A MIXTURE MODEL FOR SELF-ASSESSED STRESS AT WORK ACROSS EU[1]

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Abstract. Occupational stress is currently considered a primary social issue as well as an extensive problem of public health. Latest research on risk factors at work displays that about 25% of workers state to experience work-related stress at least "most of the time". A similar proportion also claim that their job may negatively affect their physical and psychological health and general well-being. Those evidence are usually collected by means of self-reported answers to several questions on working conditions which are often gathered on Likert scales. Implementing the CUB models, a class of mixture models suitable for ordinal data, this study aims to analyse the perception of occupational stress across European Union countries employing information from the European Working Conditions Survey dataset. Modelling results distinguishing by gender and job sustainability are presented. Results show that overall, there is a quite high perception of work-related stress among European workers, who reported their answers on work-related stress with a high degree of certainty. Results by gender show that on average, feeling estimations for women, is slightly higher than those for men. Looking at perceived job sustainability, some countries show higher levels of feeling for respondents who consider their jobs non-sustainable.

1. Introduction and theoretical framework

People spend a prominent share of their adult lives at work; therefore, work environment and other job-related features impact workers' perceived well-being. Working conditions influence employees' physical and psychological health and inevitably affect their everyday life. As established by a wide literature, employees' well-being is fundamental for their quality of life (among many others EU-OSHA, 2013; Helliwell et al., 2021).

Work factors associated with psychosocial risks include excessive workload and pace, job insecurity, lack of flexibility in working hours, which may be unpredictable or incompatible with a normal social life, poor interpersonal relations, lack of participation, an unclear role in the organisation, limited prospects for professional development, and potential conflicts between family and work demands (Cox and Griffiths, 2005). Exposure to psychosocial risks can be a source of stress among workers, resulting in a decline in their performances and, in the case of chronic exposure, the occurrence of serious health problems. According to the European Agency for Safety and Health at Work (EU-OSHA), work-related stress emerges when the demands of the working place exceed the ability of workers to cope with them (or to control them) (EU-OSHA, 2009 p. 14).

Such issue is now studied as a main societal phenomenon and stress is considered as a question of public health (among others, see Vercamer, 2018) even with respect to its implied costs. Stress affects workers' performance and causes absence from work. If prolonged, it can lead to cardiovascular or musculoskeletal disorders. All this comes with a price: the main individual costs are associated with damage to health, lower incomes and a worsening quality of life. Organisations, on the other hand, may suffer from the associated expenses of absenteeism, presenteeism, reduced productivity or high staff turnover. More specifically, the losses per year in the European Union (EU), with respect to EU15 member states, were estimated at about 26.47 billion of Euros in 2014 (Hassard et al., 2018).

Information on self-assessed stress is examined by means of a statistical modelling framework, accounting for both the perception and the uncertainty components in the response pattern. In this study, we aim to address the issue of work-related stress perception across countries at EU 28 level. The topic is also approached by analysing perceived stress distinguishing by gender and in the light of how "sustainable", in the medium-long term, respondents consider their job to be.

2. Sources and Methods

Data from the Sixth European Working Condition Survey are employed, focusing on (self-assessed) occupational stress. The European Foundation for the Improving of Living and Working Condition (Eurofound, an Agency of the EU) carries out the EWCS every five years since 1991, providing a wide range of evidence on job and workers' characteristics across Europe.

The whole dataset[2] comprises 44,000 respondents, in 35 countries, interviewed between February and September 2015, therefore, the available information offer a thorough picture of "pre-Covid 19 Europe at work", thus denoting more "ordinary" job settings. The survey questionnaire covers several topics, including individual characteristics and conditions, working time, exposure to physical and psychosocial risks, work organization, work-life balance, self-assessed health and well-being. Our response variable stems from question Q61m: "Do you experience stress in your work?", as measured on a 5-point scale ranging from "always" to "never". In the following, the wording scale has been reversed to improve readability of the results.

Several subjective and occupational determinants can be associated with stress perception, apart from the basic socio-demographic covariates: job characteristics and related risks, work-life balance and unpaid duties and other tasks, if any, performed by the respondents, should be considered. However, building on a previous research on self-assessed health (Capecchi et al., 2021), we chose to analyse how stress perception could differ across countries, differentiating by several determinants starting from the previously studied subset. In the present study, for space constraints, we present modelling results distinguishing only by gender and job sustainability. The gender covariate (question Q2a) is expressed by the usual dummy variable (where female = 1), and *sustainable job* stems from the dummy variable obtained from question (Q93): "Do you think you will be able to do your current job or a similar one until you are 60 years old?" (if respondent is older than 55, the item wording is: "Do you think you will be able to do your current job or a similar one in five years time?"). This latter item is meant to grasp the manifold features influencing job sustainability in a medium to long-term perspective and while ageing.

A preliminary screening for missing values of the selected variables, lowers the original sample to 21,118 respondents where 47.4% are men, 64.3% of respondents state to work in the private sector and about 70.2% affirm that they will be able to perform their current job (or a similar one) in the future. As it can be observed from Table 1, in general, almost 11% of the sample claim to be always stressed at work; a similar proportion affirm to be never stressed. Women report a level of perceived stress (Sometimes, Most of the Time, and Always) slightly higher than that of men.

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[2] Data have been downloaded from the UK Data Archive, http://discover.ukdataservice.ac.uk. The survey design and a comprehensive report can be found in Eurofound (2017). Apart from the 28 EU Member States interviewees, the questionnaire was indeed administered within the candidate countries for EU membership (Albania, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia, and Turkey), and in Norway and Switzerland. At the country level, the sample size was generally 1,000, with some exceptions: Poland (1,200), Spain (1,300), Italy (1,400), France (1,500), the UK (1,600), Germany, and Turkey (2,000). Some countries, of their own initiative, financed an over-sampling: Belgium, Slovenia, and Spain (with sample sizes of 2,500, 1,600, and 3,300, respectively).

Overall, from those descriptives, the difference in distributions by gender does not seem remarkable.

Table 1 − *Distribution of level of perceived occupational stress by Gender.*

Stress	Male	Female	Total
Never	13.21	11.99	12.57
Rarely	21.57	18.38	19.89
Sometimes	38.87	41.09	40.04
Most of the time	15.75	17.74	16.80
Always	10.60	10.79	10.70
Total	100.00	100.00	100.00

On the other hand, as it can be seen in Table 2, a more noticeable difference can be appreciated with respect to job sustainability assessment. In fact, workers claiming to perform a non-sustainable job and to be always stressed are almost the double of the corresponding workers holding a sustainable job. The reverse, with a lower gap, can be observed among workers "rarely" stressed.

Clearly, a simple descriptive overview could not allow for an in-depth analysis, and given the nature of the responses, it seems appropriate to also implement a modelling approach for ordinal data. The most implemented models for ordinal data usually focus on the cumulative distribution of the responses (Agresti, 2010). In such modelling structures, it is essential to assume that the answer probability of an individual with specific attributes (covariates) lies into a specific category; then, the transformed cumulative probabilities are generally assumed as a linear function of the individual drivers.

Table 2 − *Distribution of level of perceived occupational stress by Job Sustainability.*

Stress	Non-Sustainable Job	Sustainable Job	Total
Never	11.29	13.12	12.57
Rarely	15.74	21.66	19.89
Sometimes	36.57	41.51	40.04
Most of the time	20.60	15.18	16.80
Always	15.80	8.54	10.70
Total	100.00	100.00	100.00

An alternative framework allows to consider jointly the evaluation of a specific rating and the intrinsic uncertainty, even without inserting the individual characteristics. To this aim, we can suitably implement the CUB models, the acronym standing for Combination of Uniform and Binomial. One of the main features of the CUB models, especially when estimated without covariates (denoted

as CUB(0,0)), consists in the effective graphical representation of the results. A CUB(0,0) is specified by two parameters, both lying in the interval (0;1); therefore, each model can be represented as a point in the unit square, the estimated coefficients being the point coordinates. The rationale behind such framework is that respondents, when selecting a category out of an ordinal scale, are driven both by their latent perception of the item and by the uncertainty, intrinsic to any decision-making process. Briefly, CUB models assume that the data generating process of a discrete choice is given by the combination of two features: the *feeling,* expressing substantial agreement/disagreement (satisfaction/dissatisfaction; and so on) and the *uncertainty* components (for a wide review: Piccolo and Simone, 2019).

Formally, let $(R_1,\dots,R_n)$ be a sample of observations collected on an ordinal scale of $m \geq 3$ categories, e.g. answers to a given item of a questionnaire or a ranking, so that R_i denotes the score assigned by the *i*-th respondent. We say that R_i is a CUB distributed random variable with uncertainty parameter $\pi_i \in (0,1]$ and feeling parameter $\xi_i \in [0,1]$ if:

$$\Pr(R_i = r | \pi_i, \xi_i) = \pi_i \binom{m-1}{r-1} \xi_i^{m-r}(1-\xi_i)^{r-1} + (1-\pi_i)\frac{1}{m} \qquad r = 1 \dots m$$

Thus, the mixing proportion $1\text{-}\pi_i$ is referred to as the *uncertainty* parameter, although $1\text{-}\pi_i$ measures the weight of the uncertainty of the responses since it associated with the importance of the discrete Uniform in the mixture. In the simple version of CUB model, $\pi_i = \pi$ and $\xi_i = \xi$ are constant among subjects/units. Thus, CUB models allow to characterize different rating/ranking responses in terms of two parameters $(1\text{-}\pi; 1\text{-}\xi)$ only, ranging in $(0;1] \times [0;1]$, yielding a scatter plot, which easily allows comparisons among selected groups/classes of interviewees. With respect to global measures of fitting, the estimation procedure relies on likelihood methods and dedicated packages are available in R, Stata and Gretl (see Iannario et al., 2018, Cerulli et al., 2022, Simone at al., 2019).

3. Results of the estimated models

From the subset of data as described above, the estimated CUB models for perceived occupational stress for each of the 28 countries of the European Union are depicted in Figure 1. As far as *feeling* parameter is concerned, with very few exceptions, European countries range from 0.40 to 0.62. This circumstance indicates a substantial homogeneity in the perception of work-related stress. A different response behaviour is that of Bulgaria, with a value of feeling much lower, equal to

0.30, and of Romania and Latvia. The highest level of *feeling* is recorded for Malta, immediately followed by Greece and Austria.

Figure 1 − *Estimated CUB models for stress perception across EU 28 countries.*
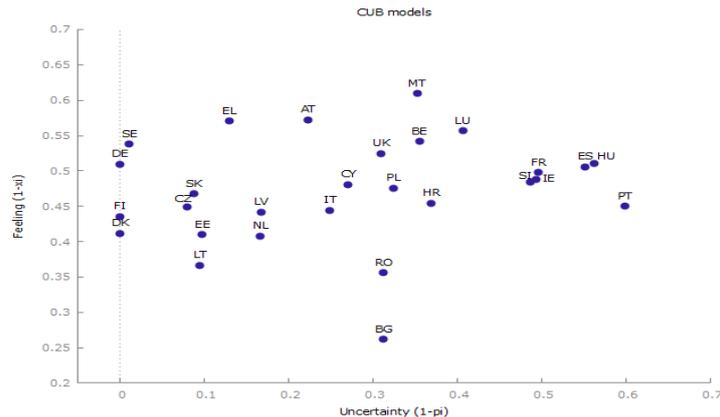
The response behaviour is quite varied with regard to uncertainty. First of all, the variability of the estimates ranges from 0.00 to 0.60, the models showing a distinct distribution by countries. First, it can be observed that the Northern European countries (Denmark, Finland, Sweden) and also Germany are characterised by no uncertainty. While, at the opposite extreme, Portugal, Hungary and Spain display the highest level of uncertainty, closely followed by France, Ireland and Slovenia. In general, it can be said that most countries exhibit low uncertainty, which is below 0.35 for more than 2/3 of the countries. Thus, we may affirm that the inherent heterogeneity on stress perception is limited for most countries, implying that the interviewed workers have expressed their responses rather decisively.

The estimation of the CUB models for each country separately by gender (Figure 2) seems to reinforce what was said above: the feeling parameters are between 0.40 and 0.65. An exception, again, is represented by Bulgaria, with a level of feeling below 0.30 for both males and females (0.22 for males). The same can be said for Romanian male respondents, whereas Romanian women are in line with most countries. The Portuguese respondents express a noticeable gap by gender: males are at 0.37; females reach 0.51, denoting a clearly higher perception of work-related stress. Maltese men and women share the highest value in terms of feeling, followed by Austrian and Luxembourg ones. In general, it can be argued that the gap in feeling between male and female workers is limited, for most countries, with feeling estimations for women slightly higher, on average, than those for men.

Figure 2 – *Estimated CUB models for stress perception across EU 28 countries by Gender.*
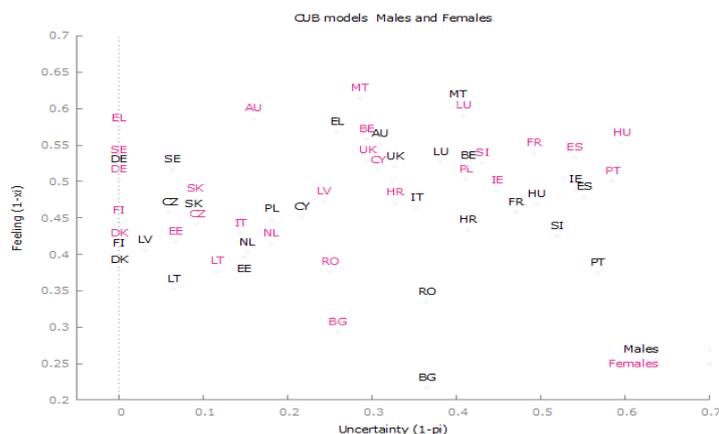
The difference by gender is significantly more pronounced with reference to uncertainty. First, it may be observed that the range for uncertainty is greater than that for feeling, and, in many countries, its level for females is distinctly different from that of males. This is the case in Italy, where women are less uncertain than men, with parameters estimated at 0.12 and 0.38, respectively. Similarly, for Greeks, an uncertainty level of 0.00 is estimated for women, while the parameter is 0.29 for men. As for Poland, the level of uncertainty for males is 0.19, while for females it reaches 0.41. At the same time, for Denmark, Finland, and Germany, both males and females display the same level of uncertainty of 0.00; while, on the opposite of the chart, Portuguese and Spanish males and females, show a level of uncertainty that rises to around 0.59. It would not seem feasible to somehow classify the countries according to the usual welfare patterns or into geographic clusters.

The picture arising from the estimations for stress with respect to the perceived job sustainability (Figure 3) is radically different. First, the ranges of the estimates, both for feeling and uncertainty, are wider: they indeed vary between 0.30 0.70 and between 0.00 and 0.70, respectively. A clear discrepancy emerges, in terms of feeling, between those who believe their jobs sustainable in the medium-long term and those who do not. In fact, a large group of countries, including Malta, Luxembourg, France, Spain and Austria, show higher levels of feeling (of about 0.15-0.20) for respondents who consider their jobs non-sustainable.

Figure 3 – *Estimated CUB models for stress perception across EU 28 countries by job sustainability assessment*
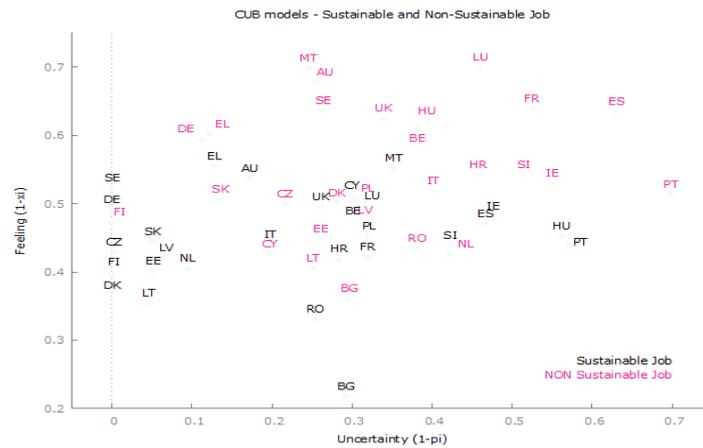
As for uncertainty, Northern European countries maintain a parameter value at 0.00, therefore showing a decisive response pattern. For Germany and the Czech Republic, the uncertainty results to be 0.00 for those who consider their employment sustainable, while it rises to 0.10 for Germans and 0.20 for Czechs who assess their jobs as non-sustainable. In Italy, this value for the uncertainty parameter increases from 0.20 to 0.40. The largest gap in uncertainty belongs to the Netherlands: the uncertainty parameter is at 0.10 for workers for whom their job is sustainable, whereas such parameter rises to 0.45 for those who consider it non-sustainable. In any case, respondents who claim their job to be non-sustainable present greater uncertainty in their response pattern.

4. Discussion and concluding remarks

Work-related stress is correlated with unsafe behavioral outcomes, among which alcohol consumption (Brown and Richman, 2012) and problems maintaining healthy relationships with one's partners and children (Repetti et al., 2009). Furthermore, stress is one of the primary causes of numerous diseases such as coronary heart disease (Sara et al., 2018). In addition, stress negatively affects workers' performance with effects not only at the individual but at organizational level too. Drawbacks of occupational stress are in contrast with goals in the workplace to support workers and organizations succeed (Meyers et al., 2013) and should worry

European countries since results of this research show that workers have a quite severe perception of occupational stress.

The main aim of this paper was to examine differences in the perception of work-related stress in EU 28 estimating CUB models based on data taken from the last European Working Condition Survey. Results show that overall, there is a quite high perception of work-related stress among European workers. Malta shows the highest level of *feeling*, while Bulgaria, Romania and Latvia the lowest. Differences in the perception of occupational stress may depend on working conditions which people face, and on the characteristics of labour markets, which are partly shaped by welfare regimes.

Before the collapse of communist regimes, labour market in Central and eastern European countries was pretty different from the rest of Europe. Before the transition to market economy, gender parity was high, wages were generally low, however workers could benefit from several social benefits. After the transition, rapid structural changes and the increasing unemployment rate were among the causes making uncertain the labour environment with labour markets characterized among other by long working hours and low wages and high job insecurity (Yarmolyuk-Kröck, 2022). Data on working conditions across central and eastern Europe show a sizable presence of psychological risks at work in different industries. However, according to Yarmolyuk-Kröck (2022), compared to other European countries, central and eastern Europe countries' workers have a different perception of psychological risks and a lack of awareness. Therefore, this different perception could be one of the reasons why our results for Bulgaria, Romania and Latvia show a low value of *feeling* (0.30). On the other hand, Malta presents the highest level of *feeling*. According to the European Commission (2018), Malta is one of the fastest growing economies in the EU. This has implied a difficult lack of labour supply in several sectors, which could be one of the causes why workers in Malta experience very long working hours, above the European average (Eurofound, 2017). However, according to Eurofound (2017), working conditions in the country are generally good compared with the European standards. Therefore, both long working hours and the perception workers have that their health or safety is at risk because of their work (Eurofound, 2017) are likely to help to explain the highest level of *feeling* within the country.

Results by gender show that overall, on average, the *feeling* estimations for women are slightly higher than those for men. Results on gender are in line with the literature (Forastieri, 2016; Nappo, 2020). Some psychosocial factors related with work-related stress may be more recurrent for women. Women play a double role at home and at work, generally they are less paid than men and are employed in more insecure job positions, they are more likely than men to deal with sexual harassment at work and domestic violence, they have to demonstrate that they are as good as

men at their jobs, those are some of the reasons why women are likely to have a higher perception of occupational related stress (Forastieri, 2016; Nappo, 2020). The most remarkable gender gap appears to that of Portuguese respondents. Such result can be explained considering that, in Portugal, working rights for women and actions against gender discrimination were formally recognized only in 1986, when Portugal adopted and ratified international organization's legal frameworks such as the Commission on the Status of Women of the United Nations, the Council of Europe and the European Economic Community. However, the effects of such ratifications still need time to produce results in terms of gender equality (Amâncio and Santos, 2021). In Portugal, women face a heavy workload within family. In the country there is still a traditional division of household, this is important for women's careers and job opportunities (Amâncio and Santos, 2021), and it affects their perception of work-related stress.

Results on work-related stress and perceived job sustainability are quite similar for countries with very different labour markets. The very content of sustainable job may be helpful to explain such results. By sustainable job is meant a job which aims to the individual's long-term employability in a position that promotes the worker's personal development over time (Lawrence et al., 2017). Therefore, it likely that non-sustainable jobs, since perceived probably as insecure jobs make workers feel stressed. Indeed, job insecurity is a main stressor for workers (Nappo et al., 2022).

Results show that, across the EU, work-related stress is a problematic issue, however, it seems still considered a subjective challenge rather than a collective/organizational one, connected to poor work organization. The EU requires further policy actions to prevent and to deal with work-related stress. In addition, more research is needed to detect workplace stressors and to encourage healthy work environments.

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