-independent jobs			
High-strain jobs			
	Work with flexible and unusual hours		
		Work with limited development opportunities and support	

2.1.3 Quality of jobs and job quality outcomes

Job quality results from the combination of a large set of job characteristics or job quality indicators. There is not one job type with all good or all bad job characteristics. The specific combination of both good and bad job characteristics and their interactions determines the quality of the job. Holman

(2012) also argues that there are different types of good quality and bad quality jobs, depending on their unique combination of job characteristics.

Job characteristics which might have negative influences on the well-being of employees, can therefore be seen as alarm signs that the job quality might be threatened, while job characteristics indicative for high job quality are giving positive signs on the job quality. The combination of these job characteristics and the trade-off between them can give a first impression of the overall job quality.

In the definition of job quality (see *infra*), Holman (2012) points out a range of job quality outcomes, by which job quality can be evaluated. These job quality outcomes are not to be confused with job quality indicators (or job characteristics). While the job quality indicators are aspects intrinsic to the job or the employment environment, the job quality outcomes are the effects of the job as a whole on the individual in terms of physical and psychological well-being, positive attitudes, job satisfaction, etc. When investigating job quality, it is essential to always keep this distinction in mind and to avoid mixing up job quality indicators and job quality outcomes (Lamberts *et al.*, 2016; Ramioul, Szekér & Vandekerckhove, 2014). Job satisfaction is an important job quality outcome that is frequently used (Loher, Noe, Moeller & Fitzgerald, 1985; Spector, 1997) and can give some insights on the job attitudes of the employee. Another job quality outcome associated with job attitudes is job sustainability (Vandenbrande *et al.*, 2012). Health is also an outcome that can be directly related to job quality. Job characteristics such as high risks for example might have a direct influence on the physical health of a worker. But also the effects of less obvious job characteristics (*e.g.* atypical working hours) on the physical and psychological well-being of an employee are already widely discussed (Karasek, 1979; Bakker & Demerouti, 2007; Vandenbrande *et al.*, 2012). Besides this, subjective security variables such as subjective job insecurity or subjective labour market security are of large importance for workers (Vandenbrande *et al.*, 2012).

The job quality of a job type thus can be assessed using these job quality outcomes. However, we cannot assume that a positive score on one job quality outcome necessary implies positive scores on all job quality outcomes. For example an employee might be very satisfied about his job, although the job has negative effects on his health or is not sustainable. Therefore multiple job quality outcomes need to be included to fully assess the job quality of a job type.

In Chapter 4 of this paper, we will look into the relationship between job types and eight job quality outcomes, taking into account the possible interactions and trade-offs between the job characteristics within each job type.

2.1.4 Aims of this study

With this paper we want to address the two main issues we identified. The first objective is to identify job types within the latest two waves of the EWCS (5th and 6th wave) across EU-28 Member States and to see if we can find indications of consistency in job types over time, presenting an analysis of the evolution between 2010 and 2015. The second objective is to get a better understanding on the relation between the job types, quality of jobs and job quality outcomes and address the issue of trade-offs between specific sets of good and bad job quality indicators.

While Holman's approach (2012) is an important point of departure, we will derive somewhat from his study by using a different job quality model and go with other job quality indicators. We will apply the WES model with three dimensions of job quality, since we believe it to be more coherent and clear-cut that the model of Holman. Further the job quality indicators developed by Lamberts *et al.* (2016) will be used, since they were developed for the 5th and 6th EWCS data and this study attempts to replicate this analysis for a broader European scope.

We will now first address the first objective of identifying job types and consistency in job types, discussing the methodology and results. Next, the methodology and results will be presented on the relation between job quality and job quality outcomes. Afterwards a paragraph will be assigned to the

evolution of the job types between 2010 and 2015, and to the distribution of the job types in European economies. We will end with some discussion and conclusions.

2.2 Job types in Europe

2.2.1 Method

2.2.1.1 Sample

We used the data of the latest available waves of the European Working Conditions Survey (EWCS) at the time of publication[2], which includes the data of all survey waves and is harmonised to allow comparisons over time. The EWCS was launched in 1990 by the European Foundation for the Improvement of Living and Working Conditions (Eurofound). Every five years, data are gathered using face-to-face interviews, which take place at the home of the respondents in the national language(s) of the country. Respondents are selected creating a multi-stage, stratified and random sample to obtain a representative sample of employees and self-employed workers in each country. The target population of the EWCS is all people that are in employment at the time of the survey and are aged 15 (or 16 in Bulgaria, Spain, Norway and UK) or older. Over time, the EWCS has developed and grown extensively (from 19 questions in the first wave to 106 in the latest survey).

We will only use the data from the two latest waves, the 5th wave from 2010 and the 6th wave executed in 2015, because the questionnaire changes are limited between these two waves and allows us to make indicators which are comparable over these two waves. The 6th EWCS covers about 44,000 respondents in 35 countries, including the EU-28 (Eurofound, 2015). The 5th EWCS covers about 44,000 respondents in 34 countries, including *e.g.* the EU-27 and Croatia (Eurofound, 2010). For this analysis we have drawn a sample including only employees from the 28 members of the European Union (in 2015), with a total sample size of 59,787 respondents for the two waves together.

In the applied latent profile analysis, missing values will be excluded on case-basis. Since the percentage of missing values per variable is not distributed equally among the EU-28 countries, leaving all these cases out could cause representativity problems and difficulties for correctly comparing the countries. Especially for the indicator *earnings*, the cultural sensitivity seems to differ greatly among the Member States (varying from 6% missing values to almost 40%). Therefore, we tried to impute estimates for all missing values, based on *wave, country, occupation (ISCO-08), gender, education (ISCED), sector (NACE rev. 2), age,* and age^2. However, for some respondents the information provided was not sufficient to adequately apply this technique. As a result, the final sample size is 58,828.

2.2.1.2 Measures: job quality indicators

Table 3.1 gives an overview of the selection of 21 job quality indicators, derived from Lamberts *et al.* (2016) that will be used in this analysis. In addition, Annex 1 presents an overview of the content, the average score in Europe for 2010-2015, and the survey questions used to construct these indicators.

The construction of the indicators was somewhat limited by the availability of items in both survey waves. In some cases, similar items were included in both survey wave, but small changes in the wording or scales occurred, which required us to use the harmonised items which Eurofound included in the data. All indicators were scaled to values between 0 and 100 to facilitate the interpretation of the results, which is advantageous for comparisons internally and between the indicators.

2 European Working Conditions Survey Integrated Data File, 1991-2015: https://discover.ukdataservice.ac.uk/catalogue/?sn=7363&type=Data%20catalogue

Table 2.2 Overview of the included job quality indicators, classified by the WES model

Work	Employment	Social relations
Task autonomy	Permanent contract	Participation
Autonomous teamwork	Full-time work	Representation
Task complexity	Wage	Supportive management
Speed pressure	Additional fees	Social support
Emotional demands	Atypical working hours	Adverse social behaviour
Repetitive tasks	Working time flexibility	
Risks (musculoskeletal, ambient and bio-chemical)	Planning autonomy	
	Career opportunities	
	Training	

Source Lamberts, Szekér & Vandekerckhove (2016)

For the construction of the indicators we followed the approach of Lamberts and colleagues (2016). However, two changes were made. First, we decided to exclude the variable *fixed workplace*, since the question wording has changed significantly between the 5th and 6th wave of EWCS. The European scope does not enable us to compensate for this change in wording with information from literature or legislation and policy evolutions to explain the obtained results. Second, the indicator for *wage* is constructed in a different way. While Lamberts and colleagues (2016) started from the more detailed wages variables (q104 and q105), we could only use a standardised income variable (inc_deciles) which was constructed by Eurofound to have a comparable wage variable (with deciles) for all countries of the survey and across survey waves.

2.2.1.3 Procedure: latent profile analysis

For this research, Latent Profile Analysis (LPA) is done to identify the job clusters. We prefer to use LPA since it has a number of advantages over hierarchical cluster analysis and K-mean clustering. A first advantage of LPA is that no set number of clusters has to be defined beforehand and no strict proximity measures are used to narrow down the number of groups. Instead, LPA estimates models with an increasing number of latent groups and returns likelihood statistics that are used to define a stopping rule. Technically it relies on the assumption of multivariate normally distributed error terms in the models estimated by Maximum Likelihood. As a result, units are not exclusively placed in one group, but rather have a probability for the membership of each of the groups. A second advantage is that LPA allows to combine different types of variables (dichotomous, categorical, and continuous) within one model and can build more complex structural models.

However, there are a few caveats to bear in mind. Some models may not converge, so in contrast with other clustering, there is not always a result. As with other techniques for data reduction, the clustering implies a loss of information. Finally, LPA is a data driven method which implies the nature of the clusters ultimately depends on the data and the variables that are used in the model.

The LPA was done use the Latent Gold software (Vermunt & Magidson, 2002). We estimated latent profile models with 5 to 9 clusters using the 21 constructed indicators for job characteristics (Table 3.1), which are a mix of dichotomous, categorical and continuous indicators. Further the survey wave and country were included in the model as covariates and the individual country weights were used.

2.2.2 Results

2.2.2.1 Can we find job types?

To determine the best fitting model, latent profile models with cluster sizes between 5 and 9 were tested. From or review of literature on job types we expected that a model with less than 5 clusters was unlikely. Hence we only tested models with 5 or more clusters. In the latent profile analysis missing values are excluded on a case wise base. This reduced the sample to 58,828 employees answering all questions involved in the indicator building process.

The comparison of the BIC (LL) of the different models showed that the 7-cluster solution was the best solution (Table 3.2). In addition, this 7-cluster solution also has the lowest classification error. Further the population of the sample was relatively satisfying distributed across the seven clusters (Table a2.1 in appendix). The smallest cluster contains 9.64% of the observations, while the largest cluster combines 19.92% of the population (Table 3.3).

Table 2.3 Results for latent profile analysis for 5 to 9 clusters: LL, BIC, AIC, classification errors

Model	LL	BIC(LL)	AIC(LL)	Npar	Classification error
5-cluster model	-531 704.939	1 065 497.378	1 063 789.878	190	0.1028
6-cluster model	-522 954.114	1 048 358.296	1 046 354.229	223	0.1156
7-cluster model	-501 167.301	1 005 147.235	1 002 846.603	256	0.0842
8-cluster model	-504 525.953	1 012 227.105	1 009 629.907	289	0.1233
9-cluster model	*	*	*	*	*

* No converging model was found.

Source results from latent profile analysis using Latent Gold software

2.2.2.2 Describing the job types

The seven job types each can be described by a unique combination of job characteristics. Table 3.3 gives an overview of the profiles of these seven different job types. Since a high score does not always indicate a positive work environment, the fields are coloured according to the most preferable situation. Using the ISCO-08 classification, it is possible to identify the most prevalent occupations for each job type. Table a2.1 (in appendix) gives the detailed scores of the job types on different job characteristics and the distribution of the job types. The seven job types are: A*ctive and flexible jobs, balanced jobs, low strain supported jobs, structured jobs, passive unsupported jobs, socially demanding and flexible jobs, low quality physical jobs*.

Table 2.4 Levels of job quality indicators for the job types

	Active and flexible jobs	Balanced jobs	Low strain supported jobs	Structured jobs	Passive unsupported jobs	Socially demanding and flexible jobs	Low quality physical jobs
Cluster size	9.64%	12.84%	12.88%	19.92%	18.37%	15.88%	10.48%
Work							
Task autonomy	H	H	M	M	M	M	L
Autonomous teamwork	H	M	H	M	L	H	M
Task complexity	H	H	M	M	L	H	L
Speed pressure	M	M	L	L	L	H	H
Emotional demands	H	L	H	L	M	H	L
Repetitive tasks	L	M	L	M	L	H	H
Risks	L	M	L	M	M	H	H
Employment							
Permanent contract	H	H	M	M	M	H	L
Full-time work	H	H	L	M	M	H	M
Wage	H	H	M	M	M	H	L
Additional fees	M	H	L	L	M	H	M
Atypical working hours	H	L	M	L	M	H	H
Working time flexibility	H	L	M	L	M	H	H
Planning autonomy	H	H	M	M	M	M	L
Career opportunities	H	H	M	M	L	H	L
Training	H	M	M	L	L	H	L
Social relations							
Participation	H	M	M	M	L	M	L
Representation	H	M	M	M	L	H	L
Supportive management	H	H	H	M	L	M	L
Social support	H	H	H	M	L	M	L
Adverse social behaviour	M	L	M	L	M	H	H

Active and flexible jobs

The first cluster contains the most attractive jobs, combining high levels of task autonomy, task complexity, and autonomous teamwork with low levels of repetitive tasks and risks, and only moderate speed pressure. Employees in this cluster almost always have a permanent contract, work often full-time, and enjoy a lot of training, career opportunities, and by far the highest wage of all clusters. Also the degree of participation, representation, supportive management and social support are clearly

above average. Negative elements of these jobs are high emotional demands, atypical working hours, and working time flexibility but these are compensated for by the very high scores on the other indicators (such as a large amount of planning autonomy). The concentration of these positive, attractive and challenging job characteristics is also found in previous research (see *infra*) and leads to the name *active and flexible jobs*. 9.64% of the European employees is employed in this kind of job. Occupations in this cluster are among others managers, engineers, economists, or ICT professionals.

Balanced jobs

The second cluster is called *balanced jobs* because these jobs have beneficial scores on almost all indicators. Work related indicators show a positive situation containing high task autonomy and task complexity but low emotional demands and moderate scores on speed pressure, repetitive tasks and risks. Employment conditions are also very positive with a lot of permanent contracts and full-time work, high wages and a lot of additional fees, a limited amount of atypical working hours and working time flexibility, but high levels of planning autonomy and career opportunities. Also the social relations component shows a positive environment: employees recognise high levels of supportive management and social support, but few contact with adverse social behaviour. In comparison with the other job types, this cluster seems to have no very negative aspects and the combination of job characteristics seems to be quite balanced. The cluster contains 12.84% of the European employees. Typical occupations are all kinds of professionals, craftsmen, construction workers, and electricians.

Low strain supported jobs

The third cluster contains 12.88% of the European employees in *low strain supported jobs*. This cluster is characterised by moderate or low levels of task complexity and speed pressure, few repetitive tasks, but high levels of autonomous teamwork, supportive management and social support. Employees in this cluster also have few additional fees, often work part-time, and encounter high emotional demands. There are similarities with *passive unsupported jobs* (see *supra*) with regard to low strain work aspects, but a remarkable difference between these two clusters lies in the social relations aspect. Therefore, this job type is called *low strain supported jobs*, and further we will discuss the *passive unsupported jobs*. Examples of jobs in this cluster are teaching professionals, clerks, customer services clerks.

Structured jobs

The fourth cluster contains 19.92% of the European employees and represents jobs that score moderate on most indicators. Distinctive characteristics of this job type are the very low scores on speed pressure, emotional demands, atypical working hours, working time flexibility, and adverse social behaviour. On the other hand, these employees also indicate the lowest level of additional fees, and a very low score on training opportunities. Because of the combination of moderate levels of the indicators regarding *Work* and the low scores on all indicators related to variability or flexibility, this cluster is called *structured jobs*. Some examples of professions are teaching professionals, clerks, refuse workers, and cleaners.

Passive unsupported jobs

More than 18% of the European employees have a *passive unsupported job*. The most differentiating aspects of this job type are the low scores on autonomous teamwork, task complexity, career opportunities, and training, in combination with very low levels of *Social relations* indicators such as participation, representation, supportive management and social support. This raises the assumption that this cluster combines rather passive and individual jobs. Similar to the *structured jobs* and *low strain supported jobs*, the indicators regarding *Employment* are almost all of a moderate level, but the main differences lie in the social relations component. While *low strain supported jobs* show a few beneficial scores (green boxes), and *structured jobs* score moderate on almost all aspects, *passive unsupported jobs* have a negative score on four of the five criteria and thus report an extremely negative social working

climate. Typical occupations with *passive unsupported jobs* are teaching professionals, clerks, personal service workers, sales workers, and cleaners.

Socially demanding and flexible jobs

Socially demanding and flexible jobs score high on a strong majority of the indicators and thus are very different from the three previous job types. Working conditions are characterised by highly repetitive but complex tasks which have to be finalised in autonomous teams under high speed pressure and are linked to high emotional demands and risks. Employment conditions are noted by a lot of permanent contracts and full-time work, followed by high wages, a lot of additional fees, training and career opportunities, but also atypical working hours and highly flexible working time. With regard to social relations at work, moderate scores are observed for participation, supportive management and social support. Remarkably, the employee representation is very high and thus well-developed, as opposed to all the other jobs types except for *active and flexible jobs*, which could compensate for the very high frequency of contact with adverse social behaviour. Hence, the combination of high levels of socially demanding tasks and situations – which are not balanced by appropriately high levels of support from management and colleagues –, and high levels of speed pressure and flexibility is reflected in the label of this cluster. Even though the job resources in this job type are moderate, the job demands are clearly high. 15.88% of the European employees is employed in this job type cluster. Similar job types are found in previous analyses (see *infra*). In this job type we can find a lot of health and care professionals, craftsmen, personal and protection services, and handicraft workers.

Low quality physical jobs

This cluster is genuinely seen as comprising qualitatively the worst jobs, containing 10.48% of the European employees. As opposed to the cluster of *balanced jobs*, these *low quality physical jobs* have unbeneficial scores on almost all indicators. Low levels of task autonomy and task complexity are combined with high levels of speed pressure, repetitiveness, and risks. Regarding employment conditions, few permanent contracts, low wages, and few training and career opportunities are combined with high levels of atypical working hours and working time flexibility, but low planning autonomy. On top of that, the social relations are merely negative too; low levels of participation are shown, as well as few representation, limited supportive management, low social support, and employees are very often confronted with adverse social behaviour. It is clear that the heavy job demands outweigh the very limited job resources, poor employment conditions and limited social relations. This category is very similar to other job types found in previous analyses (see *infra*). Often these employees are in agricultural jobs, assembly line workers, plant operators, and drivers.

2.3 Quality of jobs and job types

2.3.1 Method

2.3.1.1 Sample

For this part the same data from the 5th and 6th EWCS are used as in the latent profile analysis. Due to the constraints of the latent profile analysis, the sample is reduced to the employees that filled in all the questions used in the construction of the job types, and the questions related to the job quality outcome measured. Therefore, the number of observations varies for each outcome (between N = 51,617 and N = 58,818). Further a variable indicating the job type of each respondent is included.

2.3.1.2 Measures: job quality outcomes

For this analysis, the job quality outcomes of Lamberts *et al.* (2016) are used. They identified a set of job outcome indicators (subjective security variables, job attitude and health variables), using the items available in the 5th and 6th EWCS, from which several seem useful to consider in our analyses.

As a first group, the subjective security variables are subjective job security ('I might lose my job in the next 6 months') and subjective labour market security ('If I were to lose or quit my current job, it would be easy for me to find a job of similar salary'). A second group of job quality outcomes are health variables. They include the physical health, general health, the WHO-5 psychological well-being index, and sleep problems. This set of job quality indicators gives a comprehensive overview of the health and well-being of the employee. The third group of job quality outcomes are the job attitudes, including perceived job sustainability and job satisfaction (Eurofound, 2010, 2015). These two indicators help to picture the attitudes and general feelings the employee has regarding his or her job (Ramioul *et al.*, 2014; Vandenbrande *et al.*, 2012). More information on the construction of the job quality outcomes indicators can be found in appendix 3.

Table 2.5 Overview of the job quality outcomes

Indicators related to subjective security	Indicators related to health and well-being	Indicators related to job attitudes
Perceived job security	Physical health	Job sustainability
Perceived labour market security	General health	Job satisfaction
	WHO-5 psychological well-being index	
	Sleep problems	

2.3.1.3 Procedure: multiple linear regressions

Multiple linear regression analysis of the job types was done to predict the levels of each of the job quality outcome for the job types individually (using the beta's) using Stata. Control variables were included for country, age, education, gander, survey wave, and the individual country weights were included in the analyses.

2.3.2 Results

2.3.2.1 Indications for job quality

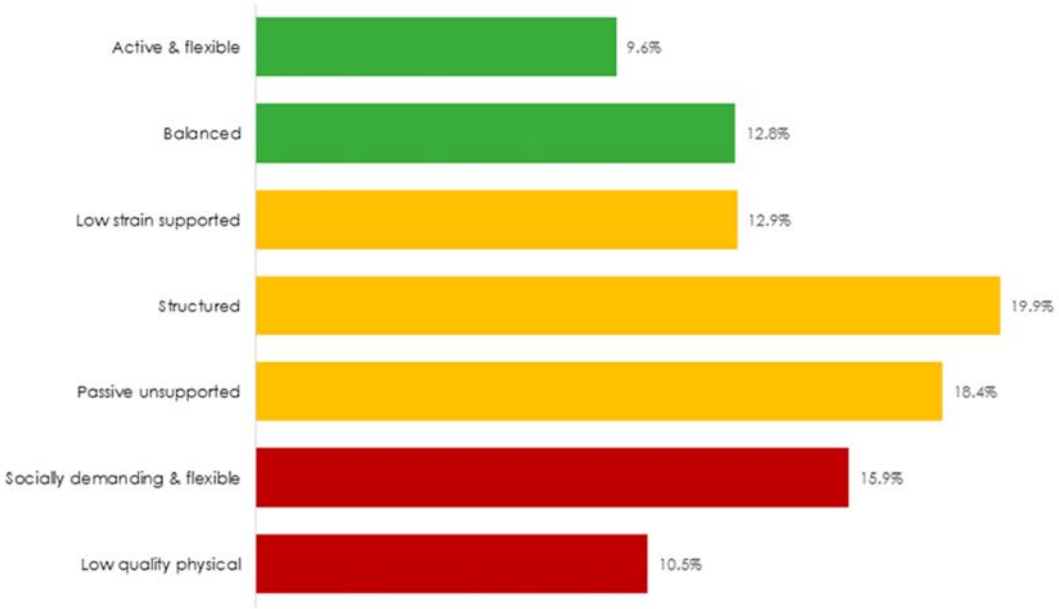
Looking at the descriptions of the seven different job types, it is clear that each consists of a typical combination of both good and bad job characteristics. However, we can spot differences in the overall picture in terms of good and bad job characteristics for each job type. As discussed earlier, all these job characteristics give signs of good job quality or alarm signs that the job quality might be threatened. For each job type we can thus assess whether there are either indications for high, moderate or low job quality, based on its specific set of job characteristics.

Active and flexible jobs and *balanced jobs* combine a lot of good characteristics, and, although some negative job characteristics are also observed (for example the high number of atypical working hours in *active and flexible jobs*), the balance is clearly positive. Therefore, we can say that for these two job types there are many indications for high job quality. About 22.4% of the European employees benefits a job in these good quality job types. The job quality of *low strain supported jobs, structured jobs,* and *passive unsupported jobs* is in general on average levels. These are indications for a moderate level of overall job quality. About 51.2% of the European employees has a job with average or moderate job quality. The other two job types, *socially demanding and flexible jobs,* and *low quality physical jobs* both have some positive or moderate job characteristics. However, the bad job characteristics clearly outweigh

the good ones, either in number or in impact. For these two clusters there are mainly indications for low job quality. About 26.4% of the European employees has a job with poor job quality.

Based on this, we made a ranking of the extent to which the job types have indications for high(/low) job quality, from highest job quality to lowest: *Active and flexible jobs, balanced jobs, low strain supported jobs, structured jobs, passive unsupported jobs, socially demanding and flexible jobs,* and *low quality physical jobs* (see Figure 4.1).

Figure 2.1 Job quality of the job types in 2010-2015



Percentages in the figure represent the proportion employees in this job type on the European labour market in 2010 and 2015.

2.3.2.2 Job types and job quality

Perceived job sustainability

The perceived sustainability of a job is certainly a relevant indicator for the quality of a job. This dichotomous indicator shows whether the respondent agrees or disagrees with the statement 'do you think you will be able to do the same job at the age of 60'. About 61% of the interviewed European employees agrees with this statement. The table below shows the mean percentages for each job type cluster with regard to job sustainability, and whether they differ significantly. By reading the table across rows, it is indicated whether the mean score of the job type in the row is significantly higher or lower than the job type mentioned in the column. Even though the differences between *balanced, low strain supported*, and *structured jobs* are not significant, it is clear that the perceived job sustainability decreases along the sequence of job types according to job quality as indicated above. With 77% of the employees in *active and flexible jobs* agreeing to the statement, this cluster has the most sustainable jobs. This percentage decreases gradually to the level of the workers in *low quality physical jobs*, of which only 40% thinks they will be able to perform the same jobs at the age of 60.

Table 2.6 Differences between job types in terms of perceived job sustainability

		Mean	1	2	3	4	5	6	7
1	Active and flexible	77	-	H	H	H	H	H	H
2	Balanced	68	L	-	ns	ns	H	H	H
3	Low strain supported	66	L	ns	-	ns	H	H	H
4	Structured	67	L	ns	ns	-	H	H	H
5	Passive unsupported	62	L	L	L	L	-	H	H
6	Socially demanding and flexible	53	L	L	L	L	L	-	H
7	Low quality physical	40	L	L	L	L	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of perceived job sustainability than the job type in the column. L indicates a significantly lower level of perceived job sustainability. Ns indicates that there is no significant difference between the two job types

Sleep problems

The idea that sleep problems can be related to the work situation is not new. Research states that sleep problems vary according to work schedule, so that atypical working hours and working time flexibility are important determinants for sleep problems (Flo, Pallesen, Mageroy, Moen, & Bjorvatn, 2012). Following our job types approach, we observe that the difference in sleep problems is not very large among the clusters. Still, the *structured jobs*, having the lowest level of imposed flexibility, score significantly lower than all other groups on sleep problems (26). On the other hand, we see that the *socially demanding and flexible jobs* and *low quality physical jobs* score significantly the highest (38 and 40) on this job quality outcome. The general mean score of European employees (2010-2015) is 31, showing that sleep problems are a considerable problem among European workers and that employees in *socially demanding and flexible jobs* and *low quality physical jobs* encounter more sleep problems than the average.

Table 2.7 Differences between job types in terms of sleep problems

		Mean	1	2	3	4	5	6	7
1	Active and flexible	28	-	H	ns	H	ns	L	L
2	Balanced	26	L	-	ns	H	L	L	L
3	Low strain supported	28	ns	ns	-	H	ns	L	L
4	Structured	26	L	L	L	-	L	L	L
5	Passive unsupported	29	ns	H	ns	H	-	L	L
6	Socially demanding and flexible	38	H	H	H	H	H	-	L
7	Low quality physical	40	H	H	H	H	H	H	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of sleep problems than the job type in the column. L indicates a significantly lower level of sleep problems. Ns indicates that there is no significant difference between the two job types

General health

The relation between work and health cannot be neglected. Researchers have frequently demonstrated that the quality of that work has an important impact on both the physical and psychological health (Green, 2006; Van der Doef & Maes, 1999). The indicator for measuring *general health* asked the respondent about his or her general health perception. The mean score is 76, presenting that a large majority indicates to be healthy. When looking at the subscores in the job types, we can see that these scores vary between 70 and 80, and that almost all differences between the clusters are significant (except for the difference between *low strain supported jobs* and *balanced jobs*, and the difference

between *low strain supported jobs* and *structured jobs*. Once again we can see the general health perception of the European employees decrease gradually according to the estimated job quality of the job types. Workers with *active and flexible jobs* have the best health, while workers in *low quality physical jobs* report the lowest score and thus the worst general health.

Table 2.8 Differences between job types in terms of general health

		Mean	1	2	3	4	5	6	7
1	Active and flexible	80	-	H	H	H	H	H	H
2	Balanced	77	L	-	ns	H	H	H	H
3	Low strain supported	78	L	ns	-	ns	H	H	H
4	Structured	76	L	L	ns	-	H	H	H
5	Passive unsupported	75	L	L	L	L	-	H	H
6	Socially demanding and flexible	75	L	L	L	L	L	-	H
7	Low quality physical	70	L	L	L	L	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of general health than the job type in the column. L indicates a significantly lower level of general health. Ns indicates that there is no significant difference between the two job types.

Psychological well-being

Psychological well-being is measured using the WHO-5 index, in which respondents have to indicate how often in the past two weeks they felt cheerful, calm, active, fresh, and like their life is filled with interesting things. The general mean of this index in our sample is 67. Similar to the previous job quality outcomes, employees in *active and flexible jobs* and in *balanced jobs* have the highest score (71 and 70, the difference is not significant), while workers in *low quality physical jobs* report the lowest level of psychological well-being (59).

Table 2.9 Differences between job types in terms of psychological well-being

		Mean	1	2	3	4	5	6	7
1	Active and flexible	71	-	ns	H	H	H	H	H
2	Balanced	70	ns	-	H	H	H	H	H
3	Low strain supported	69	L	L	-	ns	H	H	H
4	Structured	69	L	L	ns	-	H	H	H
5	Passive unsupported	66	L	L	L	L	-	ns	H
6	Socially demanding and flexible	66	L	L	L	L	ns	-	H
7	Low quality physical	59	L	L	L	L	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of psychological well-being than the job type in the column. L indicates a significantly lower level of psychological well-being. Ns indicates that there is no significant difference between the two job types.

Physical health

Also physical health is often clearly linked to the work situation. The general mean for this indicator is 60, showing large fluctuations among the job types. *Active and flexible jobs* are characterised by the highest score (70), thus the best physical health. Next, employees in *structured jobs* have the second best physical health (66), for which the difference with the first category is not significant. *Low strain supported jobs, balanced jobs,* and *passive unsupported jobs* have the same level of physical health, followed by the *socially demanding and flexible jobs,* and *low quality physical jobs* with clearly the lowest level

reported (47). Since these numbers are not percentages, it does not mean that less than half of the workers in *low quality physical jobs* are physically healthy, but it indicates that the quality of their physical health is remarkably lower than workers with *active and flexible jobs*.

Table 2.10 Differences between job types in terms of physical health

		Mean	1	2	3	4	5	6	7
1	Active and flexible	70	-	H	H	ns	H	H	H
2	Balanced	63	L	-	ns	L	ns	H	H
3	Low strain supported	65	L	ns	-	L	ns	H	H
4	Structured	66	ns	H	H	-	H	H	H
5	Passive unsupported	62	L	ns	ns	L	-	H	H
6	Socially demanding and flexible	50	L	L	L	L	L	-	H
7	Low quality physical	47	L	L	L	L	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of physical health than the job type in the column. L indicates a significantly lower level of physical health. Ns indicates that there is no significant difference between the two job types.

Job satisfaction

Job satisfaction is an important job outcome that can be associated with job quality (Loher *et al.*, 1985; Spector, 1997). In general, a majority of the European employees is satisfied with their job, the overall mean is 71. Once again, *active and flexible jobs* have the highest score (82) on this indicator. Then, the degree of satisfaction decreases gradually, similar to the trend for other indicators, with the exception of *socially demanding and flexible jobs* (72) scoring higher than *passive unsupported jobs* and equally high as the *structured jobs*. The difference in job satisfaction between the 1st and 7th job type cluster is striking.

Table 2.11 Differences between job types in terms of job satisfaction

		Mean	1	2	3	4	5	6	7
1	Active and flexible	82	-	H	H	H	H	H	H
2	Balanced	76	L	-	H	H	H	H	H
3	Low strain supported	75	L	L	-	H	H	H	H
4	Structured	72	L	L	L	-	H	ns	H
5	Passive unsupported	68	L	L	L	L	-	H	L
6	Socially demanding and flexible	72	L	L	L	ns	H	-	H
7	Low quality physical	54	L	L	L	L	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of job satisfaction than the job type in the column. L indicates a significantly lower level of job satisfaction. Ns indicates that there is no significant difference between the two job types.

Perceived job security

In times of crises job outcomes such as subjective job security and subjective labour market security are of a considerable importance for employees (and more so than in times of economic growth). Perceived job security is measured by the feeling of the possibility to lose one's job within the six coming months. The general mean is 70, indicating in general a rather high feeling of job security, but the differences among the seven job types are remarkable. With a score of 80, employees in *active and flexible jobs* report to be very secure not to lose their job in the coming period, while *low quality physical* workers only score 59 and thus worry more about being discharged. The remaining clusters score very similar to each other and vary around the general mean, between 68 and 73.

Table 2.12 Differences between job types in terms of perceived job security

		Mean	1	2	3	4	5	6	7
1	Active and flexible	80	-	H	H	H	H	H	H
2	Balanced	73	L	-	H	H	H	H	H
3	Low strain supported	72	L	L	-	H	H	ns	H
4	Structured	68	L	L	L	-	ns	L	H
5	Passive unsupported	68	L	L	L	ns	-	L	H
6	Socially demanding and flexible	72	L	L	ns	H	H	-	H
7	Low quality physical	59	L	L	L	L	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of perceived job security than the job type in the column. L indicates a significantly lower level of perceived job security. Ns indicates that there is no significant difference between the two job types.

Perceived labour market security

Perceived labour market security is measured by the feeling of the possibility to easily find a similar job with similar working and employment conditions, in case of losing one's current job. This general mean is remarkably lower: 43, indicating that even though most people are not afraid to lose their job in the coming months (see *infra*), most of them don't think they will find a similar job in case it happens. Here, the differences between the clusters are often not significant. With a mean score of 51, *active and flexible* workers score the highest, followed by workers in *socially demanding and flexible jobs* (47). Another interesting observation is that *structured jobs* seem to provide the lowest level of labour market security, lower than *low quality physical jobs*, although not significantly.

Table 2.13 Differences between job types in terms of perceived labour market security

		Mean	1	2	3	4	5	6	7
1	Active and flexible	51	-	H	H	H	H	H	H
2	Balanced	44	L	-	ns	H	ns	ns	H
3	Low strain supported	44	L	ns	-	H	ns	L	H
4	Structured	38	L	L	L	-	L	L	ns
5	Passive unsupported	42	L	ns	ns	H	-	L	H
6	Socially demanding and flexible	47	L	ns	H	H	H	-	H
7	Low quality physical	39	L	L	L	ns	L	L	-

Note: read across rows. H indicates that the job type in the row has a significantly ($p<.05$) higher level of perceived labour market security than the job type in the column. L indicates a significantly lower level of perceived labour market security. Ns indicates that there is no significant difference between the two job types.

2.4 Distribution and evolution of job types in Europe 2010-2015

2.4.1 Evolution of the job types from 2010 to 2015

Since we included data from 2010 (5th wave EWCS) and 2015 (6th wave EWCS), we can observe the evolution of the job types that have been distinguished. A red line in Figure 5.1 indicates a decrease of the employee population in this job type, while a green line reports an increase.

Figure 2.2 Evolution of the job types in EU-28 from 2010 to 2015

In general in the EU-28, the distribution of employees along the seven job types has not changed enormously. The most notable evolutions are seen in the clusters of *balanced jobs* and *passive unsupported jobs* but only comprise changes of 1.5% points. The amount of employees in *active and flexible jobs, low strain supported jobs,* and *structured jobs* remained very stable. *Socially demanding and flexible jobs* have progressed with almost 0.5% points, while *low quality physical jobs* seem to have over 0.5% points decreased. This could be a sign of a positive evolution, given that the last job type is seen as having the worst job quality. However, these numbers are averages of all EU-28 Member States and therefore it is probable that the differences between countries are large and the evolution of job types between 2010 and 2015 varies more greatly.

2.4.2 Distribution of job types on the labour market

The figures below show the distribution of European employees along the seven job types, according to country, gender, age, education, company size, sector (NACE rev.2) and occupation (ISCO-08). The coloured bars indicate the score of the subpopulation in 2015, the bullet points display the score of the subpopulation in 2010, and the grey area represents the mean score of the EU-28 population in 2015 for this background variable.

Figure 5.2 shows the distribution of national labour forces (only employees) along the seven job types to allow for discussing these numbers in more detail and for adding a geographical distributive aspect to the comparison over time. It is clear that there are large differences between the EU-28 Member States, for the national situation, as well as for the evolution observed. In some countries (Belgium, Germany, Estonia, France, Luxembourg, Austria) the distribution of employees does not vary tremendously among job types. Some other countries are characterised by large differences between the clusters. While some countries (Bulgaria, Greece, Cyprus, Lithuania, Portugal) have very few employees in the cluster of *active and flexible jobs* and score remarkable high for *structured jobs*, the complete opposite is observable for other countries (Denmark, Finland, Sweden).

Figure 5.3 contains the distribution of European employees by different background variables. First, the difference between men and women is illustrated, showing that women are considerably more often employed in *structured jobs* and in *low strain supported jobs*, while they are less present in *active and flexible jobs* and *socially demanding and flexible jobs*. The remaining three job type clusters are more balanced according to gender.

The second part of this figure shows the distribution according to education. The main differences are noticed between the youngest and the oldest employee subpopulations, and more specifically in

the clusters of *active and flexible jobs* and *low quality physical jobs*. Also, the youngest workers are remarkably present in the cluster of *low strain supported jobs*. Further, especially employees between 35 and 54 (3rd and 4th group) are very similar regarding their distribution along the job types.

Third, large differences can be seen in distribution of employees according to their education. Unsurprisingly, the differences are the largest within the cluster of *active and flexible jobs*, where only 2% of the employees with a lower secondary degree as highest degree can be found, versus 19% of the employees with at least one tertiary education degree. The reversed trend is visible for the *low quality physical jobs*, where 15% of the employees with only a lower secondary degree is employed, versus 4% of the highly educated employees.

The last part of this figure presents the distribution of employees by company size. The major differences in distribution of respondents who indicate to be the only employee in the company, is stunning. Almost 50% of these employees are clustered in *passive unsupported jobs*, followed by 26% in *structured jobs*. Further, the largest companies provide merely *active and flexible jobs* or *socially demanding and flexible jobs*.

Next, Figure 5.4 provides the distribution of employees according to sector (NACE rev.2). First, a notable observation is the concentration of employees in *mining and quarrying* in the cluster of *socially demanding and flexible jobs* (36%). Another striking concentration of a sector within one job type accounts for the employees in *activities of households as employers, undifferentiated goods- and services-producing activities of households for own use* in the cluster of *passive unsupported jobs* (57%). Last, also the sector of *activities of extraterritorial organisations and bodies* clusters strongly in the *active and flexible jobs*. Further, the distribution of the sectors along the job types varies greatly.

Finally, Figure 5.5 represents the distribution of employees according to occupation (ISCO-08). This corresponds with the examples before (see *infra*). The main observation is that managers are largely present in *active and flexible jobs* (43%), but almost none of them is categorised within the cluster of *low quality physical jobs*. For other occupations mentioned in the figure, the distribution along the job types is more equally spread, but strong differences remain visible. This shows that job types do not accord directly with occupations, but that some characteristics of occupations remain the same and cluster in similar job types, independent *e.g.* on the organisation of the work.

Figure 2.3 Job types in 2010 and 2015 by country (%)*

* Bars represent 2015, bullet points represent 2010, grey area represents EU-28 average in 2015.

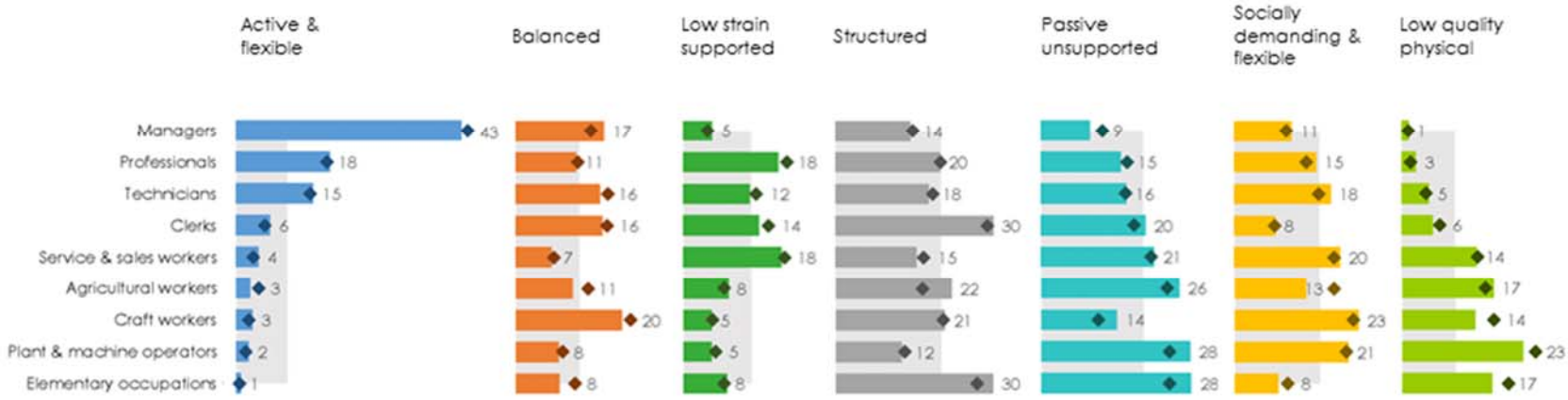
Figure 2.4 Job types in 2010 and 2015 by gender, age, education, and workplace size (%)*

* Bars represent 2015, bullet points represent 2010, grey area represents EU-28 average in 2015.

Figure 2.5 Job types in 2010 and 2015 by sector (NACE) (%)*

* Bars represent 2015, bullet points represent 2010, grey area represents EU-28 average in 2015.
A = agriculture, forestry and fishing; B = mining and quarrying; C = manufacturing; D = electricity, gas, steam and air conditioning supply; E = water supply, sewerage, waste management and remediation activities; F = construction; G = wholesale and retail trade, repair of motor vehicles and motorcycles; H = transportation and storage; I = accommodation and food service activities; J = information and communication; K = financial and insurance activities; L = real estate activities; M = professional, scientific and technical activities; N = administrative and support service activities; O = public administration and defence, compulsory social security; P = education; Q = human health and social work activities; R = arts, entertainment and recreation; S = other service activities; T = activities of households as employers, undifferentiated goods- and services-producing activities of households for own use; U = activities of extraterritorial organisations and bodies.

Figure 2.6 Job types in 2010 and 2015 by occupation (ISCO-08)*



* Bars represent 2015, bullet points represent 2010, grey area represents EU-28 average in 2015).

2.5 Discussion and conclusion

2.5.1 Limitations

The main limitations of this study can be found within the data that were used. First of all, the analysis did not include self-employed. They did not have scores on all the included items and were therefore excluded from the sample. By focussing only on employees in Europe, chances enhanced to be able to find equivalent indicators for 2010 and 2015, allowing a comparison over time and a description of the evolution.

Secondly, the indicators used in this research are not fully comparable with the indicators used in previous studies, which explains some of the differences in typologies we find. The reason to use different indicators than before are twofold. On the one hand, the conceptual and theoretical model used in this research was different from the ones used by Holman (2012) and Eurofound (2016), causing that different items were selected to match the applied literature. On the other hand, this study aimed to compare the 5th and 6th wave of EWCS data (2010 and 2015), and thus it was necessary to select only items present in both waves.

The job characteristic indicators used in this study were based on the indicators of Vandenbrande *et al.* (2012), who used a combination of empirical evidence (factor analyses) and theoretical arguments for their indicator building in a study on the Belgian data of the 5th EWCS. Using these indicators for our analysis comparing 2010 and 2015 in a European comparative perspective implied some adaptations to the indicators needed to be done (changes across the 2010 and 2015 questions, changes in wording, items which could not be properly compared across countries, etc.). These changes might have implications for the quality of the indicators we used, considerations which were not addressed in-depth in this study. In the construction of the indicators we aimed to maximise our chances to have comparable indicators over time. However, for some questions the question or scale wording changed between wave 5 (2010) and 6 (2015). When this was the case, we attempted to find a balance between *(a)* producing indicators that are fully comparable over time, and *(b)* constructing as much indicators as possible similar to those of Vandenbrande and colleagues (2012) in the best way possible.

A fourth limitation of the study lies in the use of latent profile analysis. This method excludes missing values on a case wise basis, meaning that respondents have to fill in all the items used in a part of the analysis to be included. Especially for the variable on earning this was a problem with more than 13000 respondents who did not answer this question. This was even more problematic since the sensitivity - and thus lacking responses - of this question varied largely among the EU-28 countries (from 6% missing cases in some countries up to 30% missing cases in other countries). To tackle this problem estimated values were imputed for all missings on the 21 job characteristic indicators on the basis of a linear regression using multiple background variables (see infra). This imputation however has the risk to weaken the quality of the data, in comparison with properly obtained data during interviews. Also, since sometimes the background information (on the respondent) available was not sufficient for a qualitative estimate, we could not provide estimates for all of the missing values, causing still a small reduction of the final sample.

Finally, it is important to mention that it would be very interesting to perform a similar analysis on different data, including an indicator for workload, since it seems an important missing element in the construction of the job types. In the current analysis an indicator for speed pressure is used, but this cannot be confused for or seen as a proper indicator for workload. Since the current EWCS data do not allow to construct a high-quality measure for workload, we could not insert such an indicator in the analysis. In order to get a little more information, we intersected the seven job types with an item on stress[3]. Here we can see than *socially demanding and flexible jobs* experience the highest level of

3 For this question y15_q61m 'You experience stress in your work – always, most of the time, sometimes, rarely, never' was used.

stress (M = 55.30), followed by *active and flexible jobs* (M = 52.22) and *low quality physical jobs* (M = 51.88). *Structured jobs* clearly have the lowest level of stress (M = 40.61) (see Appendix 5).

2.5.2 Discussion and conclusion

The claim of this paper is that one measure is not enough to assess job quality. That job quality itself is a multidimensional concept, has long been agreed upon. There is less agreement on how to measure this job quality properly, ensuring the multidimensionality of the concept is guaranteed. In the past years, however, the technique of constructing job types has become more and more common in this regard. Job types are introduced as an alternative but legitimate approach to analyse job quality.

The first contribution of this paper is the illustration and confirmation that job types can be very valuable when measuring and discussing job quality. They are a tool to make the complexity and multidimensionality of job quality manageable by structuring the broad set of job characteristics into job types with specific profiles or combinations of job characteristics. Subsequently, the job quality can be assessed by evaluating the scores of the job types on different job quality outcomes. In doing this, job types help to understand the trade-offs and interactions that might occur influencing the job quality outcomes. Job types can also be valuable in trying to understand other job and job quality related concepts (*e.g.* work engagement, burn out).

Also the resemblances of our typology with previous work of Holman (2012), Vandenbrande *et al.* (2012), Lamberts *et al.* (2016) and Eurofound (2016), and even similarities with the model of Karasek (1979), contribute to our belief in the validity of these job types (despite the differences in scope of the study and time frame of the data). At the same time, these resemblances and more strongly the differences with previous typologies of job quality, strengthen the observation that we cannot define one final typology of job types that accounts for all situations, groups, countries, time periods, etc. with cluster analysis or latent profile analysis. For that purpose, these methods are too dependent on the specific data, time and indicators used - and the items included in the indicators.

Nevertheless, we noticed some consistency in the job types across the different typologies. Some of clustering of job characteristics seem to reoccur in all studies. Every study shows a job type that scores high on (almost) all indicators (*e.g. saturated work, active and flexible jobs, high flying jobs*), as well as a cluster of jobs that score low or negative on (almost) all indicators (see *low quality physical jobs, indecent work*, etc.). The two extremes have a lot in common over multiple analyses. Next to that, every study also seems to present a cluster with very balanced jobs, including the suggestion that these jobs might on the long term benefit job quality outcomes more than the group with all high scores. Fourthly, every study seems to distinguish at least one job type that creates the impression that these jobs are additional to the lives of the employees, that their work does not impact their health, well-being, happiness, or personal development in a strong manner (*e.g. low strain supported jobs, work with limited career opportunities, supported work*). Often, part-time work is very common in these job types. Depending on work organisation and social relations, these jobs can easily trend towards good or bad job quality. Therefore, it is important to invest in the social environment and personal development or training of these employees. On the negative side, we also see a cluster with emotionally or socially demanding jobs reoccur, having quite some good aspects, but suffering from high speed pressure, high flexibility demands and working with people. The idea of this reoccurring job type characterised by heavy emotional or social demands shows the importance of the social relations component in measuring job quality, as opposed to the job demands-job control approach of Karasek (1979). Currently, these social aspects of jobs are strongly underestimated, and thus not sufficiently questioned and analysed. In the framework of job demands and resources, it means making a difference between task resources (*e.g.* autonomy and participation in decision-making) and social resources (support from colleagues, supervisors or employee representatives) (Hu, Schaufeli & Taris, 2016).

In conclusion, it is important to stress that jobs are not in total good or bad. Each job and thus each job type consists of multiple aspects, of which some are better than others and some are worse.

Each job type has its factors of improvement that deserve attention and action. For example, *active and flexible jobs* have a high score on almost all indicators and are genuinely seen as the best jobs, but they do not score well on sleep problems and stress (see *infra*). On the other hand, part-time work may be seen as qualitatively lower than full-time work, but according to job quality outcomes, these employees report a very good health situation. Nevertheless, we clearly made a hierarchy of job types according to their job quality outcomes, which indicates that a lot of possibilities exist to make sure the job quality of the worst job types increases.

Currently in Europe, 26.4% of the employees is categorised in a cluster with unbeneficial or bad job quality outcomes. Improving these job types with regard to job quality may be more complex than it seems, because job types are not a direct representation of occupations. Depending on work organisation and social relations, similar occupations can be situated in different job type clusters (see *supra*). This important nuance can be used by policy makers to improve job quality on their labour markets by investing and focussing on certain possibly harmful job characteristics, rather than occupations in general.

For further research it would be interesting to perform this analysis on other data, to include an indicator on workload, and to elaborate more strongly the importance of social relations in the measurement of job quality.

3. Measuring vulnerability to adverse working conditions: evidence from European countries

Prepared by Nathalie Greenan & Majda Seghir

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 & 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 & 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 the 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, five objective and 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 reali-

sation. 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 thus 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 second 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 fourth section presents the results before concluding in the last section.

3.1 Risk and vulnerability at the workplace: concept and measurement

Before looking at how to measure vulnerability to adverse working conditions, a worthwhile starting point is to examine how the concept is defined in the social sciences literature. This will help us to propose a conceptual framework for addressing vulnerability in the specific context of work.

3.1.1 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[4] 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 & Quisumbing, 2008; Ligon & 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 to other

4 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.

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 thus 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 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 wage and 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 characterise 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 rights protection. 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 year 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 vulnerable workers. However, all workers are not equally vulnerable and especially non-unionised workers are more exposed. Indeed, unions can protect from employment vulnerability as it raise their members' awareness of employment rights and provide them with the resources to claim them (Pollert & 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 condition or the work itself.

While there are some attempts to conceptualise vulnerable employment, empirical evidences are mostly focused on a small number of risks with an ex-post approach of vulnerability assessment. To our best knowledge, Bazillier *et al.* (2014) 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 focused 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 rely on an ex-ante approach to anticipate workers that are likely to face adverse working conditions in the future, conditional on individual information 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.

3.1.2 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 condition above a predefined threshold, conditional on both the jobs' and employees' characteristics.

The probability can be stated as follows:

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

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 adverseworking 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:

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

where $X_{i,t}$ represents a bundle of employee as well as job characteristics, α_i is unobservable individual-specific factors 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

$$E[I_{i,t+1}] = \hat{\beta} X_{it} + \hat{\alpha}_i.$$

From (Equation 1), an employee vulnerability to adverse working conditions depends, not just on its expected (*i.e.* mean) exposure looking forward, but also on its variability (*i.e.* variance, from an intertemporal 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 and, 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:

$$Var\left[I_{i,t}|X_{i,t},\hat{\beta},\hat{\alpha}_i\right] = \hat{\sigma}_i^2.$$

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 as 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:

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

where ϕ is the normal cumulative distribution function.

3.2 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 adverse working conditions threshold, used to construct the probabilities associated with vulnerability.

3.2.1 Data sources

In these stages, we rely on the five latest editions of the European Working Conditions Survey (EWCS).[5] 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 active population, aged 15 year and over and living in each of the Member States. The target number of interviews is 1,000 in all countries, except for Luxembourg

5 The EWCS is performed by the European Foundation for the Improvement of Living and Working conditions (Eurofound) to gather information about working conditions, the quality of work and employment in order to contribute to the planning and design of policies aiming at improving the conditions of life and work of Europeans.

(target 500).[6] 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, Netherlands, Portugal, Kingdom, Finland and Sweden. For issues of sample size in the development of our methodology, we have aggregated Belgium with Luxembourg. As a results EU-15 is decomposed into 14 national entities and the acronym 'Blu' refers to Belgium and Luxembourg.

3.2.2 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.

3.2.2.1 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, filling our purpose of time and country comparison shorten the number of dimensions that could be considered in our composite indicator. Notwithstanding data constraints, the AWCI takes into account several aspects of adverse working conditions that are organised as follows.[7]

- 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 include 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 the different cases of discrimination against employees such as discriminations 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).

6 Detail on the methodology and characteristics of the EWCS can be found at the Eurofound's website.

7 A detailed description of the questions used is provided in the Appendix a6.

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 & 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 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.

3.2.2.2 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 tackled by numerous researchers and organisation. 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

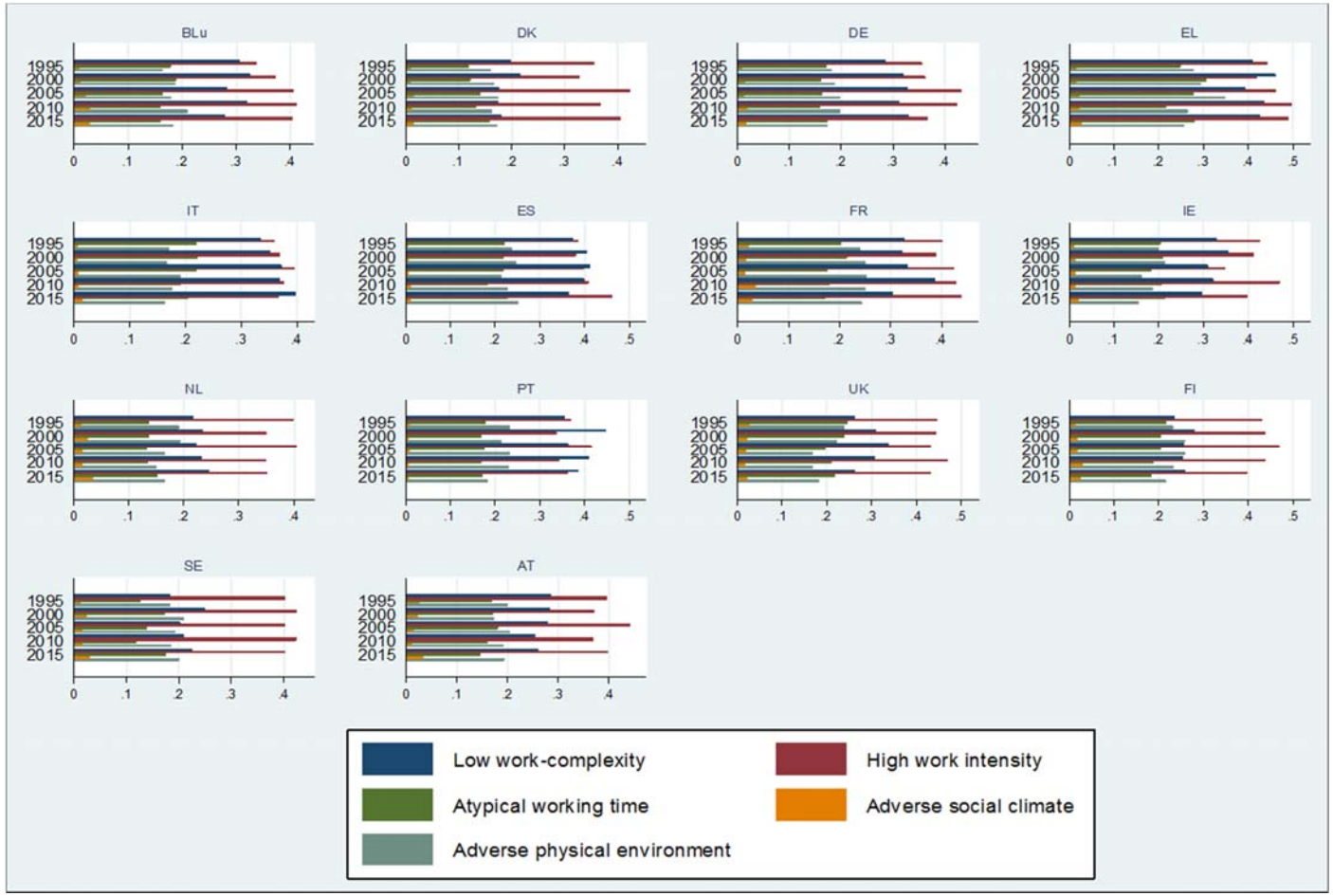
weighting procedures such as statistical methods, participatory methods or normative methods (Decancq & Lugo, 2013) for a detailed presentation of the different weighing approaches). However, there is no consensus regarding the reliability of one method over the others and the choice of the weighting 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.[8] 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 3.1 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 notice 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 can notice 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, Netherlands, Portugal or Austria. Along with high work intensity, the second major and acknowledged workplace risk is low work-complexity. Regarding this component, two groups of countries are noticeable: 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, 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 that 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 3.1 shows an increasing perception of social discrimination in some countries such as France, Finland, Sweden, Austria, Netherlands, Belgium, Luxembourg and Greece.

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

Figure 3.1 **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)

Turning to the AWCI, Table 3.1 reports some descriptive statistics per survey year and country. 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 every country in 2000, but this is not the case in 2010 as average vulnerability increases in four countries only (Belgium, Luxembourg, France, Ireland and 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 a.8.1 in appendix a8).

Table 3.1 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).

3.2.3 Determinants of adverse working conditions

Relying on the set of employee information available in the European Working Conditions Survey, the included determinants of adverse working conditions are a combination of socio-demographic background, employment contract and firm characteristics. Table 3.2 presents some descriptive statistics of the main variables used for the whole sample and by country. About two thirds or EU-15 workers live in couple or are 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 and 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 3.2 Descriptive statistics of adverse working conditions determinants

	BLu	DK	DE	EL	IT	ES	FR	IE	NL	PT	UK	FI	SE	AT	ALL
Live in couple:															
No	31.9	26.2	35.5	35.1	36.8	37.8	36.4	36.9	31.0	30.3	32.6	34.5	33.1	37.5	34.0
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:															
No	32.2	34.9	28.9	35.1	39.6	31.3	30.6	32.0	35.8	36.2	34.4	27.7	30.4	31.5	32.7
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 :															
On an 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
On a 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
On a 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
On 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

	BLu	DK	DE	EL	IT	ES	FR	IE	NL	PT	UK	FI	SE	AT	ALL
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 compared with other European countries. Large companies (more than 500 employees) are predominant in the United Kingdom (21.1%), the Netherland (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 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.

3.3 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[9] consist of gender, country and birth year in ten year spans.[10] After grouping into cohorts, 140 cohorts were constituted and may be tracked over the five used editions of the EWCS. Table 3.3 reports the 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. The individual observations of the selected variables are averaged over cohorts leading to an equation expressed in terms of cohort means, which then becomes the units of observation in the pseudo-panel. Equation (2) becomes:

9 Further details about the pseudo-panel construction are provided in the Appendix a7.

10 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.

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

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 and $\bar{X}_{c,t}$ are the mean[11] 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.

Table 3.3 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

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).

3.4 Estimation and analysis of vulnerability

3.4.1 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 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 3.4 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 previously constructed AWCI indicator.[12] Overall, the results are convergent regardless of how the AWCI is designed.

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

11 A weighting adjustment is made in the computation of each cohort mean.

12 In order to check the result sensitivity to the methodology used to construct the AWCI indicator, we also report the estimation results with the AWCIpca indicator.

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 the employment contract characteristics, we see that self-employed are less exposed to adverse working conditions compared with employees. 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 ber 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.

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, we can notice that 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[13] 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.

13 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 3.4 Fixed effect model of the Adverse Working Conditions Index, first stage regression

Variables	AWCI(1)		AWCIpca(2)	
Live in couple	-0.0470	(0.043)	-0.0349	(0.042)
Main breadwinner	0.1223***	(0.036)	0.1018***	(0.035)
Number of children under 15, reference None				
One child	-0.0693	(0.052)	-0.0731	(0.051)
2 children	0.1250*	(0.076)	0.1305*	(0.074)
3 children	-0.3503**	(0.162)	-0.3565**	(0.158)
4 or more children	-0.1921	(0.277)	-0.0644	(0.271)
Employment status, reference Employed				
Self-employed	-0.2439*	(0.148)	-0.2056	(0.145)
Other	-0.1775	(0.113)	-0.2127*	(0.110)
Employment contract, reference Unlimited employment contract				
Fixed term contract	0.1712***	(0.054)	0.0886*	(0.053)
Temporary employment agency contract	0.0107	(0.103)	-0.0836	(0.101)
Apprenticeship or other training	-0.3445**	(0.143)	-0.2936**	(0.139)
Other	-0.1775***	(0.050)	-0.1206**	(0.049)
Tenure	0.0020	(0.002)	0.0018	(0.002)
Occupation, reference Legislators, senior officials & manager				
Professionals	-0.3029***	(0.079)	-0.3454***	(0.077)
Technicians and associate professionals	-0.2683***	(0.082)	-0.2867***	(0.080)
Clerks	-0.1394	(0.091)	-0.1939**	(0.089)
Service workers/ shop and market sellers	0.0220	(0.078)	-0.0236	(0.076)
Skilled agricultural and fishery worker	0.1593	(0.108)	0.1253	(0.105)
Craft and related trade workers	0.2180**	(0.089)	0.1491*	(0.087)
Plant and machine operators and assembly workers	0.3058***	(0.099)	0.1849*	(0.096)
Elementary occupations	0.0323	(0.084)	-0.0185	(0.082)
Armed forces	1.0414***	(0.248)	0.8228***	(0.242)
Company ownership, reference Private				
Public	-0.1645***	(0.047)	-0.1315***	(0.046)
Other	0.0805	(0.059)	0 .0374	(0.058)
Workplace size, reference 50-499 employees				
1 employee	0.0503	(0.063)	0.0668	(0.062)
2-9 employees	-0.0301	(0.046)	-0.0143	(0.045)
10-49 employees	0.0115	(0.045)	0.0428	(0.044)
500 or more employees	0.0718	(0.052)	0.0925*	(0.051)

Variables	AWCI(1)		AWCIpca(2)	
Sector, reference Industry				
Agriculture, hunting, forestry and fishing	-0.0202	(0.042)	0.0038	(0.041)
Services (excluding public administration)	0.1085***	(0.029)	0.1098***	(0.028)
Public administration and defence; compulsory social sector	0.0867	(0.054)	0.1066**	(0.052)
Other services	0.1626***	(0.036)	0.1788***	(0.035)
R2 (Within)	0.32		0.30	
Cohort fixed effect	YES		YES	
Number of cohorts	700		700	

Note: the dependent variable in Model (1) is the AWCI performed with equal weighting in the all construction stages. In Model (2), the dependent variable is the AWCIpca with our second measurement (See section III.2. for details).
Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

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.

3.4.2 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 3.5 reports the average probabilities of vulnerability as well as their standard deviations per country and per survey edition while Figure 3.2 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 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 can observe a general increase of the level of vulnerability except in countries such as Finland or Denmark 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, on the contrary has the lowest level of vulnerability denoting a working environment, on average, less risky than the European median level. Finally, we can notice a class of countries with higher and constant average level of vulnerability in comparison with mean value of vulnerability in each survey edition. For instance, the average vulnerability in 1995 is around 0.34 and three countries are far above this average, namely Greece (0.99), Spain (0.52) and France (0.42).

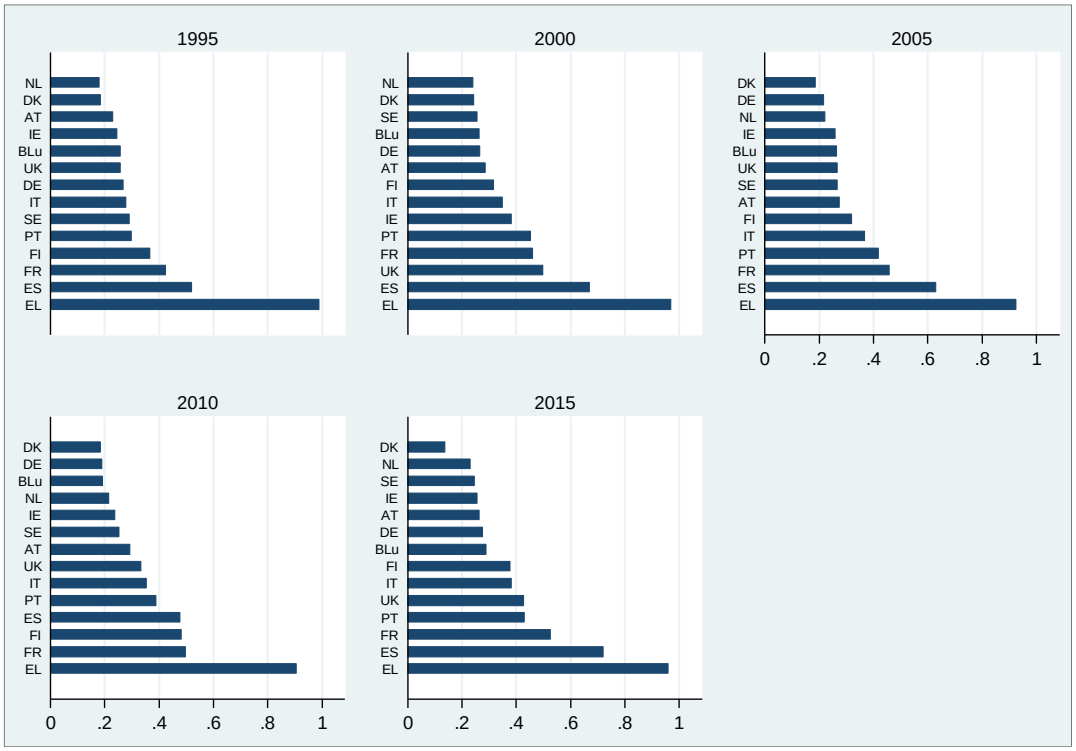
The most striking observation when considering this set of countries is the high and constant level of vulnerability both in comparison with the average vulnerability of each survey edition and in comparison with the average vulnerability of each country. Portugal, Italy, the UK and Finland are the next closest group of country, the UK and Finland being characterised, like Spain in the first group, by larger time variations. 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' divergences across European States (Esping-Anderson, 1990; Gallie, 2007). Nonetheless, traditional arguments from institutional theories apply only for some countries such as Denmark, Sweden, Greece or Spain. For some other countries such Finland, Italy or Ireland, these arguments do not hold. 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. Similarly, the trends of work-related risks are divergent between the United Kingdom and Ireland that are often grouped within liberal regime. Finally, comparatively to other Southern European countries, Italy and Portugal record a lower average vulnerability to adverse working conditions than Spain, Greece or France.

Table 3.5 **Average vulnerability per country and per survey edition**

	1995		2000		2005		2010		2015	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
BLu	0.26	0.11	0.27	0.12	0.26	0.10	0.19	0.10	0.29	0.11
DK	0.19	0.10	0.24	0.05	0.19	0.07	0.19	0.05	0.14	0.10
DE	0.27	0.08	0.27	0.07	0.22	0.12	0.19	0.11	0.28	0.14
EL	0.99	0.02	0.97	0.06	0.92	0.15	0.91	0.15	0.96	0.07
IT	0.28	0.13	0.35	0.15	0.37	0.14	0.36	0.19	0.38	0.19
ES	0.52	0.23	0.67	0.22	0.63	0.28	0.48	0.19	0.72	0.10
FR	0.42	0.16	0.46	0.08	0.46	0.25	0.50	0.22	0.53	0.18
IE	0.25	0.09	0.39	0.24	0.26	0.15	0.24	0.12	0.26	0.15
NL	0.18	0.08	0.24	0.05	0.22	0.07	0.22	0.06	0.23	0.09
PT	0.30	0.14	0.45	0.09	0.42	0.16	0.39	0.12	0.43	0.13
UK	0.26	0.12	0.50	0.24	0.27	0.13	0.33	0.20	0.43	0.19
FI	0.37	0.21	0.32	0.18	0.32	0.25	0.49	0.21	0.38	0.17
SE	0.29	0.07	0.26	0.07	0.27	0.11	0.25	0.15	0.25	0.14
AT	0.23	0.13	0.29	0.06	0.27	0.13	0.29	0.08	0.27	0.08
All	0.34	0.23	0.40	0.24	0.36	0.25	0.36	0.26	0.40	0.25

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 3.2 **Average vulnerability per country and per survey edition**

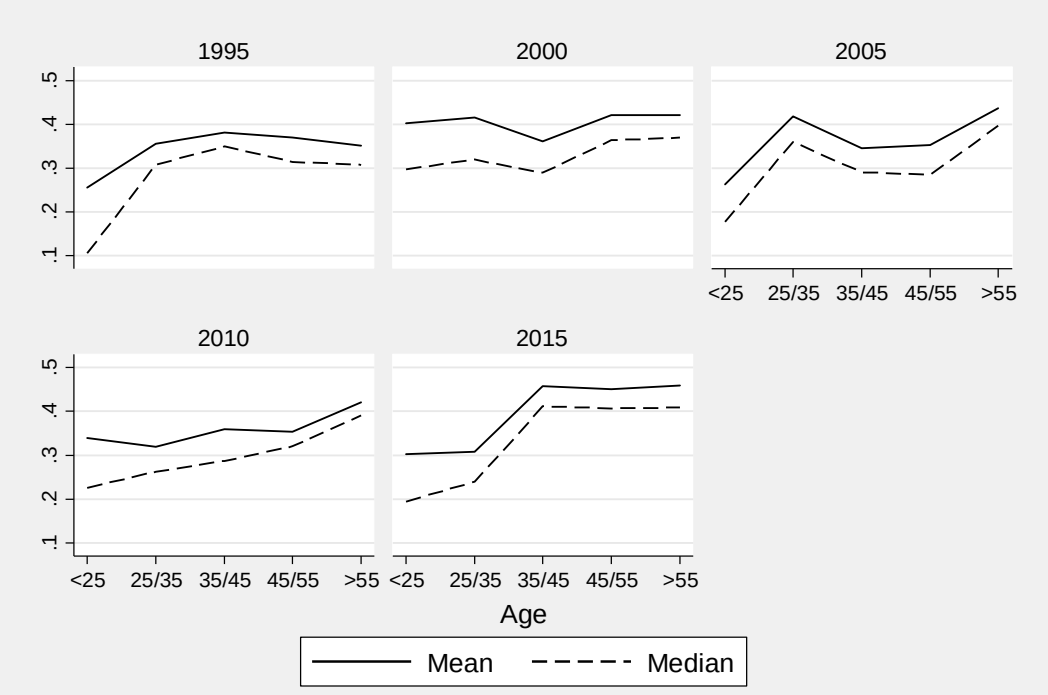


Note: country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France(Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT) , Germany (DE), Belgium &Luxembourg(BLu), Netherland (NL), Sweden (SE), Denmark (DK).

Two employee characteristics that have been extensively investigated as enhancing risks at the work-place are gender and age. Beginning with the age effect, Figure 3.3[14] 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 2010: 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 rose up to 35/45 where it reached a peak of 0.40 and then declined. In 2000 vulnerability increased for younger and older cohors, changing the age profile to a U shape, which remained in 2005, with a decrease in the vulnerability of the youngest age cohort. From 2010, the age profile becomes an increasing one and in 2015 the increase in vulnerability for the middle age and older cohorts is notable: the previous peak of 0.40 is exceeded from age 35/45 and plateaus up to retirement age.

Turning to the distribution of vulnerability by gender, Figure 3.4[15] compares time evolution between men and women. Men are more vulnerable to adverse working conditions than women in all survey editions. The median probabilities of vulnerability for men vary between 0.30 and 0.40 while for women they vary between 0.25 and 0.36. However, the time trends are somehow similar with a surge of vulnerability from 1995 to 2000 and from 2010 to 2015. Nonetheless, the overall increase is much greater form women than for men, which tends to close the gender gap at the end of the period.

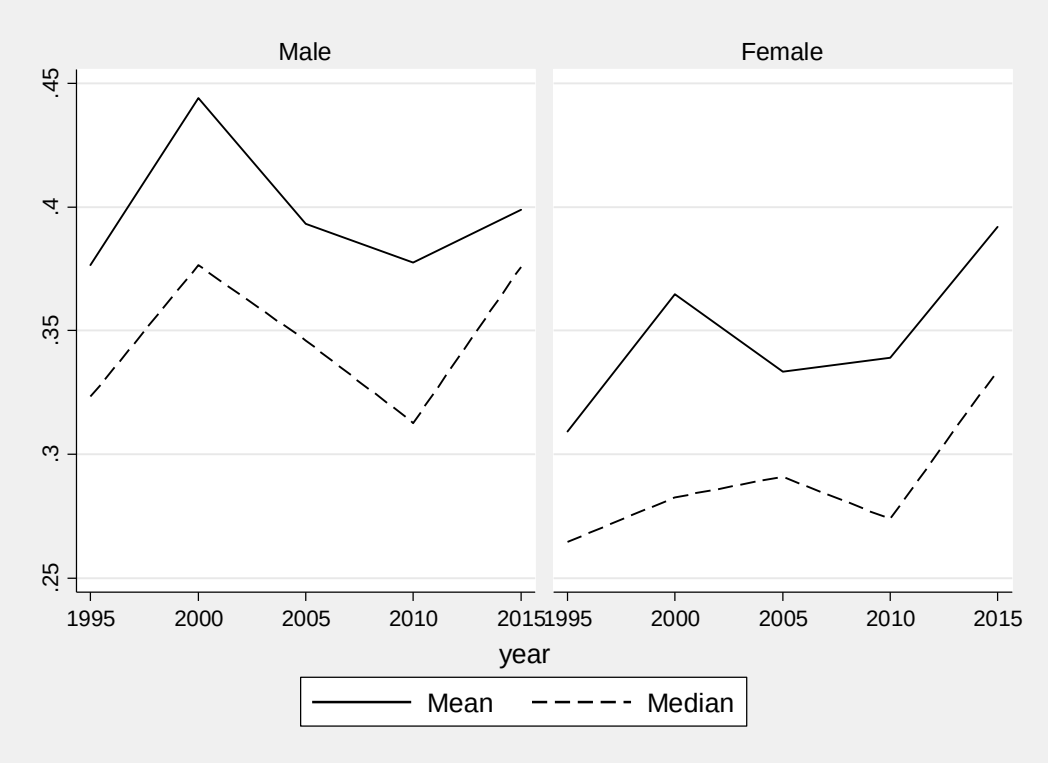
Figure 3.3 Average vulnerability per age category



14 Figure a8.2 in the appendix a8 plots the average vulnerability per age categories and per survey edition for each country.

15 Figure a8.3 in the appendix a8 reports The average vulnerability by gender and per year survey for each country.

Figure 3.4 Average vulnerability by gender



3.4.3 Who is vulnerable?

Stakeholders and protection policies 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 3.6 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. Relying on an independent samples *t-test*[16] 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 AWCI. We had also found that self-employed were less exposed to adverse working conditions than employees. Vulnerable cohorts are however more often self-employed (19%) 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.

16 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.

Occupation is another critical determinant of both the type of working conditions and vulnerability. Non-vulnerable cohort have significantly 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 6%, 19% and 12% on average) than in non-vulnerable cohorts (respectively 2%, 16% and 10% on average).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, 44% 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.

Table 3.6 Characteristics of vulnerable groups versus non-vulnerable groups, threshold of 0.50

	Non-vulnerable	Vulnerable	Pmean
Married	0.64	0.60	0.10
Mean breadwinner	0.61	0.58	0.24
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	0.03	0.27
Apprenticeship or other training	0.02	0.01	0.23
Employment status:			
Self-employed	0.12	0.19	0.00
Employed	0.86	0.79	0.00
Tenure	10.24	10.43	0.79
Occupation:			
Legislators, senior officials and managers	0.08	0.06	0.00
Professionals	0.16	0.12	0.00
Technicians and associate professionals	0.15	0.10	0.00
Clerks	0.13	0.12	0.15
Service workers/shop and market sellers	0.16	0.19	0.02
Skilled agricultural and fishery worker	0.02	0.06	0.00
Craft and related trade workers	0.12	0.14	0.04
Plant and machine operators and assembly workers	0.07	0.07	0.62
Elementary occupations	0.10	0.12	0.01
Armed forces	0.01	0.01	0.23
Company ownership:			
Public	0.26	0.20	0.00
Private	0.72	0.75	0.03
Sector:			
Industry	0.09	0.11	0.14
Agriculture, hunting, forestry and fishing	0.24	0.22	0.07
Services (excluding public administration)	0.39	0.42	0.12
Public administration and defence; compulsory social sector	0.10	0.08	0.03
Workplace size:			
1 employee	0.07	0.12	0.00
2-9 employees	0.24	0.32	0.00
10-49 employees	0.27	0.26	0.09
50-499 employees	0.26	0.21	0.00
500 or more employees	0.15	0.09	0.00

3.4.4 Varying the threshold of vulnerability

Table 3.7 Percentage of vulnerable cohorts

	0.50		0.33	
	Non-Vulnerable	Vulnerable	Non-Vulnerable	Vulnerable
1995	85.7	14.3	60.7	39.3
2000	76.4	23.6	49.3	50.7
2005	80.0	20.0	52.9	47.1
2010	78.6	21.4	57.9	42.1
2015	75.7	24.3	45.7	54.3
Total	79.3	20.7	53.3	46.7

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 3.7 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, 39.3% 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, although half of the population has a probability of vulnerability above 0.33 in 2000 and 2015 denoting a strong deterioration of working conditions in comparison with other survey years. The interest of changing the vulnerability threshold also lies in assessing the profile of vulnerable cohorts. To this end, we report in Table 3.8 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 3.8 Characteristics of vulnerable groups versus non-vulnerable groups, threshold 0.33

	Non-vulnerable	Vulnerable	Pmean
Living in couple	0.60	0.66	0.00
Main breadwinner	0.56	0.67	0.00
Employment contract:			
Unlimited employment contract	0.68	0.59	0.00
Fixed term contract	0.11	0.10	0.31
Temporary employment agency contract	0.03	0.02	0.05
Apprenticeship or other training	0.02	0.01	0.00
Employment status:			
Self-employed	0.09	0.19	0.00
Employed	0.89	0.80	0.00
Tenure	8.79	11.98	0.00
Occupation:			
Legislators, senior officials and manager versus	0.07	0.09	0.00
Professionals	0.16	0.14	0.00
Technicians and associate professionals	0.16	0.12	0.00
Clerks	0.14	0.11	0.00
Service workers/shop and market sellers	0.18	0.16	0.01
Skilled agricultural and fishery worker	0.02	0.05	0.00
Craft and related trade workers	0.11	0.15	0.00
Plant and machine operators and assembly workers	0.06	0.08	0.00
Elementary occupations	0.10	0.11	0.01
Armed forces	0.01	0.01	0.22
Company ownership:			
Public	0.27	0.23	0.00
Private	0.71	0.74	0.03
Sector:			
Industry	0.09	0.11	0.02
Agriculture, hunting, forestry and fishing	0.23	0.24	0.22
Services (excluding public administration)	0.40	0.39	0.51
Public administration and defence; compulsory social sector	0.10	0.09	0.04
Workplace size:			
1 employee	0.06	0.11	0.00
2-9 employees	0.24	0.28	0.00
10-49 employees	0.29	0.25	0.00
50-499 employees	0.26	0.23	0.00
500 or more employees	0.15	0.12	0.00

Overall the vulnerable cohort characteristics' are similar when considering both vulnerability thresholds. Nonetheless, some features turn significant when the threshold is set at 0.33. For instance, being in couple or the main breadwinner exposes to further work-related risks as illustrated by the higher mean proportion of these characteristics within vulnerable cohorts (66% and 67% respectively). 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 3.6. Differences are also worth noting regarding the occupational status of employees when the threshold of vulnerability is set at 0.33. Results regarding the middling and unskilled occupations hold for both vulnerability thresholds *i.e.* the mean proportion of such employees in such occupations is higher in the vulnerable group denoting great risks surrounding these occupations. 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: 9% instead of the 6% obtained when the threshold is set at 0.5. Turning to the employer characteristics, the results are convergent with Table 3.6 except for the industrial sector that records a significantly higher proportion of vulnerable employees (11%) in comparison with the non-vulnerable group (9%).

3.5 Conclusion

This paper has used the five last editions of the European Working Condition Survey to identify and to analyse vulnerability at the workplace to cumulative adverse working conditions. 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, Netherlands, Portugal, 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 sustainable high level of vulnerability. This classification is somehow surprising as the composition does not fit the usual categorisation sets by employment regimes theory with respect to similarities and dissimilarities of job quality and worker protection between European countries.

Indeed, Nordic countries[17] tend to have strict employment protection laws, more influential trade unions and high union membership ensuring thus very low levels of workforce vulnerability (Eurofund, 2015; Gallie, 2007). This assertion is convergent with our results except for Finland which record very high levels of vulnerability. Conversely, Ireland which is often assimilated to United Kingdom as having a liberal regime with less employment protection has on average a level of vulnerability which is similar to Nordic countries. 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 recording the highest levels of vulnerability while the average vulnerability in Italy is closer to the average in Ireland than in Spain. The relationship between employment regimes and vulnerability 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 work arrangement or self-employed, in private-owned companies and with small-sized firms 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 tighten-

17 Denmark, Finland, Sweden.

ing or widening depending on the year and the country considered but remains overall small. Regarding the age effect on vulnerability, our results highlight greater vulnerability for both middle-aged and older employees.

4. Measuring job quality with EWCS-data: towards an international standard for scale construction with EWCS 2010

Prepared by Anina Vercruyssen & Guy Gyes

The European Working Conditions Survey (EWCS) organized by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) is considered to be "the most complete source of information about job quality in Europe" (Simões et al., 2013). It is especially praised for its wide scope of objective and subjective dimensions of job quality and its international character. However, measuring job quality over different countries can be complicated. Different structural and cultural characteristics of the countries may influence what is deemed to be a 'high quality' or 'good' job (Holman, 2013; Munoz-Bustillo et al., 2009). Moreover, differences in economic and social policies form different contexts in which people are employed and experience their job (quality). Still, researchers and policy makers want (and need) to compare different countries, especially in light of the European Employment Strategy - remember the Lisbon Strategy stressing the European Union needs more and better jobs (European Commission, 2003). In this report, we first give an overview of how job quality has been conceptualized and operationalized with EWCS 2010, offering various options for theory-driven scale constructions to measure job quality. The 2010 or fifth wave is the last available dataset of the survey, which started in 1991. This section consists of two parts: an overview of the core conceptual papers on job quality using EWCS 2010 and a comparison of the empirical studies in peer-reviewed journals. Second, we make recommendations on how to prepare the data and scales properly for cross-national research, paying attention to data quality, harmonization of key concepts and validity. As such, we hope to provide guidelines to improve the measurement of job quality with the data of EWCS – focusing especially on the 2010 data.

4.1 Conceptualizing job quality with EWCS 2010 in mind

Combining the long-term experience of the global research and consulting agency Gallup with the insights from Eurofound's European Working Conditions Observatory (EWCO) expert group, the EWCS-survey relies on strong methodological and conceptual knowledge (Gallup Europe, 2013a; 2013b; EWCS, 2013). In line with the recommendations for quality control in social science research (Quality Standards Working Group, 2015), a thorough translation process and a pre-test preceded the fielding of the questionnaire for EWCS 2010 (Gallup Europe, 2013b). Cognitive post-tests were executed in the three prospective EU-Candidate countries where lack of time limited the possibilities for a pre-test. This thorough instrument development process for EWCS combined with the fieldwork efforts led to an impressive and very detailed international dataset on working conditions throughout Europe.

EWCS includes a vast array of job quality indicators, leaving a plenitude of options with regard to the construction of job quality scales with the available survey data. Although the content of the survey came into being after careful consideration and debating, no specific scale constructions are suggested in the methodological reports on EWCS 2010. A first necessity to build a proper job quality scale, however, is a conceptual framework for defining and delimiting the core concepts, in this case job quality, followed by a correct construction of indicators, scales or indexes. Therefore, we start by identifying the most recent, relevant theoretical works on how to conceptualize job quality in general and in EWCS 2010 specifically. With regard to defining and operationalizing job quality in general, the reports of Green and Mostafa

(Eurofound, 2012), Holman et al. (2015), Munoz de Bustillo et al. (2015) and Vandekerckhove and De Spiegelaere, (2013) seem to form the core of contemporary conceptual thinking about the complex and multidimensional concept of job quality in the realm of EWCS. These four works tend to acknowledge one another and partially build on the same insights. Based on these works, it seems clear that job quality should be treated as a multidimensional construct that needs to acknowledge objective versus subjective approaches, include positive and negative indicators, and could apply weights to sub-dimensions (Table 1).

The theoretical building blocks of these four conceptualizations and operationalisations are to a large extent intertwined. Eurofound (2012) draws strongly on Green (2006) and Muñoz de Bustillo et al. (2011). Vandenbrande et al. (2013) use Holman and McClelland (2011) as well as Muñoz de Bustillo et al. (2011) as a touchstone for their conceptual development. Muñoz de Bustillo et al. (2015) is an improved version of Muñoz de Bustillo *et al.*, (2011) adapted to EWCS 2010, which also still recognizes the work of Holman (2012), Holman and McClelland (2011), Green and Mostafa (Eurofound, 2012), and others such as ILO (2012) and Leschke et al. (2012). Holman (2012) and Holman and McClelland (2011) have a widely used conceptual framework for conceptualizing and operationalizing job quality for the 4th edition of EWCS from 2005. For the 2010 edition of EWCS, Holman et al. (2015) strongly build on Eurofound's (2012) definition and instructions. Practical details on the creation of the indexes in each of the four aforementioned studies can be found in Table 2.Despite these obvious influences and interlinkages, it remains mostly unknown how the validity of the four resulting indexes was assessed in these four works. Only Eurofound (2012) explicitly mentions testing based on criterion validity, meaning the operationalization was tested and approved by its relationship with outcomes of job quality – making it a predictive validity test only. Most of them resort to an index score, which allows to express job quality in a single number. This has some advantages as it reduces the complexity of the multidimensional concept of job quality, but it also conceals trade-offs between sub-dimensions (Szekér et al., 2015). As such, a singular composite score does not allow detailed, nuanced comparison. Vandenbrande et al. (2013) choose a data-driven creation of the scale with factor analysis that brings them to a four-dimensional scale dubbed JWES (after the initials of the names of the four subdimensions) that does allow a more nuanced view. Still, all scales need to define what is "good" or "bad", but that can be what is "good" in one job type is not necessarily always so in another (Szekér et al., 2015). The debates about this are still very much alive. Researchers should explain and document their choices in this regard well. Details for which items were used in each scale can be found in Table 2.

Table 4.1 Conceptualisation and operationalisation of job quality for EWCS 2010 in the four core works

Author (year)	Number of dimensions	Objective-Subjective distinction	Positive indicators	Negative indicators	Construction	Dimensional weights	Missing values	Validation
Green and Mostafa (Eurofound 2012)	4	Yes	Yes	Yes	Summation + normalization to 1-100	optional	refrain from imputation	criterion validity
Holman (2015)	4	Yes	Yes	Yes	Rescaled scores to 1-100	unknown	unknown	unknown
Munoz de Bustillo et al. (2015)	4	Objective > subjective	Yes	Yes	Summation of arithmetic averages (Rescaled to 1-100)	optional	unknown	unknown
Vandenbrande et al. (2013)	4	Yes	Yes	Yes	Factor analysis	equal weights	exclusion	unknown

Table 4.2 Practical operationalisation of job quality for EWCS 2010 in the four core works

Authors	Dimension	Brief description of content/sub-dimensions	EWCS items
Eurofound (2012)	1. Earnings	Hourly earnings	ef10-11, q18
	2. Prospects	Job security, career progression, contract quality	q77a,c, q6-7
	3. Intrinsic	Job quality skills and discretion	q61a,c, q49c,e-f, q50a-c, q51c,e,l,o, q24h, ef1_isced, isco_88_2
		Good social environment	q51a-b, q58a-e, q77e, q70a-c, q71a-c
		Good physical environment	q23a-i, q24a-e
		Work intensity	q45a-b, q46a-e, q51g,l,p, q24g
	4. Working Time Quality	Duration, scheduling, discretion, and short-term flexibility over working time	q18, q32-q35, q39-40, q43
Holman et al. (2015)	1. Skills and discretion	Discretion	q50a-c
		Cognitive job demands	q49c,e-f
		Training	q61a
	2. Work risks	Environmental risks	q23a-e, q23.g
		Physical demands	q24a,c,e
	3. Work intensity	Workload	q45a-b
		Task interdependence	q46.a-e
	4. Working time quality	Hours worked per week	q18
		Shifts	q32-q35
Munoz de Bustillo et al. (2015)	1. Intrinsic quality of work	Skills	isco, q49d-f
		Autonomy	q25a,q49b, q50b-c
		Social support	q51a
	2. Employment quality	Contractual stability	q6-q7, q12
		Development opportunities	q61a, q77c
	3. Workplace risks	Physical risks	q23a-g, q24a,c,e
	4. Working time and work-life balance	Duration	q18
		Scheduling	q32-q35
		Intensity	q45a-b

Authors	Dimension	Brief description of content/sub-dimensions	EWCS items
Vandenbrande et al. (2013)	1. Job content	Autonomous team work	q53, q56, q57a-c
		Emotional pressure	q46b, q51m,n,p
		Repetitive tasks	q46a, q46c-e, q51g
		Task autonomy	q50a-c
		Task complexity	q49a-f
		Working time autonomy	q17, q39, q51f,o
	2. Working conditions	Risks	q23a-g, q23i, q24a-c
		Dealing with people	q24f-g
		Fixed workplace	q26-27
	3. Employment conditions	Career opportunities	q77c
		Contract	q7
		Earnings	ef7b-g, ef7i-j, ef10-11
		Full-time work	q18
		Training	q61a-c
		Unusual working hours	q32-q36
		Working time flexibility	q37a-f, q40, q42
	4. Social relations	Say	q51c-e, q58e
		Supportive management	q58a-d
		Social support	q51a-b
		Violence and harassment	q71a-c
		Voice	q63-64

4.2 An overview of conceptual choices in empirical studies using EWCS

Whereas the abovementioned reports had a very explicit aim for developing a standard for conceptualizing job quality, we now assess how peer-reviewed empirical studies have addressed the conceptualization of job quality with EWCS-data. Using Web Of Science, we found 44 peer-reviewed empirical articles published between 2005 and 2016 using the EWCS-data to investigate (dimensions of) job quality. One article had to be excluded as it was only available in Chinese, which is beyond our language skills. Interestingly, each of the 43 considered articles uses a different operationalization of (dimensions of) job quality. Of these 43 articles, 32 articles studied one to nine separate aspects of job quality, but none of them assessed these explicitly as a multidimensional concept of job quality nor as a composite scale or index. This leaves us with eleven articles focusing on job quality as a multidimensional measure.

As can be seen in Table 3, only six of these eleven articles explicitly use the term 'job quality' (Simões et al., 2015; Green et al., 2013; Holman, 2013; Kirchner, 2015; Piasna et al., 2013; Van Aerden et al., 2014). Other strongly related terminology being used in these eleven articles is 'employment quality' (Van Aerden et al., 2014; 2015), 'quality of working life' (Greenan et al., 2014; Sverko & Galic, 2014, Wagenaar et al., 2012) and the more or less contrasting term 'employment precariousness' (Puig-Barrachina et al., 2014). Each study uses a different conceptualization and operationalization of job quality. Even the four articles that use the EWCS 2010 survey data (Table 4) all have different ideas on how to shape the multidimensional concept of job quality. Given that the EWCS-data has a very broad range of indicators of job quality that has altered and expanded over the editions, these many different choices in conceptualization and operationalization may not be that surprising. But, as a consequence, comparison over time and between different peer-reviewed studies on job quality is seriously hampered.

One common tendency that can be identified among most of the eleven articles is that they rely on the dominant articles in the literature for the conceptualizations of job quality (e.g. Eurofound, 2012; Munoz de Bustillo et al, 2009; 2011; Holman & McClelland 2011; Holman 2012), often (re)modelled or adjusted in function of the availability of indicators in the EWCS-survey data (Green et al., 2013; Piasna et al., 2013; Puig-Barrachina et al., 2014; Van Aerden et al., 2014; 2015) or in function of critique on the dominant conceptual guidelines (Sverko & Galic, 2014). Others are more explicitly driven by the international policy agendas (e.g. the Laeken indicators in Simões et al., 2013), some just rely on the availability of indicators in EWCS-survey as a guideline (Greenan et al., 2014) and yet others do not explicitly specify how they come to their conceptual choices despite having a clear delimitation of the sub-dimensions of job quality in line with the dominant literature (Kirchner, 2015; Wagenaar et al., 2012). The main inspirations for the conceptualization in the four studies working with EWCS 2010 can be found in Table 4.

Despite some cross-referencing to the conceptual guidelines found in the reports mentioned in section 1 and to the same dominant conceptual articles in the literature, all studies end up with different conceptualizations and operationalisations of job quality. What they do have in common is that they all consider job quality as a multidimensional concept, both those studies working with EWCS 2010 as those working with other editions. The number of dimensions ranges from three to eleven in the eleven empirical studies (Table 3), although the four articles using the most recent available edition of EWCS (2010) limit the number of dimensions to three or four (Table 4). Also noticeable in the four latter articles is the tendency for a slightly more modest number of items per dimension. This seems to indicate a trend towards more compact operationalisations of job quality. The techniques to construct scales for job quality, however, are far from converging. Some opt for turning the sub-dimensions of job quality into separate scales based on the conceptualization, whereas others chose to compile them into a scale or index based on more data-driven grounds. The authors resort to many different techniques to construct composite scales or indices: factor analysis, latent class analysis, multiple correspondence analysis, logit estimations or a combination of techniques (Table 3).

Table 4.3 Operationalisation of job quality in peer-reviewed articles using EWCS

	Authors	EWCS edition	Countries	Indicator name	use of job quality	Number of dimensions	Scale construction
EWCS 2010 (and earlier)	Kirchner (2015)	2010	1	job quality	predictor	3	Separate items + Factor analysis
	Sverko & Galic (2014)	2010	27	quality of working life	outcome	4	Factor analysis
	Green et al. (2013)	1991, 1995, 2000, 2005, 2010	15	job quality	outcome	4	Rescaled scores to 1-100
	Piasna et al. (2013)	2010	27	job quality	outcome	4	Summation + normalization to 1-100
	Simoes, Crespo & Pinto (2015)	2005	31	job quality	outcome	11	Max-min normalized dimensional indices
EWCS 2005 (and earlier)	Van Aerden et al. (2015)	2005	27	employment quality	predictor	7	Latent Class Cluster Analysis
	Van Aerden et al. (2014)	2005	27	employment quality	outcome	7	Latent Class Cluster Analysis
				intrinsic job quality	outcome	7	Latent Class Cluster Analysis
	Greenan, Kalugina & Walkowiak (2014)	1995, 2000, 2005	15	quality of working life	outcome	3	Multiple Correspondence Analysis
	Puig-Barrachina et al. (2014)	2005	27	employment precariousness	outcome	8	8 separate indicators
	Holman (2013)	2005	27	job quality	outcome	5	Multiple correspondence analysis + Factor analysis
	Wagenaar et al. (2012)	2000, 2005	27	quality of working life	outcome	3	9 separate scales and indicators

Table 4.4 Operationalisation of job quality in peer-reviewed articles using EWCS 2010

Authors	Conceptual inspiration	Dimension	EWCS items
Kirchner (2015)	unspecified	1. labour market conditions	EF10-11, q77a-c
		2. work pressures	q42, q51n
		3. autonomy	q49a-f, q51a-c
Sverko & Galic (2014)	Critique on Eurofound (2012)	1. economic security	q77a-c,(f)
	Efraty & Sirgy (1990); Elizur & Shye (1990); Lawler (1982); Sirgy et al. (2001)	2. social relationship at work	q77(d)-e, q51a-b
		3. meaningfulness at work	q51h,(i),j
		4. autonomy	q51c-f,o
Piasna et al. (2013)	Eurofound (2012)	1. good physical environment	q23a-i, q24a-e
		2. absence of work pressures	q45a-b, q24g, q51g,l,p, q46a-e
		3. working time quality	q32-35, q39-40
		4. prospects	q77a,c, q7
Green et al. (2013)	Munoz de Bustillo et al. (2011)	1. work quality	q49c-f, q24h, q50a-c
		2. work intensity	q45a-b, q46a-e
		3. good physical environment	q23a-e,g, q24a,c,e
		4. working time quality	q18, q32-35, q39-40

4.3 Towards an international standard for a job quality scale with EWCS

Based on the overview of the core works in conceptual thinking about job quality applied to EWCS 2010 and on the empirical peer-reviewed studies using this 5th edition of EWCS, it becomes clear that there is still no gold standard for the conceptualization and operationalization of job quality. What is clear when looking at the abovementioned studies, is that there are some ingredients deemed indispensable for constructing a good job quality scale. On a conceptual level, we need to acknowledge the multi-dimensionality (e.g. Holman et al., 2011; 2015 Munoz-Bustillo et al., 2009; 2015), acknowledge the distinction between subjective and objective indicators (e.g. Eurostat, 2012), include positive and negative items (Eurostat, 2012; Holman et al., 2011; 2015 Munoz-Bustillo et al., 2009; 2015) and take into account that weights could be assigned to particular dimensions if their importance is deemed higher in relationship to the outcome variables (Eurofound, 2012). These key elements of multi-dimensionality, subjective versus objective indicators, and positive versus negative item are also all taken into account by the empirical studies published in peer-reviewed outlets using EWCS 2010 (Table 4). Preferably, we also need to be able to control for differences in the quality of work organization as e.g. white and blue collar jobs will have partially different definitions of quality (e.g. Greenan et al 2010; Holman & McClelland, 2011).

All the above-mentioned studies rely on theory-driven operationalisations of job quality. When performing exploratory and confirmatory factor analysis on these theoretically selected items per scale, however, we found that none of them automatically conjures these constructs perfectly as theoretically described or at least not for the full sample of 34 countries. To be fair, none of the peer-reviewed article intended to include all of the 34 participating countries. The other studies will most likely have resorted to specific recoding of variables, specific proximity measures and rotations to come closer to the desired scales, but without the exact methodological description of the construction of these scales, they are hard to reproduce. Pure data-driven scaling of theory-driven operationalisations of job quality does not seem to work well in EWCS 2010, so having access to the exact instructions starting from the recoding until the details of the index construction is very necessary. A partial exception is the scale of Sverko & Galic (2014), who did described in detail which items needed to be removed as they did not load univocally in the factor analysis (see items between brackets in table 4), but else we mostly end up with a multitude of at least six sub-dimensions that do

not create the theoretically intended grouping of items into the well-defined concepts exactly as conceptually intended when we do not have the exact "recipe" of the authors. These six or more sub-dimensions that do show up with factor analysis are, however, more in line with the higher number of dimensions in the peer-reviewed studies in Table 3, showing that there is a clear tendency in the data to group a higher number of sub-dimensions than in comparison to the mostly "handmade" summations in Table 1 restricted to four sub-dimensions.

Given that not even a premeditated selection of items such as in the above-mentioned studies generates the exact scales as theoretically intended implies that leaving a job quality scale to pure data-driven conjuring does not seem to be a promising strategy at all – especially because of the vast amount of indicators in EWCS. Furthermore, given the multitude of job quality related indicators in EWCS 2010 and given that no job quality conceptualization or scale was encountered more than once in the aforementioned reports and peer-reviewed studies, it does not seem to be recommendable to impose one, singular theory-driven operationalization of job quality either. Differences in theoretical background knowledge, differences in conceptual preferences and differences in the goals of the studies will lead to different preferences for how to construct a specific job quality scale over another one. Additionally, the extensive number of job quality related indicators in EWCS is exactly part of its uniqueness as a survey and an enormous advantage. Setting one singular scale as the standard would also shroud the diversity of subscales that are possible with this data. Hence, we will refrain from singling out one particular theory-driven conceptualization as an international standard.

Still, the theory-driven conceptualization of job quality needs to be complemented with valid scale construction. As could be seen in the overviews, however, validity testing remains rather scarce, leaving the international comparability of job quality scales under-investigated. Also, the comparability over the different countries needs to be addressed both on a conceptual and a methodological level. Before we address the scale construction and international comparability, we first still need to pay attention to the data quality of the singular items and potential need for recoding. To enable harmonization and international comparability of job quality scales with the EWCS-data we need to address the data quality and recoding options on the level of the items and on the level of the potential scales. This will be done in the next sections.

4.3.1 Data quality and harmonization on item level

To improve survey data quality, data cleaning and recoding are obvious recommendations. Although the end-users of EWCS receive a rather clean dataset, there is still some room for improvements on a micro level: handling item nonresponse and recoding of answer options in function of the job quality scales. Moreover, given that international comparisons of job quality is an aspired goal, harmonization of the content of the items is required as well.

Given the vast amount of items in EWCS, we will focus our attention on those that were used in the existing scales in Table 2 and 4 for EWCS 2010 when illustrating the steps to guarantee good data quality on the level of individual items and questions.

4.3.1.1 Handling item nonresponse

Nonresponse in surveys can happen on two levels: unit nonresponse, which is nonresponse on the whole survey (complete non-participation), and item nonresponse, which is refusing to answer or answering "don't know" on singular or multiple questions. Item nonresponse occurs because people genuinely do not know the answer because of e.g. retrieval or memory problems or lack of knowledge on the topic or because they do not wish to reveal this information, e.g. social desirability bias (see e.g. Groves et al., 2009 for an overview). In most of the cases, item nonresponse means cases cannot be used when the item is included in the scale, shrinking the total number of useable cases in the analyses.

Sometimes, however, the blanks can be filled in rather easily by using other variables directly, or imputation techniques can be used. Directly filling in the blanks is actually only a real possibility with the income question ef10, which can be complemented by the information in ef11. The simplest way to proceed is to recode the ef11-categories to the midpoint of the interval and add this information to ef10. In essence, this is a form of imputation of the mean score with the extra advantage that we actually have several interval means instead of one mean score for income to fill in the blanks, making it a more accurate approximation than with imputation of the overall mean. The upside is that many gaps have now been filled and many cases can be recovered for analyses. The downside is that the distribution of the values is affected by the imputed data as there now will be many cases with a value that coincides with an interval midpoint. Mind that this also affects the standard errors, confidence intervals and test statistics. The other way around is also an option, but reverting the wages from ef10 to the categories of ef11 does imply losing some information details obviously. Yet, it also helps to recover quite some cases and fitting the detailed wages from ef10 into the categories of ef11 leaves us with more accurate data than when filling in the blanks with a reasonable proxy such as the interval midpoints. Multiple ways for imputation are possible too, of course. The easiest is imputation of the mean score, as described above. Other, more advanced types are regression imputation, hot deck imputation, and multiple imputation (see e.g. Groves et al., 2009 for an overview). However, all of these techniques are contested to some degree because of the aforementioned effects on the standard errors, confidence intervals and test statistics.

When imputation is not an option, creating an extra category for respondents with item missings is a possibility for categorical variables. As such, a potentially different group of people who did not (want to) answer the question is included in the analysis. However, given that the number of people with item nonresponse tends to remain below 5% of the total realized sample size, comparisons are hampered due to the statistically too small group to ensure reliable calculations. In Table 5, suggestions for creating extra categories for a (sub)group of missing cases are made when such an extra category can be helpful. As the self-employed were not offered Q7, Q58, Q63 and Q64 in the questionnaire, these questions all have almost 20% cases with missing information, which can easily be solved by creating an extra category for the self-employed. If not, then any model including Q7, Q58, Q63 and Q64 with a listwise deletion standard setting for handling missing data will always exclude the self-employed. Q77a also has a high percentage (8.8%) of cases with missing information. However, for 4.6% of the cases this is a matter of being 'not applicable', which is and should stay clearly distinct from a "don't know" or refusal.

Two other options still exist as well: re-contacting the respondent for a follow-up to fill in the blanks in his/her data line or finding auxiliary data that can be linked to the survey data. Returning to the respondent, whether in person, by phone call or e-mail, will always require extra resources, however. The extra personnel costs, extra time and delay of making the datasets available are costs that cannot always be made within the budgets of the data collection project. Re-contacting the respondent also does not guarantee that he/she will provide an answer this time around. Refraining from answering e.g. the income question can be a matter of not understanding the sometimes complicated definition of wage (e.g. including overtime and extra-legal benefits or not), not knowing exactly (e.g. conditional bonus systems depending on monthly quota), recall effects when asking about a wage in the past, or it can be skipped because it is considered as sensitive information. The other option is gathering auxiliary data, such as official registry data, tax declarations, or even more "unusual" data such as neighbourhood observations made by the interviewer or through Google Street View. Some of these auxiliary data would fill in the blanks about e.g. income or household composition very accurately whereas other data would only provide us with proxies. Moreover, auxiliary data will not contain exact answers to subjective questions such as the personal experience of job quality. Additionally, obtaining auxiliary data from official sources, such as the official registry or tax agency, tends to be extremely difficult in most European countries. Scandinavian countries, such as Sweden, tend to have a more open policy towards the accessibility of basic socio-demographic

and income-related data on their citizens, but countries such as Belgium have very strict privacy rules and a strenuous procedure to apply for access. And even if access is granted, it is not a guarantee to get complete or perfectly accurate data.

We conclude that item nonresponse is rather seldom fixable in a fully satisfactory way. But when simple solutions, as mentioned in this section, are possible, they should be considered to improve the data quality and analyses. Less simple ways that require extra external data input, such as follow-ups with the respondents or linked auxiliary data, can be considered as well but it needs to be kept in mind that this requires more resources. In the case of secondary use of the EWCS data this is almost impossible.

4.3.1.2 Harmonization of items

A first pointer is considering recoding of the values to improve the interpretation of the items and scales. As most scholars try to measure job quality rather than job *in*equality, it can be more intuitive to reverse the coding of the answer options in order to have higher scores expressing more job quality rather than less. Interpretations and reporting would be easier that way. Next to reverse coding, reducing recodings can also be helpful to make the big amount of items more easily interpretable, as suggested in Table 5. Item batteries such as Q23 and Q24 could be simplified by recoding them to binary variables expressing exposure/occurrence or not. When the gradation of exposure matters, dichotomizing items of course leads to loss of differentiation. When compressing a battery of items into one single indicator is more important, recoding all items to binary before e.g. summation is a good option. This also simplifies turning these related items into one single indicator as e.g. taking the average of a set of categorical variables would lead to a nonsensical mean score that also confounds the content of the question. E.g. ask yourself what a score of 3.4 means over all the items of Q23 or Q24 when the answer categories express quartile percentages of time spent and what is would mean if the respondent has three items with the maximum score and hardly being exposed to any other of the listed hazards. Constant exposure to three hazards may lead to a similar "average" score as being exposed to all hazards about half the time. Such an overall mean value would not express well what employees are confronted with nor would it lead to substantively comparable scores between employees.

The biggest challenge, however, is harmonizing the content of the questions. For the 2010-data this is an ex-post harmonization as the data collection was already finished. An example of ex-ante (input) harmonization is the translation of surveys to the mother tongue of the country or the adaptation of the education level options from the country-specific system to ISCED or categorization of occupations with ISCO (see e.g. Wolf et al., 2016). This is taken care of rather well by Gallup Europe and Eurofound's European Working Conditions Observatory (EWCO) expert group. Ex-post harmonization relies on the assumption that survey questions in the different languages and cultures all refer to the same underlying concept. This is sometimes hard to evaluate.

An especially tricky indicator to compare related to the measurement of job quality is income. EWCS 2010 offers an ex-post converted income variable expressing all wages in Euro. As such, the variables on income are already expressed in the same currency (Euro). However, the monetary value of the Euro is not so harmonically interpretable because the cost of living differs extensively throughout the European Union. Hence, comparing the lump sums of net income, even when all converted to the Euro currency, does not lead to substantively comparable wages in general and in the context of quality of jobs specifically. An option to even these differences out is applying indexations. These indexation sources are viable candidates: Purchasing Power Parities for Europe (PPP's, see OECD/Eurostat 2014), the PPP's of the International Comparison Program (ICP, see The World Bank Group, 2015), Applying such a harmonization index for income is strongly recommended.

A thing to note for comparability with the previous surveys, EWCS2010 differs on several occasions. Mostly, previous surveys offered less detailed answer categories (e.g. Q39) or had fused

two questions into one (e.g. Q50a-b). The dataset offers recoded items that adjust the coding to the more confined previous questionnaire options. This implies a small loss of detail in the international data, but at least correct comparisons are enabled as such. But sometimes researchers are confronted with the hard choice between more valid harmonization and retaining a more sizeable number of countries in their analyses (Wolf et al., 2016).

4.3.2 Harmonization on scale level

4.3.2.1 Construction of the scale

After the preparation of the variables, we still need to achieve "harmonization" of the scales for job quality. When we want to compare groups based on survey data, we actually need to be able to prove measurement invariance. This is a necessary precondition for international or cross-cultural comparisons (see e.g. Cieciuch et al., 2016). This means that whichever scale for job quality may be preferred, needs to lead to an instrument that is valid for all countries in the study. Before we can assess whether a scale "does the same thing" for all countries involved with multi-group confirmatory factor analyses, we need to take some technical specifications into account. The operationalization obviously needs to correspond to these conceptual constructs (construct validity; Cronbach & Meehl, 1955). However, it is nearly impossible to exactly recreate the scales in Table 2 and Table 4 with the limited information that these studies provide about the construction of their scales. Without exact information about what extraction method and rotation methods were used, it is a very hard endeavour to recreate the intended scales, an endeavour in which we unfortunately did not succeed.

Additionally, among the conceptually orientated papers (see Table 1), only one intended the scales to be composed with factor analysis. The other scales are "handmade" summations and rescales scores. Moreover, it also needs to be pointed out again that none of the peer-reviewed studies from Table 3 aimed to use their scales on all 34 participating countries from EWCS 2010. With that in mind, it is perhaps not so surprising that we did not manage to conjure any of the scales from the studies in Table 2 and Table 4 perfectly as these theoretically delimited constructs for the 34 countries, not with exploratory factor analysis nor with confirmatory factor analysis forcing the number of factors to be the same as the conceptually defined ones. This seems to mean that we rather have to construct the scales for the sub-dimensions "manually" to reflect the theoretically defined content.

4.3.2.2 Scale validity

After the proper technique for creating an index or scale has been chosen and the scale has been constructed for the entire dataset, the validity and comparability of the scale needs to be assessed. To assess whether a scale measures the concept as intended, several types of validity can be tested. For the scales in Table 2 and Table 4, validity tests are hardly mentioned. The one exception is Eurofound (2012) who explicitly mention criterion validity based tests by confirming the relation between their job quality scale and outcome variables identified from previous research. *Criterion validity* (cf. also Rammstedt, 2010) implies measuring the correlations between the indicator's values and relevant external criteria and establishing its *predictive validity*, as is done for the Eurofound scale. What could also be assessed is the *concurrent validity* by proving the scale's strong correlation with previously established scales on job quality. Additionally but also related to this is c*onstruct validity*. In the approach of Cronbach and Mehl's (1955) this entails validation by testing theory-derived predictions about the correlations between the indicator's values and those of other variables. And before assessing these types of validity, *content validity* is usually achieved by presenting the questions or items to a group of experts on the subject. This should obviously be executed in the questionnaire development phase and was hopefully done during the construction of the questionnaire of EWCS 2010. So, whichever scale is picked for measuring job quality with the EWCS-data, and many different ones could be chosen, testing the validity of the scale is important to guarantee that it really measures

what it is supposed to measure. But again, to execute such a test, the exact detailed description of how the scales were created need to be available first.

If we want to compare countries then we also need to know if the scale works the same way for every single country involved in the comparison. We need to be sure that we measure the same constructs in every country and that these constructs have the same meaning within these different countries (and cultures). What we need is measurement invariance. The most widely used method to assess measurement invariance across any type of groups (e.g. countries, language groups) is multi-group confirmatory factor analysis (MGCFA, see Jöreskog, 1971; Cieciuch et a., 2016). Measurement invariance needs to be achieved on several levels. First of all, there needs to be configural invariance (see e.g. Cieciuch et al., 2016): do the items load (or not) on the same factors in every group? For partial measurement invariance we also need metric measurement invariance. This second level of invariance requires that the loadings of the items on the factor are equal across the groups. In this way, the meanings of the underlying factors can be considered to be invariant. The third level of measurement invariance is the scalar invariance, which requires the indicator intercepts to be equal across groups. The fourth and highest level is residual invariance and is tested by comparing the observed (co)variance across the groups. When the fourth level of invariance is confirmed, strict or full measurement invariance can be claimed. However, this tends to happen only rarely. Hence, partial measurement invariance is usually considered to be sufficient, still requiring minimally metric and scalar invariance to be proven. Therefore, any scale that is intended to be used to compare groups or countries, such as the job quality scales made with EWCS data, should test whether the same factors show up for each country and whether the items load in a similar fashion on these factors to guarantee comparability of the scale.

4.4 Conclusion

"Given the high 'documentation burden', lack of documentation of harmonization procedures can be expected to be the rule rather than the exception." (Wolf et al., 2016, p.516). This seems to be true for the mostly post-hoc constructed job quality scales made with EWCS 2010 data as well. Also, the lack of documentation on the exact construction of the scales (e.g. the recoding of items, the choice of proximity measures and rotations in factor analysis) and the lack of (documentation on) scale validity testing was specifically noticeable for the available scales. Our overview has showed that several theory-driven scales are already available in the literature on job quality scales with EWCS 2010 data. We do not wish to impose one singular gold standard for the definition and conceptualization of job quality and its sub-dimensions in this report. The EWCS-data is very rich and is exactly intended to offer a vast amount of indicators on job quality. Scholars should make informed choices based on a theory-driven or conceptual basis. Afterwards, they need to construct the scale properly, test its internal validity and the comparability over the countries. Mind, comparison over time with the different editions of EWCS is unfortunately hampered by changes in the questionnaire.

We conclude this report with a summary of our recommendations for constructing a job quality scale in general and with EWCS2010-data in particular:

- Chose a proper theory-driven conceptualization of job quality;
- Provide detailed information on how the items were recoded;
- Improve the data quality on item level by handling missing values properly and recoding the answers to intelligible values;
- Harmonize the income variable by applying an indexation such as PPP, ICP or HICP;
- Chose the appropriate indexing or scaling technique and provide detailed information;
- Test the validity and measurement invariance/equivalence of the scale;
- If the scale fulfils the criteria of configural and metric invariance, international comparison can be executed based on partial measurement equivalence.

5. Conclusion

This report has presented a framework for analysing job quality and vulnerability at-work in Europe, developed jointly by HIVA-KU Leuven and the CNAM-CEET as part of the European project InGRID. Two complementary approaches have been taken to meet the objectives of this report: characterising vulnerable groups to poor working conditions and OSH issues and developing identification methods for these groups in future European surveys.

Accordingly, the first chapter's concern is about categorising jobs relying on a broad set of job quality dimensions. Seven job types are recorded: active and flexible jobs, balanced jobs, low strain supported jobs, structured jobs, passive unsupported jobs, socially demanding and flexible jobs, low quality physical jobs. These job types are classified into high-moderate or low quality jobs relying on the following balance principle: if the number of good job characteristics' outweighs the number of bad job characteristics', the job type is considered as of high quality. In a second step and in order to better understand job quality differences across job types, each type is evaluated by considering a set of subjective workers' outcomes such job satisfaction, job security or physical health. The results highlight that each job type consists of multiple aspects, of which some are better than others and some are worse. As an illustration, active and flexible jobs have a high score on almost all indicators, but they do not score well on some employees' subjective outcomes, namely sleep problems and stress. Conversely part-time employees have a low job quality in comparison with full-time employees but report a very good health situation when considering subjective outcomes. To sum up, each job has a number of relative advantages and drawbacks and the typology of jobs proposed in this work provides a synthetic and useful guide to improve each job type

The second chapter's focus is on vulnerable groups, how to define them and how to identify them. First a conceptualisation of employment vulnerability is proposed, within which vulnerability is driven by the risks at the workplace; by the danger of cumulative adverse working conditions (AWC) that may threaten the worker's well-being. Second and in order to fit this definition, a composite indicator of AWC is developed and a probabilistic approach is adopted to identify vulnerable groups by computing with a pseudo-panel approach the likelihood that each cohort of employees has a level of AWC above some predefined threshold. Third the results highlight a great divergence of risk exposure across European countries, a serious deterioration of working conditions since 1995 and some employment characteristics that are more often associated with greater vulnerability. Indeed, Countries such as Greece, Spain and France observe a very high and sustainable level of vulnerability to AWC in comparison with the European median level while unsurprisingly Nordic countries (except of Finland) enjoys lower level of workplace vulnerability. Considering the time evolution, the highest values are observed in 2000 and 2015, while the average vulnerability remained flat between 2005 and 2010. Along with these interesting insights on vulnerability patterns over time and across countries, one meaningful contribution of this report is the characterisation of vulnerable groups. The profile of vulnerable groups relying on both employment and socio-demographic features is as follows: fixed work-arrangement and self-employment status are more often synonym of vulnerability to AWC; working within private owned-companies in small-sized firms entails more vulnerability; high skilled manuals and elementary occupations also entail considerable work-related risks and by extension greater vulnerability. The demographic profile of vulnerable groups involves on average more men than women but the gender gap has been closing, more middle-aged and older workers than young workers.

Finally, the third chapter comes up with a set of recommendations for the construction of an internationally applied standard for scale construction to measure job quality and its multiple aspects, based on the fifth EWCS. As illustrated by the previous chapters, this survey provides very rich and relevant information that may be used to improve the (measurement of) European job quality and the protection of employees at risk. Though the European Working Conditions Surveys enjoy a very high level of quality and reliability, there is still room for improvement in using this data to measure job quality. Following the scales of several key typologies to conceptualise and measure job quality, the construction of an international standard for a job quality scale seems difficult. Issues of non-response, and the lack of harmonation on item and on scale level make it hard to unify the various approaches. The harmonisation of the methodological protocol across European countries is also a desirable improvement to facilitate data comparability.

appendix 1 Job quality indicators

Table a1.1 Overview of the job quality indicators

Indicator name	Content	Survey questions involved
Task autonomy	Autonomy on the organisation of the tasks: the order, methods and tempo.	y15_q54a y15_q54b y15_q54c
Autonomous teamwork	The degree to which a respondent works in team and the degree to which this team can function autonomously.	y15_q55 y15_q58 ° y15_q60a y15_q60b y15_q60c
Task complexity	Complexity and high quality demands of the tasks.	y15_q53a y15_q53b y15_q53c y15_q53d y15_q53e y15_q53f
Speed pressure	Tight deadlines, dependency on external factors, dependency on colleagues, quantitative production norms, automatic speed, direct control, sufficient time to finish the task.	y15_q49a y15_q49b y15_q50a y15_q50c y15_q50d y15_q50e y15_q61g
Emotional demands	Emotional pressure.	y15_q50b y15_q61o y15_q30f y15_q30g
Repetitive tasks	Short-cycle tasks of less than 1 minute, of less than 10 minutes.	y15_q48a y15_q48b
Risks	Exposure to ergonomic, ambient and biochemical risks.	y15_q29a y15_q30a y15_q30b y15_q30c y15_q30e y15_q29e y15_q29f y15_q29g y15_q29i y15_q29b y15_q29c y15_q29d
Permanent contract	Permanent contract or not.	y15_q11
Full-time work	Full-time employment or not.	y15_q24

Indicator name	Content	Survey questions involved
Wage	The net income rate, not taking into account the employment rate of the respondent.	Income deciles constructed
Additional fees	Productivity compensation, overtime compensation, compensation for unfavourable weather conditions, compensation for work on Sunday, profit-sharing, shares, others.	y15_q101b ° y15_q101c ° y15_q101d ° y15_q101e ° y15_q101h ° y15_q101i ° y15_q101j °
Atypical working hours	Working at night, on Sunday, on Saturday, more than 10 hours per day.	y15_q37a y15_q37b y15_q37c y15_q37d
Working time flexibility	Flexibility demanded by the employer, predictable working scheme.	y15_q39a y15_q39b y15_q39c y15_q39d y15_q39e y15_q43
Planning autonomy	Control on the working time or working scheme.	y15_q23 y15_q42 y15_q61f y15_q61n
Career opportunities	Prospects.	y15_q89b °
Training	Whether the respondent received training during the past year, or had the possibility to do so – paid by the employer.	y15_q65ab_lt y15_q65c
Participation	The degree to which the employee is involved in decision making related to his tasks.	y15_q61c ° y15_q61e y15_q61d
Representation	Whether the employee can formally or informally have a say on aspects of the organisation, collective representation.	Indicator constructed using: y15_q71c y10_q64
Supportive management	Feeling of being guided and supported, receiving feedback.	y15_q63a_lt y15_q63e_lt
Social support	Help and support by colleagues and the direct chef for the execution of the tasks.	y15_q61a y15_q61b
Adverse social behaviour	Asocial behaviour of colleagues, chefs or other persons the employee gets in contact with during his work.	y15_q80a y15_q80b y15_q80cd_lt y15_q81a y15_q81b y15_q81c

appendix 2 Job quality indicators per job type

Table a2.1 Detailed overview of job quality indicators per job type (for EU-28, for 2010-2015)

Indicator name	Mean	1	2	3	4	5	6	7
Cluster size		9.64%	12.84%	12.88%	19.92%	18.37%	15.88%	10.48%
Task autonomy	66.14	64.32	62.99	68.55	70.60	73.62	30.62	92.39
Autonomous teamwork	39.07	30.44	0.00	58.20	54.88	44.68	36.28	56.87
Task complexity	69.65	64.08	58.81	79.64	68.90	74.34	52.23	88.13
Speed pressure	36.03	30.52	28.74	46.76	27.23	35.65	48.51	36.04
Emotional demands	46.11	41.00	43.56	53.75	50.35	41.68	41.61	49.35
Repetitive tasks	33.62	31.73	28.48	44.25	26.67	32.72	49.58	17.20
Risks	17.22	13.85	13.94	28.78	10.17	16.70	28.16	7.18
Permanent contract	80.59%	76.82%	75.13%	84.54%	75.18%	85.71%	69.80%	93.25%
Full-time work	77.93%	75.84%	69.55%	87.23%	59.13%	86.86%	79.17%	92.35%
Wage	50.92	43.67	43.86	57.58	41.17	56.87	37.30	80.63
Additional fees	16.32	0.00	14.65	31.78	8.64	25.16	19.02	19.70
Atypical working hours	31.17	9.29	29.68	58.21	26.52	13.77	44.69	42.62
Working time flexibility	25.68	0.00	32.47	46.85	32.05	0.00	38.54	45.38
Planning autonomy	38.72	35.25	36.42	41.02	36.77	42.19	19.16	66.72
Career opportunities	54.05	43.55	38.92	52.54	46.21	54.74	25.84	68.49
Training	54.60%	39.81%	38.41%	69.61%	55.67%	56.14%	36.06%	80.18%
Participation	46.12	43.82	38.09	54.06	48.21	53.31	18.14	75.09
Representation	57.92%	49.92%	44.00%	69.18%	60.51%	65.19%	34.52%	84.99%
Supportive management	82.87	84.28	77.50	85.20	88.20	88.74	64.77	92.60
Social support	72.19	73.87	61.54	75.99	78.45	77.76	58.31	80.48
Adverse social behaviour	17.45%	9.45%	15.47%	29.82%	12.35%	10.28%	26.71%	11.62%

1 = structured jobs, 2 = passive unsupported jobs, 3 = socially demanding and flexible jobs, 4 = low strain supported jobs, 5 = balanced jobs, 6 = low quality physical jobs, 7 = active and flexible jobs.

appendix 3 Job quality outcomes indicators

Table a3.1 Overview of the job quality outcomes indicators

Indicator name	Content	Mean (for EU-28 for 2010-2015)	Survey questions involved
Perceived job sustainability	The ability to continue this work until the age of 60.	61.73%	y10_q75 y15_q93
Sleep problems	General fatigue, the frequency of occurrence of sleep difficulties.	31.53	y15_q79a y15_q79b y15_q79c y10_q69m y15_q78i
Psychological well-being	WHO-5 index for measuring psychological well-being.	66.96	y15_q87a y15_q87b y15_q87c y15_q87d y15_q87e
Physical health	Frequency of occurrence of physical health problems in the past 12 months.	59.57	y15_q78c y15_q78d y15_q78e
General health	General health perception.	75.88	y15_q75
Job satisfaction	Perceived job satisfaction and fulfilment.	71.41	y15_q61h y15_q61i y15_q61j y15_q88 y15_q89e
Perceived job security	Feeling of the possibility to lose one's job within the six coming months.	70.31	y15_q89g
Perceived labour market security	Feeling of the possibility to easily find a similar job in case of losing one's current job.	43.74	y15_q89h

appendix 4 Distribution and evolution of the job types – tables

Table a4.1 Distribution of job types in 2010 by country (%)

	1	2	3	4	5	6	7
Belgium	10	16	15	11	21	16	11
Bulgaria	2	12	11	38	12	10	14
Czech Republic	7	13	14	12	26	15	13
Denmark	26	11	20	5	12	21	5
Germany	11	9	18	17	18	14	14
Estonia	10	9	15	22	17	18	9
Greece	4	9	10	35	17	10	16
Spain	6	10	12	30	20	9	13
France	6	13	9	14	25	18	14
Ireland	13	11	13	29	12	15	7
Italy	4	25	10	15	23	11	12
Cyprus	3	22	9	40	12	5	10
Latvia	8	12	13	30	16	14	8
Lithuania	6	12	14	34	12	10	13
Luxembourg	10	14	11	16	24	17	8
Hungary	9	9	9	30	15	14	14
Malta	7	24	9	26	13	16	6
Netherlands	18	12	21	18	14	12	5
Austria	11	14	16	16	15	18	11
Poland	7	13	14	19	20	14	12
Portugal	6	10	8	38	21	7	10
Romania	7	9	12	25	21	15	12
Slovenia	15	16	13	15	8	18	14
Slovakia	5	16	9	14	21	20	15
Finland	15	20	10	4	13	33	5
Sweden	18	17	13	5	13	24	9
United Kingdom	15	8	14	23	14	18	8
Croatia	5	10	13	25	20	15	12
Mean EU-28	10	14	13	20	18	16	11

Table a4.2 Distribution of job types in 2015 by country (%)

	1	2	3	4	5	6	7
Belgium	12	12	16	17	21	14	9
Bulgaria	6	11	14	39	11	9	12
Czech Republic	9	14	13	14	26	18	9
Denmark	15	10	17	4	13	28	6
Germany	11	9	15	18	24	13	12
Estonia	5	18	11	11	16	22	8
Greece	11	10	10	33	14	11	19
Spain	13	8	9	32	20	15	12
France	7	13	12	11	20	22	11
Ireland	7	10	16	22	11	19	9
Italy	13	16	10	22	27	11	10
Cyprus	9	13	9	33	19	10	13
Latvia	17	14	9	22	29	11	9
Lithuania	13	12	15	28	16	13	12
Luxembourg	18	16	16	17	16	17	7
Hungary	22	9	10	26	29	12	8
Malta	17	25	11	24	8	16	7
Netherlands	17	9	20	16	15	15	8
Austria	4	9	13	12	29	15	9
Poland	2	12	14	15	26	14	12
Portugal	3	6	11	42	17	7	10
Romania	4	9	10	19	25	22	9
Slovenia	7	11	17	20	11	16	11
Slovakia	5	12	12	12	26	16	14
Finland	5	16	13	5	18	25	6
Sweden	6	15	11	4	16	27	9
United Kingdom	7	16	14	17	9	19	8
Croatia	6	10	11	21	19	18	15
Mean EU-28	10	12	13	20	19	16	10

Table a4.3 Distribution of job types in 2010 by gender (%)

	1	2	3	4	5	6	7
Men	11.81	15.63	9.15	16.10	16.52	18.75	12.04
Women	6.98	11.41	17.14	24.00	18.79	12.04	9.65
Total	9.52	13.63	12.94	19.85	17.60	15.56	10.90

Table a4.4 Distribution of job types in 2015 by gender (%)

	1	2	3	4	5	6	7
Men	12.45	13.27	9.10	16.47	18.28	19.39	11.04
Women	7.16	10.87	16.40	23.40	19.96	13.08	9.13
Total	9.76	12.05	12.81	19.99	19.14	16.18	10.07

Table a4.5 Distribution of job types in 2010 by age (%)

	1	2	3	4	5	6	7
15 – 24 years old	3.41	11.49	19.48	17.25	15.64	16.93	15.81
25 – 34 years old	9.10	14.14	13.15	19.12	16.84	17.17	10.48
35 – 44 years old	10.79	14.31	11.63	19.61	16.93	16.09	10.63
45 – 54 years old	10.40	13.52	11.83	19.93	18.29	15.18	10.83
55 years or older	10.54	12.99	12.61	23.71	20.60	10.85	8.69
Total	9.52	13.63	12.94	19.85	17.59	15.56	10.91

Table a4.6 Distribution job types in 2015 by age (%)

	1	2	3	4	5	6	7
15 – 24 years old	3.73	9.84	18.33	16.20	18.01	17.13	16.77
25 – 34 years old	8.90	11.99	12.82	18.63	17.46	19.41	10.79
35 – 44 years old	11.15	12.60	12.08	19.50	19.43	16.55	8.70
45 – 54 years old	10.85	12.84	11.72	20.76	18.51	15.46	9.86
55 years or older	9.98	11.04	13.03	23.22	22.61	11.89	8.24
Total	9.77	12.04	12.81	19.98	19.14	16.20	10.06

Table a4.7 Distribution job types in 2010 by education (%)

	1	2	3	4	5	6	7
Lower secondary education	2.43	11.32	10.45	25.14	19.79	14.37	16.50
Upper secondary education	5.67	15.13	11.67	18.91	17.57	17.75	13.30
Tertiary education	19.46	13.72	15.49	18.37	16.21	13.29	3.45
Total	9.47	13.89	12.65	20.01	17.58	15.62	10.77

Table a4.8 Distribution of job types in 2015 by education (%)

	1	2	3	4	5	6	7
Lower secondary education	2.46	11.62	9.91	25.92	22.05	12.66	15.38
Upper secondary education	5.39	11.71	12.42	18.88	21.21	17.97	12.41
Tertiary education	19.10	12.76	14.59	18.95	14.96	15.22	4.42
Total	9.77	12.07	12.79	20.00	19.14	16.18	10.06

Table a4.9 Distribution of job types in 2010 by company size (%)

	1	2	3	4	5	6	7
Only employee	4.52	4.37	3.59	25.72	56.13	3.32	2.35
2 – 9 employees	6.38	13.09	14.36	25.17	18.26	13.14	9.59
10 – 249 employees	9.92	14.61	13.66	19.10	15.76	15.67	11.27
250 or more employees	16.49	13.73	10.14	11.47	12.39	22.89	12.88
Total	9.70	13.77	13.06	19.91	17.20	15.60	10.77

Table a4.10 Distribution of job types in 2015 by company size (%)

	1	2	3	4	5	6	7
Only employee	7.84	6.27	5.27	25.73	47.57	3.46	3.86
2 – 9 employees	10.09	13.73	16.80	19.10	17.84	13.55	8.89
10 – 249 employees	12.57	12.94	13.52	15.22	15.46	19.12	11.18
250 or more employees	20.18	12.81	9.84	9.14	13.58	23.84	10.61
Total	13.61	12.92	13.17	14.88	16.17	18.76	10.49

Table a4.11 Distribution of job types in 2010 by sector (NACE rev.2) (%)

	1	2	3	4	5	6	7
A	4.93	11.05	9.00	22.02	21.58	16.59	14.82
B	11.19	15.89	5.53	12.95	6.01	30.70	17.73
C	8.56	17.50	6.79	17.62	14.72	16.48	18.33
D	10.30	26.27	7.01	18.19	11.70	21.34	5.18
E	8.10	14.32	5.99	19.44	15.33	18.93	17.88
F	5.22	20.96	5.41	20.32	11.88	21.11	15.10
G	6.44	13.31	16.03	21.86	19.04	11.56	11.76
H	6.25	10.92	7.75	11.72	26.07	20.52	16.78
I	4.84	7.12	18.04	14.22	16.53	18.81	20.43
J	26.27	21.19	10.63	14.37	13.78	10.81	2.95
K	22.72	22.55	12.10	16.71	13.73	8.89	3.31
L	15.68	13.32	11.53	19.89	24.35	9.10	6.13
M	20.45	14.94	12.97	24.97	16.37	8.16	2.14
N	6.43	13.08	9.03	23.12	22.50	12.61	13.23
O	12.81	13.83	12.43	28.06	13.10	14.01	5.76
P	9.66	8.03	26.07	25.56	21.72	7.02	1.94
Q	8.84	8.21	17.46	15.59	13.13	28.43	8.33
R	12.49	5.89	19.36	17.55	22.18	15.53	6.99
S	9.42	10.17	13.72	21.04	28.75	10.08	6.82
T	0.00	3.48	3.90	26.73	59.30	2.30	4.28
U	23.24	21.13	4.89	14.27	31.14	2.37	2.96
Total	9.52	13.60	12.94	19.84	17.60	15.58	10.93

A = agriculture, forestry and fishing; B = mining and quarrying; C = manufacturing; D = electricity, gas, steam and air conditioning supply; E = water supply, sewerage, waste management and remediation activities; F = construction; G = wholesale and retail trade, repair of motor vehicles and motorcycles; H = transportation and storage; I = accommodation and food service activities; J = information and communication; K = financial and insurance activities; L = real estate activities; M = professional, scientific and technical activities; N = administrative and support service activities; O = public administration and defence, compulsory social security; P = education; Q = human health and social work activities; R = arts, entertainment and recreation; S = other service activities; T = activities of households as employers, undifferentiated goods- and services-producing activities of households for own use; U = activities of extraterritorial organisations and bodies.

Table a4.12 Distribution of job types in 2015 by sector (NACE rev.2) (%)

	1	2	3	4	5	6	7
A	4.65	6.97	9.58	17.56	27.14	14.63	19.46
B	8.41	22.97	6.37	6.47	8.56	36.26	10.96
C	8.75	16.02	5.48	17.96	16.99	17.95	16.85
D	20.90	21.66	8.33	13.47	10.63	18.76	6.25
E	9.02	17.42	2.60	24.54	14.00	20.81	11.60
F	6.78	20.40	5.14	22.08	12.81	22.78	10.02
G	7.58	11.72	16.36	18.59	21.70	12.57	11.47
H	5.88	10.12	7.81	11.14	32.04	17.69	15.33
I	4.75	5.01	16.66	13.85	19.53	21.16	19.04
J	29.62	16.82	10.00	16.14	12.58	11.15	3.70
K	22.01	21.56	10.67	19.44	15.27	7.65	3.40
L	18.60	14.38	13.26	24.21	16.76	10.78	2.01
M	18.34	17.54	12.13	22.91	16.66	10.10	2.31
N	7.81	10.87	10.94	25.82	24.21	10.88	9.47
O	14.18	12.05	12.89	25.76	13.44	17.23	4.45
P	10.10	8.51	24.11	28.49	18.49	8.13	2.17
Q	7.78	7.92	15.53	15.53	13.33	30.35	9.56
R	9.06	7.51	21.79	17.33	23.39	12.71	8.21
S	9.58	8.61	14.54	22.10	28.85	8.63	7.67
T	0.84	2.19	2.91	31.86	56.68	1.69	3.84
U	34.73	15.15	6.71	14.50	18.92	3.39	6.60
Total	9.77	12.06	12.81	19.95	19.14	16.19	10.07

A = agriculture, forestry and fishing; B = mining and quarrying; C = manufacturing; D = electricity, gas, steam and air conditioning supply; E = water supply, sewerage, waste management and remediation activities; F = construction; G = wholesale and retail trade, repair of motor vehicles and motorcycles; H = transportation and storage; I = accommodation and food service activities; J = information and communication; K = financial and insurance activities; L = real estate activities; M = professional, scientific and technical activities; N = administrative and support service activities; O = public administration and defence, compulsory social security; P = education; Q = human health and social work activities; R = arts, entertainment and recreation; S = other service activities; T = activities of households as employers, undifferentiated goods- and services-producing activities of households for own use; U = activities of extraterritorial organisations and bodies.

Table a4.13 Distribution of job types in 2010 by occupation (ISCO-08) (%)

	1	2	3	4	5	6	7
Managers	43.90	14.26	4.51	14.72	11.48	9.86	1.28
Professionals	17.29	11.67	19.63	19.93	16.21	13.59	1.68
Technicians	13.99	17.35	13.69	18.54	15.88	15.96	4.59
Clerks	5.40	17.27	16.07	28.90	17.51	7.61	7.25
Service & sales workers	3.17	7.16	19.17	16.70	20.68	18.82	14.29
Agricultural workers	4.32	13.63	7.65	16.37	23.65	18.69	15.70
Craft workers	2.40	21.59	5.39	20.32	10.69	22.34	17.27
Plant & machine operators	1.81	8.84	6.04	13.03	24.12	20.99	25.17
Elementary occupations	0.59	11.11	7.59	26.75	24.03	9.94	19.99
Total	9.47	13.60	12.97	19.87	17.63	15.52	10.94

Table a4.14 Distribution of job types in 2015 by occupation (ISCO-08) (%)

	1	2	3	4	5	6	7
Managers	42.65	16.66	5.38	14.19	9.08	10.79	1.25
Professionals	17.71	11.43	17.94	19.89	15.01	15.36	2.66
Technicians	14.56	15.91	12.44	17.74	16.04	18.21	5.09
Clerks	6.34	16.26	14.31	29.88	19.61	7.71	5.88
Service & sales workers	4.18	6.72	18.44	15.29	21.30	19.87	14.20
Agricultural workers	2.64	10.65	8.38	21.92	25.91	13.32	17.17
Craft workers	3.01	19.93	5.21	20.66	14.14	23.32	13.73
Plant & machine operators	2.24	8.05	5.19	12.45	27.88	21.39	22.81
Elementary occupations	0.81	8.14	8.09	29.72	28.15	8.15	16.95
Total	9.72	12.04	12.81	20.04	19.21	16.10	10.08

appendix 5 Job types and stress

Table a5.1 Job types intersected with y15_q61m – stress

	Mean	Standard error	Lower end of 95% conf. interval	Upper end of 95% conf. interval
Active and flexible jobs	52.22	0.0042	51.40	53.04
Balanced jobs	44.22	0.0037	43.48	44.95
Low strain supported jobs	42.80	0.0036	42.09	43.50
Structured jobs	40.62	0.0031	40.01	41.22
Passive unsupported jobs	42.72	0.0032	42.09	43.34
Socially demanding and flexible jobs	55.30	0.0035	54.62	55.99
Low quality physical jobs	51.88	0.0044	51.02	52.74

appendix 6 Variables included in the AWCI

a6.1 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

a6.2 Adverse social climate (6 questions, yes answers):

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

a6.3 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?

a6.4 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

a6.5 Low work complexity (9 questions, no answers):

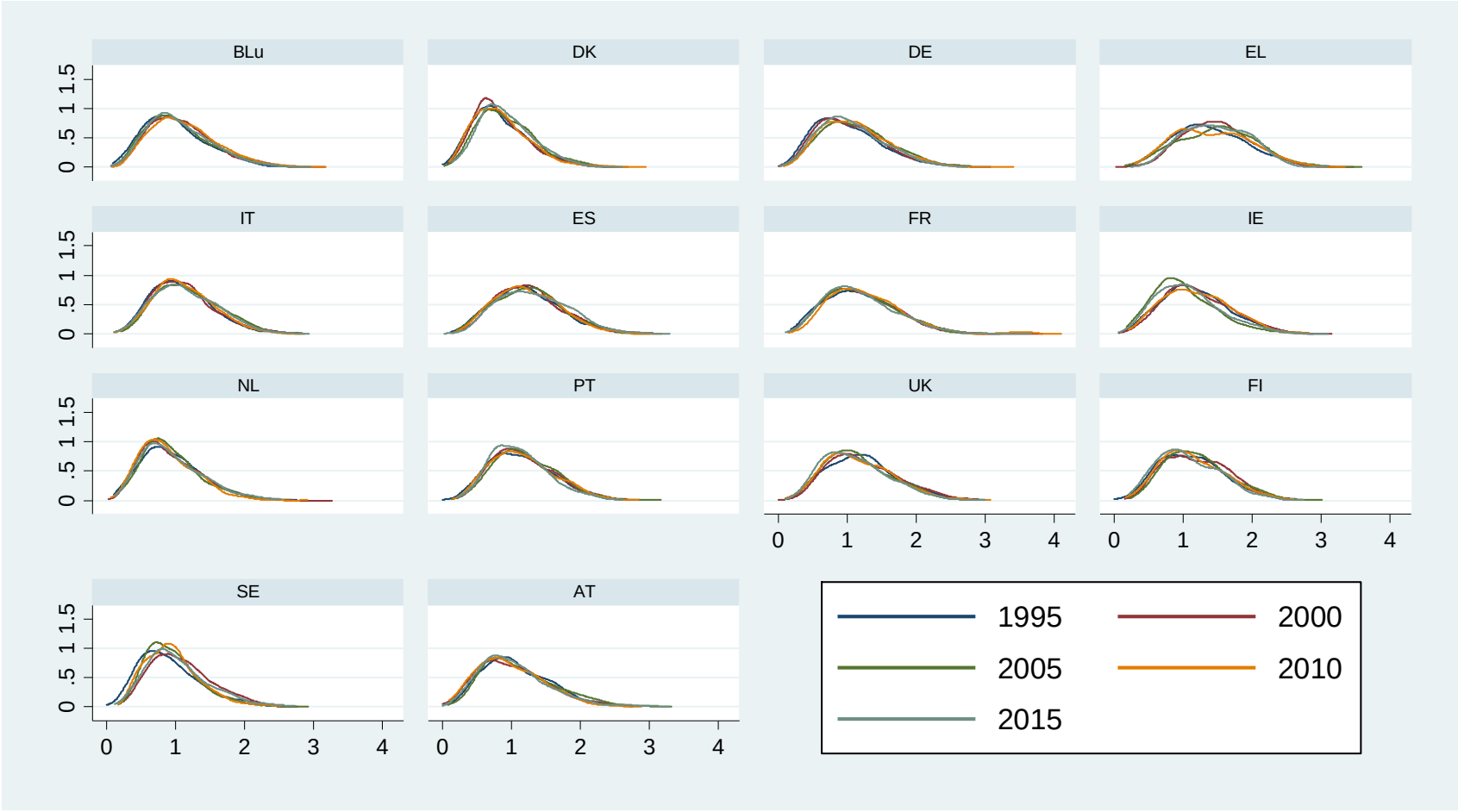
- Generally, does your main paid job involve?
  - Meeting precise quality standard?
  - Assessing yourself the quality of your own work?
  - Solving unforeseen problems?
  - Complex tasks?
  - Rotating tasks between you and your colleagues
  - Learning new things
- -Are you able to choose or change?
  - Order of tasks
  - Methods of work
- You can get assistance form your colleagues if you ask for it?

appendix 7 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 data surveys from 1995 through 2010. The averages for each birth year are generated by country and by gender.

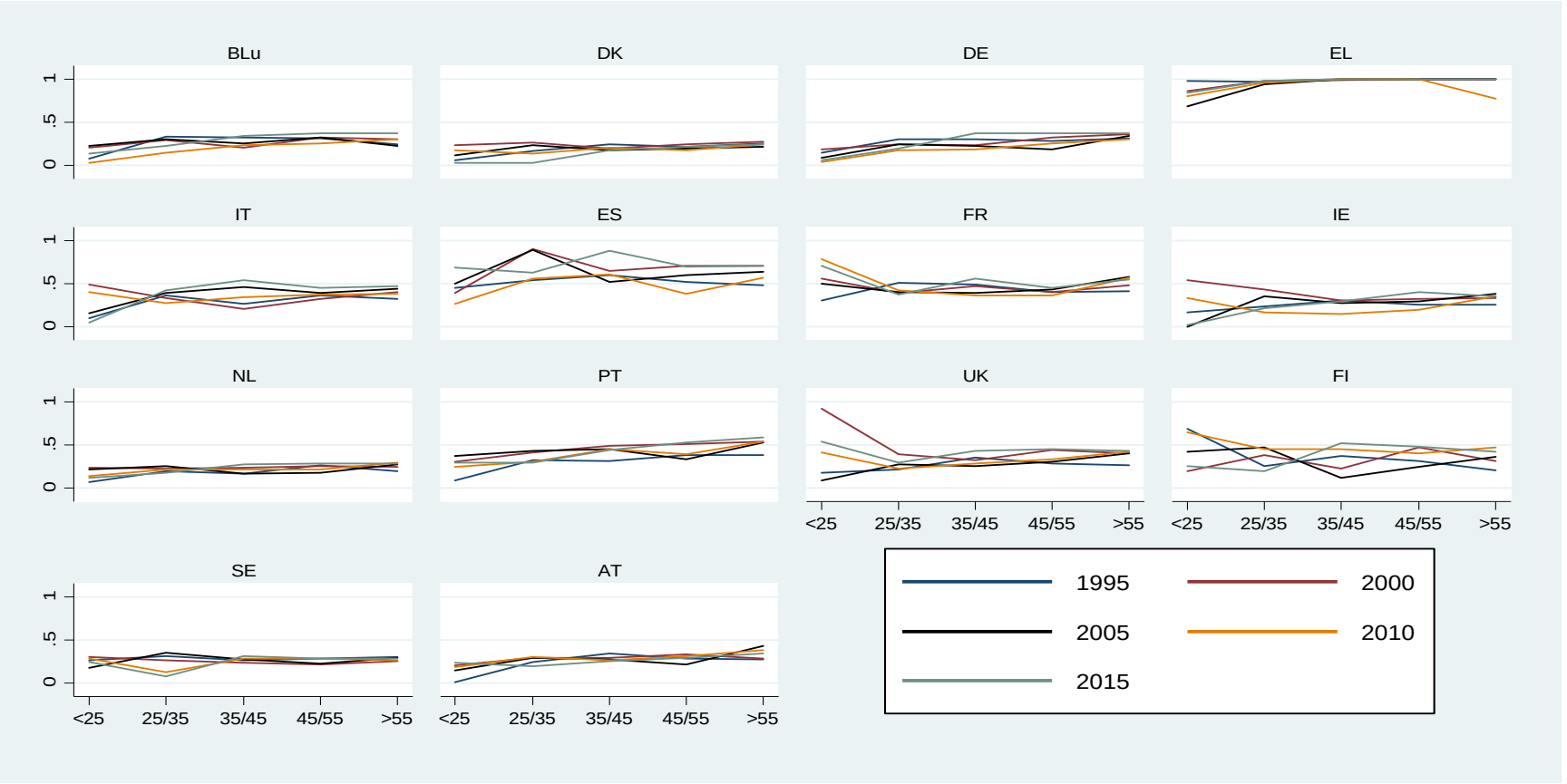
appendix 8 Further results

Figure a8.1 Kernel density of AWCI using EWCS 1995, 2000, 2005, 2010, 2015



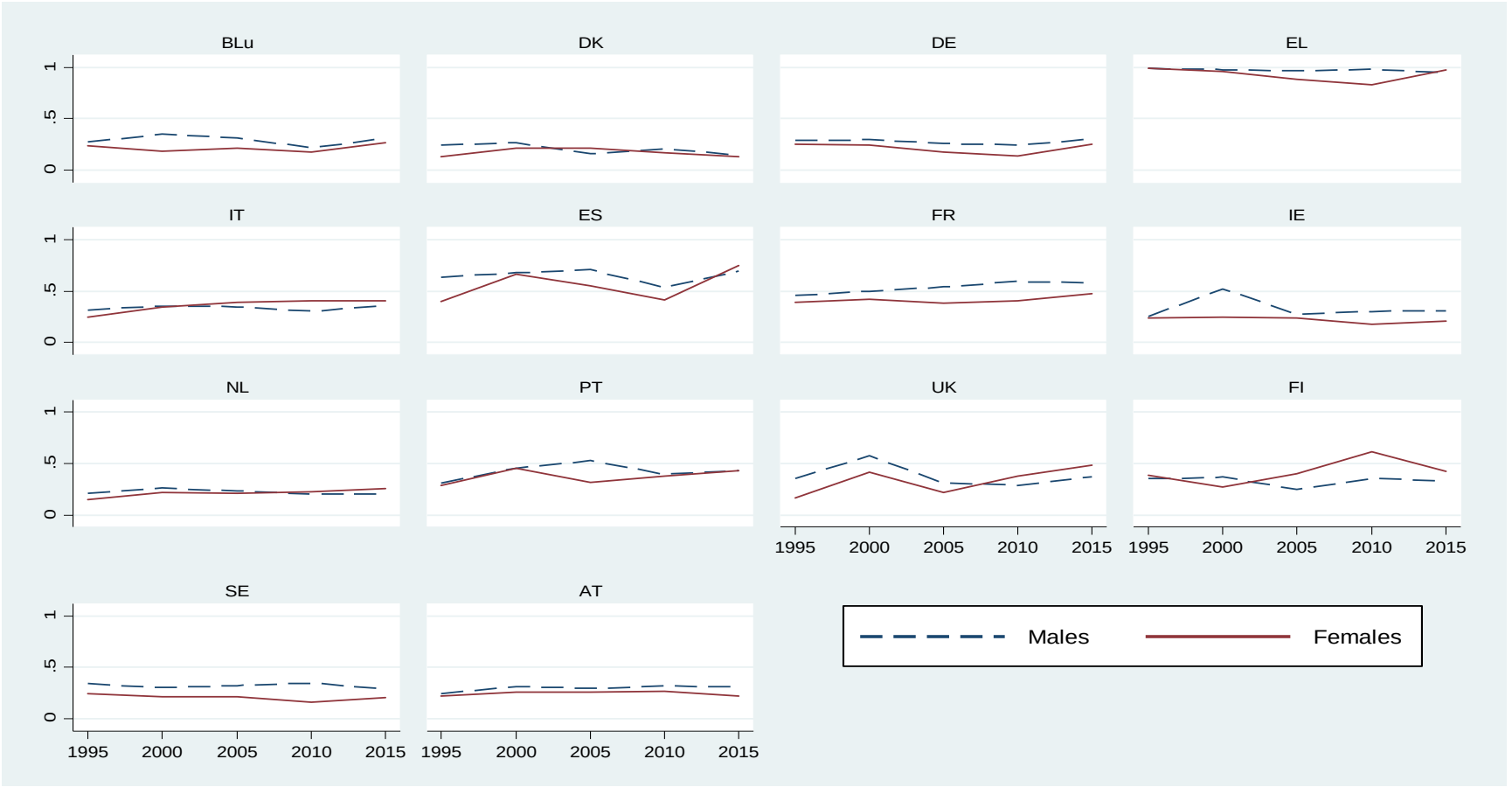
Note: Country abbreviation: Greece (EL), Spain (ES), United Kingdom (UK), France(Fr), Ireland (IE), Portugal (PT), Finland (FI), Italy (IT), Austria (AT) , Germany (DE), Belgium &Luxembourg(BLu), Netherland (NL), Sweden (SE), Denmark (DK)

Figure a8.2 Average vulnerability per age category by year survey 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 a8.3 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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Inclusive Growth Research Infrastructure Diffusion

Referring to the EU2020-ambition of Inclusive Growth, the general objectives of InGRID – Inclusive Growth Research Infrastructure Diffusion – are to integrate and to innovate existing, but distributed European social sciences research infrastructures on 'Poverty and Living Conditions' and 'Working Conditions and Vulnerability' by providing transnational data access, organising mutual knowledge exchange activities and improving methods and tools for comparative research. This integration will provide the related European scientific community with new and better opportunities to fulfil its key role in the development of evidence-based European policies for Inclusive Growth. In this regard specific attention is paid to a better measurement of related state policies, to high-performance statistical quality management, and to dissemination/outreach activities with the broader stakeholder community-of-interest, including European politics, civil society and statistical system.

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More detailed information is available on the website: www.inclusivegrowth.be

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Infrastructure Diffusion
Contract No 312691

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