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ABSTRACT

Measuring Job Risks When Hedonic Wage Models Do Not Do the Job*

Hedonic wage regressions show little evidence that European workers facing larger job risks and other workplace disamenities receive higher wages. On the other hand, workers in more risky or unpleasant jobs are less satisfied with their jobs, ceteris paribus. If labor markets were perfectly competitive and workers fully informed of their working conditions ex ante, according to the theory of compensating differentials, there should be no relationship between on-the-job risk and job satisfaction because wages would fully adjust to compensate for differences in job characteristics. We show that when wages do not fully compensate for on-the-job risks, the willingness to pay to reduce mortality risks estimated from hedonic regressions needs to be complemented with a residual effect of job risks on utility which is not capitalized on wages. We explore the potential of job satisfaction regressions as an additional valuation approach to estimate the tradeoffs between wages and risks that keep job satisfaction constant.

JEL Classification: Q51, I12, I18, J17, J31, K32

Keywords: on-the-job risk, experienced preference, job satisfaction, hedonic wages, stated preference, value of a statistical life

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1. Introduction

A main benefit of many environmental, health, and transportation policies is to reduce mortality risks. For example, in the United States, about 85% of the monetized benefits from the Clean Air Act are from reductions in premature mortality associated with abatement of ambient particulate matter (EPA 2011). A measure of society's willingness to pay to reduce mortality risks, the Value of a Statistical Life (VSL), is thus a crucial component in the benefit-cost analyses of public policies (Sunstein 2014, Kniesner and Viscusi 2019, Banzhaf 2022).

There are two main categories of studies empirically estimating VSLs. First and foremost, *revealed preference* studies use data on compensation levels for actual risks revealed in real markets. Hedonic wage studies, the largest group in this category, combine wage information with data about on-the-job risks, to infer people's willingness to accept on-the-job risks in return for higher wages. If workers must be paid, say, $900 on average to assume a mortality risk of 1/10,000, then the implicit VSL would be $9 million.

The conceptual model underpinning hedonic wage regressions is the theory of compensating differentials that, all else equal, utility maximizing workers demand higher wages to accept jobs that expose them to higher risks and worse conditions. Profit maximizing firms, on the other hand, incur costs to provide a safer and better workplace, and are willing to pay higher wages to workers who accept jobs with higher fatality risks (Rosen 1974; Jones-Lee 1974). Hundreds of hedonic wage studies and dozens of metanalyses (including a metanalysis of metanalyses by Banzhaf 2022), report a positive correlation between on-the-job mortality risks and wages. The VSLs estimated in individual studies are however, heterogeneous, and despite a publication bias that makes small positive and negative VSL values less likely to be reported (Ashenfelter and Greenstone 2004, Doucouliagos et al. 2012), there is mounting evidence that lower wage workers tend to experience worse workplace conditions and greater injury rates than would be expected if compensating differentials held (Dorman and Hägstrom 1998, Böckerman and Ilmakunnas 2006, Bonhomme and Jolivet 2009, Maestas et al. 2018, Park et al. 2021, Dorman and Boden 2021, Clark et al. 2022).

Hedonic wage regression models rely on strong assumptions of perfectly competitive labor markets, where workers are perfectly informed, rational, and can switch jobs freely. Even when these assumptions hold, as noted by Hamermesh (1999), to the extent that workplace safety is a normal good, increases in earnings inequality like the ones observed in the 1980s and 1990s (and that have continued in the last two decades, very markedly in the US), have led to increases in the inequality in the burden of job disamenities and of workplace injury risks in particular, so that wage-inequality understates the inequality in the total returns to work (Clark et al. 2022).

More often than not, however, the restrictive assumptions that form the basis for deducing compensating wage differentials in hedonic models do not hold. As noted in Mortensen (2003), allowing for imperfectly competitive labor markets and utility dispersion across job matches implies that higher paying jobs might also have more desirable non-wage characteristics. In the case of search frictions, Lang and Majundar (2004) demonstrate that compensating wage differentials are a special rather than the general case, and that there is no guarantee that competition will prevent the emergence of "bad" jobs with lower wages and greater risks for workers of equivalent potential productivity.

Labor market frictions and lack of mobility are problematic for the use of a hedonic framework which relies on a process of equilibration through workers costlessly switching jobs.[1] Another challenge in hedonic studies is that, even when they change jobs, there are questions of whether workers are sufficiently informed about all the job characteristics and their outside options, and whether their decisions are fully rational. When people take jobs, it is not easy for them to isolate the component that is attributable to mortality risks from other job characteristics (Sunstein 2014).

A second approach to the estimation of VSLs sidesteps many of the challenges of hedonic wage regressions. *Stated preference* studies directly ask people how much they are willing to pay to reduce statistical risks. A contingent valuation study, for example, might ask: "Are you willing to pay $X (for a well-defined intervention) to reduce the risk of death by 1/10,000?" An advantage of stated preference studies is that they can isolate people's willingness to pay to avoid mortality risks from other workplace features since they are based on a hypothetical scenario. This makes them useful for studying risk preferences when job market data are not well suited for obtaining revealed preference evidence (Banzhaff 2021), but because the questions are hypothetical and unfamiliar to the respondent, there are concerns about whether they provide an accurate measurement of preferences (Diamond and Hausman 1994).

In this paper we propose a third approach to calculate the VSL, an "*experienced preference* approach" that relies on directly estimating the tradeoff between wages and risks

[1] Anecdotal evidence during the "great resignation" of 2021 points at the prevalence of frictions and limitations to mobility in labor markets. In the words of Prince Harry, The Duke of Sussex, "Many people around the world have been stuck in jobs that didn't bring them joy, and now they're putting their mental health and happiness first. This is something to be celebrated." This statement, as well as the rebuke it originated in the yellow press accusing the Duke of Sussex of being "out of touch," suggest that changing jobs is not easy for many people, and that workers were, in the words of consulting firm Grace Ocean CEO Phillip Kane, making "a decision to no longer accept the unacceptable" (Miller 2021).

that keep utility constant. Empirically, because we cannot observe utility directly, we employ the level of satisfaction which individuals report with respect to their job as a proxy measure for their utility at work. An indicator of job satisfaction is well-suited to measure the utility that workers derive from participating in the labor market (Clark 1996 and 1999, Clark and Oswald 1996, Kaiser and Oswald 2022). Job satisfaction is consequential and it helps predict job separation (Freeman 1978, Clark 2001, Kaiser and Oswald 2022). More broadly, considering the central role that work plays in most people's lives, the analysis of the factors that determine job satisfaction and of the tradeoffs between wages and risks that keep job satisfaction constant is important on its own right. We spend a considerable amount of our waking time at work. Working hours have decreased in the last decades but, on average, in OECD countries we invest around 90,000 hours or about one third of our adult lives at work (Pryce-Jones 2011, Hannon et al. 2012).[2]

The experienced preference approach proposed in this paper shares some analogies with both revealed-preference and stated-preference methods. Like stated-preference methods, it relies on survey data, but rather than recording individuals' choices over hypothetical wage and risk profiles, it appeals to direct information on their level of satisfaction with their job, which we match to data on wages and on-the-job risks (both objective and perceived). In essence, our approach estimates whether those who face lower risks in their job are happier/more satisfied with their jobs, given their current level of wages, than individuals facing higher risks with the same or higher wages. Like revealed-

[2] In this there are gender differences. Burniaoux et al (2004) indicate that for individuals participating in the labor market, on average, men in OECD countries spend 55% of their time at work, compared to 48% for women.

preference methods, our approach elicits risk preferences of individuals indirectly, but unlike hedonic pricing, it does not rely on frictionless labor markets nor on the ability of workers to find a job match that maximizes their utility *ex ante*. It relies on their satisfaction with the working conditions they experience *ex post*. Referring to the distinction between decision and experienced utility in Kahneman et al. (1997), our approach relates to *experienced* utility –the *ex-post* hedonic quality associated with workers' labor market outcomes– while hedonic pricing relates to decision utility –the *ex-ante* expectation of experienced utility (Welsch and Ferreira 2014).

We use data from two rounds of the European Working Conditions Survey (EWCS) on self-reported job satisfaction, wages, and a broad range of job, employer, and employee characteristics, that we match to data on fatal and non-fatal job accidents from the European Statistics on Accidents at Work (ESAW) measuring objective on-the-job risks. We first estimate a conventional hedonic wage regression and find little evidence of compensating differentials in European labor markets. We then estimate a job satisfaction regression to test if workers in more risky jobs are, *ceteris paribus*, less satisfied with their jobs. If the strict assumptions of perfectly functioning labor markets held, no relationship should exist between on-the-job risk and job satisfaction because wages would fully adjust to compensate for differences in job risks. However, workers face significant switching costs and other labor market imperfections. Consistent with this fact, we estimate a negative relationship between workplace disamenities –including perceived job risks– and job satisfaction.

Our work is closest and some of our findings similar to Böckerman and Ilmakunnas's (2006) who show that, for the Finnish labor market, perceived job disamenities are not related to wages and are negatively associated to job satisfaction. We focus on job risks, however, and compare conventional non-market valuation approaches to the proposed experienced preference approach and their potential to provide estimates of the VSL. When wages do not fully compensate for on-the-job risks, we theoretically show that the VSL estimated from hedonic regressions needs to be complemented with an estimate of the residual effect of job risks on workers' utility which is not capitalized in wages.

The rest of the paper proceeds as follows: section 2 presents the conceptual framework that serves as the base for the empirical specifications in section 3. Section 4 describes the data used to estimate both hedonic and job satisfaction regressions with results shown in Section 5. Section 6 discusses the results and concludes.

2. Conceptual framework

The theory of compensating wage differentials, dating back to Adam Smith, can be illustrated with a very simple model. Let $U = U(w, r)$ be the indirect utility function of a representative individual, where w is wage and r is the mortality risk (within a defined period) associated with the job. Utility increases in the wage $\partial U/\partial w = U_w > 0$ and decreases in the job risk $\partial U/\partial r = U_r < 0$.

In Figure 1, making the appropriate concavity assumptions, the curve $U = U_0$ traces combinations of wages and risks that leave utility unchanged at level U_0. The other curve, $\Pi = \Pi_0$, traces the corresponding combinations that leave employer profits Π unchanged at

Π_0 (=0 if we assume perfect competition). The tangency shows the point in the contract curve where profits and utility are jointly maximized.[3]

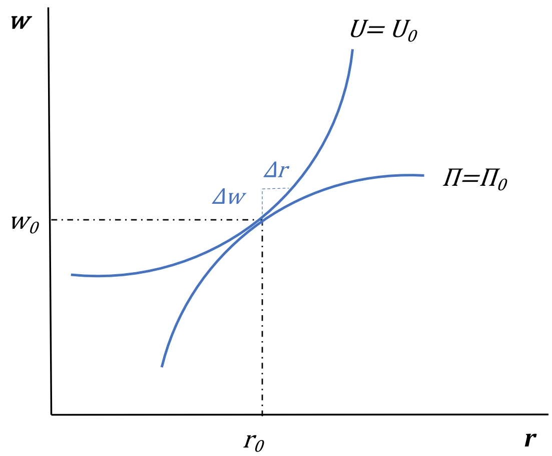

Figure 1: Model of wages and occupational risk in equilibrium for one worker and one firm

In this model, jobs differ only in their wage and level of risk, and workers are compensated for higher risks with higher wages, $w = w(r)$ with $\partial w/\partial r > 0$. In equilibrium, the utility $U = U(w(r), r)$ that a worker of a given productivity type could obtain in different jobs is equalized (otherwise they would have an incentive to switch jobs). This entails that

$$\frac{dU}{dr} = U_w \frac{\partial w}{\partial r} + U_r = 0. \quad (1)$$

[3] In a more general model, there would be many workers with different preferences towards risk and income, reflecting both tastes and ability to deal with risky situations. Similarly, there would be many firms that differ on the cost at which they can provide safety to their employees (depending on sector or technology, for example). The contract curve or market opportunity locus is given by the interaction of the supply and demand of workers at different degrees of risk.

That is, in equilibrium, the marginal disutility derived from an increase in risk is exactly offset by the marginal utility from a wage increase. By rearranging (1), we can express the implicit price of risk as:

$$-\frac{U_r}{U_w} = \frac{\partial w}{\partial r} \tag{2}$$

Equation (2) represents the VSL or the marginal rate of substitution between mortality risk and money. The VSL, or the willingness to pay for small reductions in mortality risks, is the ratio of the marginal utility from a reduction in mortality risk, $-U_r$, and the marginal utility from an increase in income, U_w; measured, in practical terms, in "dollars per unit of risk reduced" ($\partial w / \partial r$).

A testable implication of equation (1) is that if wages fully compensate for job risks, these should not affect utility at the margin (i.e. the total derivative of utility with respect to risk is zero). But what if labor markets are not in a perfectly competitive equilibrium? Then, the utility that a worker could obtain in different jobs is not necessarily equalized, i.e. there is utility dispersion, and equation (1) does not hold:

$$\frac{dU}{dr} = U_w \frac{\partial w}{\partial r} + U_r \neq 0 \tag{3}$$

Rearranging (3), the implicit price of risk is now calculated as

$$-\frac{U_r}{U_w} = \frac{\partial w}{\partial r} - \frac{dU/dr}{U_w}. \tag{4}$$

In this case, $\partial w / \partial r$ is not a complete measure of the implicit price of risk, as wages do not fully adjust to reflect differential job risks. It omits a residual effect, - $(dU/dr)/U_w)$; the effect of job risk on utility that is not capitalized in wages. That is, the willingness to pay for small risk reductions in this case should be calculated as the dollars per unit of risk reduced identified in hedonic regression plus that residual effect.

3. Empirical framework

3.1 Revealed preference approach to risk valuation: Hedonic wage regression

Most hedonic regressions estimate the wage-risk relationship in labor markets ($\partial w/\partial r$ from equation (2)) by specifying a reduced-form earnings equation:

$$\ln w_i = \alpha + \beta_1 r_i + \boldsymbol{H}_i'\boldsymbol{\beta}_2 + \boldsymbol{X}_i'\boldsymbol{\beta}_3 + \theta_c + \varphi_t + \theta_c \times \varphi_t + \varepsilon_i \qquad (5)$$

where w_i is worker i 's wage rate, r_i is the fatality risk associated with worker i's job, $\boldsymbol{H}_i$ and $\boldsymbol{X}_i$ are vectors of personal and job characteristics for worker *i*, respectively, and ε_i is a random error reflecting unmeasured factors influencing worker i 's wage rate. The terms α, β_1, $\boldsymbol{\beta}_2$, and $\boldsymbol{\beta}_3$ represent parameters estimated through regression analysis. Of critical importance is β_1, which, as stated in (2), forms the basis of the VSL *if labor markets are in a perfectly competitive equilibrium*. Applied to equation (5), $\partial w/\partial r = \beta_1 \overline{w}$, where $\beta_1$is multiplied by the average wage, given that in (5) wage takes a logarithmic form.

We use ordinary least squares (OLS) to estimate equation (5). As is conventional, we express wages in log form since a lognormal distribution better approximates their rightly skewed distribution and this helps ensure that the residuals are normally distributed. The coefficients in the right-hand side of (5) can then be interpreted as semi-elasticities; the percentual change in wages in response to marginal changes in the explanatory variables.

The personal characteristic variables denoted by $\boldsymbol{H}_i$ include a variety of human capital measures, such as education, job training and job experience, as well as other individual measures, such as age, seniority and marital status. The job characteristic variables represented by $\boldsymbol{X}_i$ often include characteristics of the workplace (such as size or unionization status) and indicators for the worker's occupation (blue-collar, white-collar, management positions), industry, measures of physical exertion, disamenities, and nonfatal injury risk associated with worker i 's job. These two sets of variables reflect both workers' preferences over jobs as well as firms' offer curves for labor.

As detailed in the data description below, we use a dataset that was specifically designed to measure working conditions across Europe. This allows us to control for a larger set of variables than is typically employed in hedonic regressions and thus mitigate endogeneity concerns arising from omitted variables bias. Another source of endogeneity in hedonic regressions, however, might arise from workers possibly choosing the degree of riskiness they face at work. The argument is a standard selectivity bias problem: workers sort into jobs offering different wage/risk combinations depending on their level of risk aversion. Intuitively, workers with less risk aversion match with more dangerous jobs and require less compensation to do so, yielding wage compensating differentials that are biased downwards.

The standard Heckman-Lee selectivity correction applies to binary variables, so we present results using Garen's (1984, 1988) correction as job risks are continuous variables. To instrument an individual's fatal and non-fatal risk we used the mean fatality risk and the mean nonfatal injury risk faced by similar individuals (i.e. individuals in the same country, economic activity and occupation). As an additional robustness check, we performed a conventional two-stage least squares estimation using the aforementioned instruments for job risks.

Finally, because the data employed in the regression analyses are for multiple European countries in two rounds (2010 and 2015), equation (5) includes country (θ_c) and time (φ_t) fixed effects and their interaction ($\theta_c \times \varphi_t$). Cultural influences on risk preferences and labor market institutions affect the VSL (Viscusi and Aldy 2003). As long as these factors depend on the country where the worker lives, they are captured by the country fixed effects, which account for country specific time-invariant characteristics (e.g. related to institutional or cultural factors that change slowly), and by the country × time fixed effects, which control for (potentially) time-varying country-specific unobserved determinants of wages. In addition, the time fixed effects (a year dummy for 2015 in our case) account for temporal factors like global technological change, business cycles, or EU-wide policies that affect all the countries in our sample.

3.2 Experienced preference approach to risk valuation: job satisfaction regression

In contrast to hedonic pricing, the experienced preference approach proposed in this paper directly estimates the marginal rate of substitution (MRS) between risk and wages by specifying a job satisfaction regression, where job satisfaction (JS) is a proxy for the utility derived at work, U.

$$JS_i = \alpha + \gamma_1 r_i + \gamma_2 \ln w_i + \boldsymbol{H}_i' \boldsymbol{\gamma}_3 + \boldsymbol{X}_i' \boldsymbol{\gamma}_4 + \theta_c + \varphi_t + \theta_c \times \varphi_t + v_i \qquad (6)$$

This is the empirical counterpart to the indirect utility function $U = U(w, r)$, which assumes that the utility individuals derive from work depends positively on wages, w_i ($\partial U / \partial w = U_w > 0$), negatively on the level of job risks, r_i ($\partial U / \partial r = U_r < 0$). It also depends on a set of other individual ($\boldsymbol{H}_i$) and job ($\boldsymbol{X}_i$) characteristics, including hours of work (Clark and Oswald 1996, Krekel et al. 2019).

Kaiser and Oswald (2022) provide compelling evidence that job satisfaction indicators are a good proxy for utility at work; a job satisfaction variable has greater predictive power of the decision to change jobs than a combination of socioeconomic influences. If *JS* is indeed a good proxy for utility at work, we can directly estimate the MRS between on-the-job risks and wages that leaves utility constant. That is, we can estimate the left-hand side of equation (4), the VSL, *even when labor markets are not in perfectly competitive equilibrium*. Applied to equation (6), this is the ratio of the partial derivatives of *JS* with respect to risk and wages:

$$-\frac{U_r}{U_w} \approx \frac{JS_r}{JS_w} = \gamma_1 \frac{\bar{w}}{\gamma_2}, \tag{7}$$

where the ratio of the coefficients γ_1/γ_2 is multiplied times the average wage, given that wage enters in a logarithmic form in (6).

We further note that the estimation of equation (6) excluding the wage variable provides a test for the theory of compensating differentials. In the conceptual model, a testable implication of equation (1) was that job risks should not affect utility, at the margin, if wages fully compensate for risks; i.e. the *total* derivative of utility with respect to risk, dU/dr, should equal zero.

We estimated (6) (and a version of (6) that excluded the wage variable) using ordered probit since, as described below, *JS* is a categorical variable. Compared to an ordered probit, OLS imposes cardinality, but studies that estimate life satisfaction regressions using both approaches find the results to be similar; in particular, ratios of coefficients such as the MRS are unaffected (Ferrer-i-Carbonell and Fritgers 2004). We found this to be the case for job satisfaction as well. Thus, the results section discusses the OLS results which are easier to interpret, with the ordered probit results presented in the appendix.

4. Data

4.1. Data sources

Data for the estimation of equations (5) and (6) come from the fifth and sixth rounds of the European Working Conditions Survey (EWCS) conducted by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) in 2010 and 2015, respectively. The EWCS contains detailed information on socio-economic and demographic characteristics of workers across countries, occupations, sectors and age groups in Europe as well as a broad range of variables related to working conditions, such as exposure to physical and psychosocial risks, work organization, work-life balance, and health and well-being, offering a unique source of comparative information on the quality of working conditions across Europe. Thus, this dataset allows comparing jobs within occupation-industry cells, while also holding constant a wide range of factors such as physical exertion, working conditions, unionization status, or socio-demographic characteristics.

We select the 2010 and 2015 rounds, which employ the current version of the industry standard classification system used in the European Union, the Statistical Classification of Economic Activities in the European Community, NACE revision 2 (NACE Rev. 2) for a total of 88 activities. Compared to previous versions, NACE Rev.2 includes sixteen new activities (e.g., water supply; waste management; telecommunication activities) to reflect the modernization of the economy.[4] In addition, the more recent rounds specify wages per employee in levels whereas previous rounds included this information by intervals. In 2021, a new round of fieldwork was carried out but we omit from our analysis as it was conducted during a time when working lives were suffering considerable challenges from the COVID-

[4] The detail of the NACE classification has substantially increased, from 514 to 615 classes. This is especially visible at all levels of service-production activities.

19 pandemic, and a change in interviewing mode (to a telephone survey) makes comparison with previous editions not possible.

The sample in the EWCS is representative of the people employed during the fieldwork period in each of the thirty countries covered in the analysis.[5] As is conventional in hedonic regressions, we report results for a sample restricted to individuals between 16-65 years of age, excluding the self-employed. Results were robust to using the full sample.

In most VSL applications risks are measured as the annual occupational mortality rate faced by workers in a given job type. Accordingly, we match the EWCS with data on the incidence rate of fatal and non-fatal accidents at work in 2010 and 2015 from Eurostat's European Statistics on Accidents at Work (ESAW) (Eurostat 2015). ESAW is the main data source for EU statistics relating to health and safety at work. Launched in 1990, it harmonizes data on accidents at work in Europe for all accidents resulting in more than three days' absence from work (Eurostat, 2001; Eurostat 2013).

4.2. Variable description

Table 1 and Appendix A.1 present the summary statistics and the detailed definitions of the

[5] These countries, for which we have data for both 2010 and 2015 (as well as occupational mortality risk) are Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Greece, Spain, France, Ireland, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, Great Britain, Croatia, Norway and Switzerland. In the EWCS the target sample size is 1,000 interviews per country, but this is increased in several larger countries to reflect a larger workforce. For that reason, all analyses are weighted with supra-national sample weights to ensure cross-country comparability. A multi-stage, stratified and clustered sample design was followed in each country with a 'random walk' procedure for the selection of the respondents during the last stage (Eurofound 2014; Eurofound 2016). All interviews were conducted face-to-face in the respondent's own home.

variables, respectively. Unless otherwise specified, all variables are sourced from the EWCS. The dependent variable for the hedonic wage regression (5) is the real hourly wage. We construct it by dividing net monthly earnings *("Please can you tell us how much are your NET monthly earnings from your main paid job? Please refer to your average earnings in recent months. If you don't know the exact figure, please give an estimate")* by the hours worked per month. It is expressed in 2015 Euro using the exchange rate on the median date of fieldwork for each country and the harmonized index of consumer prices (Eurostat, 2021).

The dependent variable for the job satisfaction regression in (6) comes from the answers to a job satisfaction question ("*On the whole, are you very satisfied, satisfied, not very satisfied or not at all satisfied with working conditions in your main paid job*?"), in a 1–4 Likert scale from "*not at all satisfied*" to "*very satisfied*". With a 3.05 average, workers in Europe report to be fairly satisfied with their job (Table 1).

To measure job risk, we use the incidence rate of mortal accidents at work expressed as the number of fatal accidents (accidents that lead to death in less than a year) per 10,000 employed. Data are available by country and year for 88 economic activities according to the NACE Rev.2 classification, from the ESAW. Many previous studies have also used an industry classification for risk (Mrozek and Taylor 2002. Evans and Schaur 2010) but ideally, we would be able to match risk data by industry and occupation. Risk information by industry and occupation is not available in ESAW but the EWCS does record the occupation of the respondent for which we control in all the models. The regressions also control for non-fatal risk, or the incidence rate of non-fatal accidents at work, measured as the number of non-fatal accidents per 10,000 persons in employment with ESAW data.

Mortality risk widely varies across activities, with the average highest incidence rates found in mining and quarrying (39.80 per 10,000), followed by forestry and logging (34.06

per 10,000), and fishing and aquaculture (26.75 per 10,000). At the other end of the spectrum, computer programming and consultancy, legal, accounting and related activities present the lowest risks (0.019 and 0.016 per 10,000, respectively). As noted below, in order to control for other inter-industry wage differentials, we include dummy variables for industrial activity.

An objective indicator of mortality risk like the one described above, assumes that workers of a given type face the same continuous, uniform-scale measure of risk. This has been criticized as being at odds with an ethical or normative conception of risk and with reality, wherein people are willing to put up with substantial risks in some aspects of their life and work but not in others (Dorman and Boden 2021). Another limitation is that it assumes that workers care only about the amount of risk exposure and not about how that risk level was determined. As noted in Slovic (2000) (and perhaps upon one's own introspection), individuals perceive less risk or are less perturbed by it when they believe they have control over it.

In our analysis, therefore, in addition to the ESAW objective risk variable we consider three alternative indicators of risk perception as reported by the individuals themselves in the EWCS to test the validity of the results. The first variable is a subjective measure of risk perception obtained from the answers ("*Yes*/*No*") to the following question: "*Do you think your health or safety is at risk because of your wor*k?" In our sample, 26% of respondents report that to be the case (Table 1). The use of this variable addresses the concern that different individuals may perceive the same objective risk differently and helps control for unobserved individual characteristics that may affect wages.

A second variable pertaining to job risk in the EWCS captures the degree to which the employee feels informed about health and safety risks at the workplace*: "Regarding the* *health and safety risks related to the performance of your job, how well informed would you say you are?"* from 1 = "*not at all well informed*" to 4 = "*very well informed*"). We pay particular attention to this variable as one of the underlying assumptions in hedonic regressions is that workers are perfectly informed about the characteristics of their jobs. We interact the risk information variable with mortality risk to test whether the association between risk and wages is moderated by the degree of information possessed by the individual. Finally, a third variable in the EWCS that allows us to check robustness measures the number of days of absence from work attributable to accidents at work over the past 12 months. On average, workers report missing four fifths of one workday per year for this reason.

The regressions control for a rich set of individual characteristics and human capital variables ($\boldsymbol{H_i}$) available at the EWCS. Age enters in a quadratic form in the regression to reflect an inverted U-shaped of VSL over the life course (Viscusi 2010, Ehrlinch and Yin 2005; Aldy and Smyth 2007). We also control for the number of children, as the high VSL at the middle of the age spectrum reported in previous literature might reflect parents' altruistic concerns for their children (Viscusi 2010). Education level is measured with the International Standard Classification of Education (ISCED). A variable about the nationality of the respondent and their parents is included as past work shows the relevance of controlling by race and ethnicity (e.g., Black and Kniesner 2003). Other standard controls are sex, living with a partner or spouse, self-reported health status (from 1 = "*very bad*" to 5 = *"very good*"), and two variables: training on-the-job and increase in salary in the last 12 months that may reflect individual productivity.

As for workplace and job characteristics ($\boldsymbol{X_i}$), the EWCS collects information on workplace size, having or not a union representative in the workplace, whether the organization is public or private, and whether the contract is of unlimited duration. Importantly, it also asks about the degree of exposure to bad conditions at the workplace including vibrations, noise, high and low temperatures, smoke, second-hand smoke, vapors, chemicals and infectious substances. We include a summary variable constructed as the average of these nine items which are measured in a 1 ("*never*") to 7 ("*all the time*") scale. This helps address another criticism of the mortality risk data typically employed in hedonic regressions that they do not capture risks from sustained occupational exposures to hazardous conditions (Dorman and Boden 2021). Additional variables account for whether the work involves working at very high speed, if it requires meeting precise quality standards, doing overtime work, whether it offers incentive payments for individual, team, and company performance, profit sharing, payments for overtime, bad conditions and Sunday work.

Finally, dummies for 28 categories from the International Standard Classification of Occupations, ISCO88 2-digit classification are included to control for occupation. As far as industry is concerned, estimations include dummies for 88 2-digit NACE activities.

Table 1. Summary Statistics

Variable		Mean	Std Dev	Min	Max
Real Hourly Wages		9.76	14.01	.003	1,561.27
Job Satisfaction		3.052	.693	1	4
Mortality Risk		.218	.859	0	133.66
Non-fatal Risk		145.71	191.78	0	7,822.20
Risk Perception		.258	.438	0	1
Risk Information		3.309	.722	1	4
Accident Leave		.807	8.4	0	365
Female		.528	.499	0	1
Age		41.77	11.55	16	65
Partner		.653	.476	0	1
Children		.848	1.03	0	8
National		.852	.355	0	1
Health		4.004	.759	1	5
Seniority		9.826	9.47	1	60
Training		.404	.491	0	1
Education:	0 = Pre-primary	.004	.062	0	1
	1 = Primary	.032	.177	0	1
	2 = Lower secondary	.147	.354	0	1
	3 = Upper secondary	.42	.494	0	1

4 = Post-secondary	.069	.253	0	1
5 = First stage of tertiary	.32	.466	0	1
6 = Second stage of tertiary	.009	.096	0	1
Salary Increase	.293	.455	0	1
Workplace Size: 1 employee	.035	.183	0	1
2-9 employees	.268	.443	0	1
10-249 employees	.552	.497	0	1
250+ employees	.145	.352	0	1
Union	.49	.5	0	1
Private	.686	.464	0	1
Indefinite contract	.8	.4	0	1
Exposure to Bad Conditions	1.737	.9	1	7
Work Speed	4.433	2.01	1	7
Quality Standards	.735	.441	0	1
Overtime Work	1.923	4.44	0	31
Incentives and Additional Payments				
Piece Rates	.115	.319	0	1
Group Pay	.169	.374	0	1
Profit Sharing	.114	.317	0	1
Shares Pay	.028	.164	0	1
Overtime Pay	.335	.472	0	1
Bad Conditions Pay	.077	.267	0	1
Sunday Work Pay	.176	.381	0	1
Hours Worked per month	160.973	46.04	4.342	642.57

5. Results

The average hourly wage in our sample is €9.76 (Tables 1, 2), but it varies significantly according to the level of risk, with those employed in activities with mortality risks above the mean) earning significantly *lower* wages (about €2 less) than those in jobs with mortality risks at or below the mean (Table 2). Similarly, those who perceive their health or safety to be at risk because of their work earn significantly less (about €1.5) than those who do not. People reporting more days of absence because of accidents at work or being exposed to worse conditions at the workplace also report lower wages. The only indicator of job risk for which there is consistency with the theory of compensating differentials is the non-fatal risk. Workers who feel better informed about the risks related to the performance of their jobs also report higher wages than those worse informed. Simple correlations among the variables (Table 3) confirm these findings.

Table 2: Mean real hourly wage and job satisfaction by job risk

	Mean Real hourly wage (€)	Mean Job satisfaction
Full sample	9.760	3.052
Subsamples:		
Mortality risk above mean	8.270	2.984
Mortality risk below (or equal to) mean	10.188	3.072
Non-fatal risk above mean	10.996	3.023
Non-fatal risk below (or equal to) mean	9.080	3.067
Risk perception = 1	8.685	2.735
Risk perception = 0	10.179	3.166
Accidents leave above mean	8.923	2.922
Accidents leave below (or equal to) mean	9.854	3.068
Exposure to bad conditions above mean	8.906	2.894
Exposure to bad conditions below (or equal to) mean	10.286	3.146
Risk information above mean	10.076	3.207
Risk information below (or equal to) mean	9.510	2.927

Note: The difference in mean value of real hourly wage and job satisfaction between groups is statistically significant (95% confidence level) for all the risk variables considered. Differences are also statistically significant when defining the groups according to median instead of mean risks.
Source: EWCS (2010, 2015)

Job satisfaction presents a positive and significant association with wages (Table 2 second column, Table 3) in line with expectations and according to previous literature (e.g., Clark et al. 1996, Card et al. 2012). Also unsurprisingly, those in riskier jobs (including non-fatal risks) and in jobs with worse conditions report, on average, a lower job satisfaction than those in better jobs.

Negative correlations between wages and mortality risks (objective or perceived) and bad conditions and positive correlations between exposure to bad conditions and all the indicators of job risks suggest that there may be "bad" jobs with worse pay and conditions. Simple correlations, however, do not control for any additional individual or workplace characteristic. To see if these correlations carry over to a multivariate regression analysis, Table 4 presents the results of hedonic wage regressions based on the model in equation (5) where those additional controls are included.

Table 3. Correlations between real hourly wages, job satisfaction and risk variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Real Hourly Wage	1.000						
(2) Job Satisfaction	0.096***	1.000					
(3) Mortality Risk	-0.035***	-0.033***	1.000				
(4) Nonfatal Risk	0.049***	-0.029***	0.194***	1.000			
(5) Risk Perception	-0.047***	-0.272***	0.064***	0.062***	1.000		
(6) Risk Information	0.012**	0.241***	-0.001	-0.056***	-0.063***	1.000	
(7) Accidents Leave	-0.003	-0.048***	0.004	0.031***	0.074***	-0.018***	1.000
(8) Exposure to bad conditions	-0.065***	-0.207***	0.103***	0.145***	0.366***	-0.063***	0.074***

**** p<0.01, ** p<0.05, * p<0.1*

5.1 Hedonic wage regressions

The first column in Table 4 reports the OLS estimates of a conventional hedonic wage regression where job risks are measured with the (objective) mortality risk variable and non-fatal risk is controlled for. The two risk indicators are statistically significant at the conventional levels but show the "wrong" sign –higher risks are associated with lower wages.

Table 4: Determinants of Log Real Hourly Wages.

	(1)	(2)	(3)	(4)	(5)	(6) Risk inf.<4	(7) Risk inf. = 4
Mortality Risk	-0.003**		-0.003*	-0.003*	-0.026**	-0.005**	0.003
	(0.001)		(0.001)	(0.001)	(0.011)	(0.002)	(0.003)
Non-fatal Risk	-0.00005***		-0.00005***	-0.00005***	-0.00006***	-0.00004**	-0.0007***
	(0.00001)		(0.00001)	(0.00001)	(0.00001)	(0.00002)	(0.00002)
Risk Perception		-0.014**	-0.014**	-0.013**	-0.013**	-0.024***	0.000
		(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)
Accidents Leave				0.0001	0.0001	0.00004	0.0003
				(0.0002)	(0.0002)	(0.0003)	(0.0003)
Risk Information				0.013***	0.011***		
				(0.003)	(0.003)		
Risk Information x Mortality Risk					0.001**		
					(0.000)		
Bad conditions	-0.022***	-0.020***	-0.020***	-0.019***	-0.019***	-0.017***	-0.023***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)

Obs.	33,914	33,914	33,914	33,914	33,914	18,900	15,014
R-squared	0.783	0.782	0.783	0.783	0.783	0.785	0.784

Notes: All regressions are estimated using OLS, and include controls for employee, employer and workplace characteristics (see Appendix A.2 for full set of results), dummies for occupation (28), economic activity (88), country (30), country-year interactions and sample weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

As shown in Table 4, all the regressions control for exposure to bad conditions at the workplace, which itself exhibits a negative and statistically significant coefficient, suggesting that wages are not compensating for perceived job disamenities either, as in Böckerman and Ilmakunnas (2006). The results on additional controls for employee, employer and workplace characteristics, presented in Appendix A.2, are consistent with previous literature (see Cotton and Tuttle (1986) for an early review).

That hedonic wage regressions show little evidence of compensating differentials in European job markets is, perhaps, not surprising. In their meta-analysis of hedonic labor market studies, Mrozek and Taylor (2002) recommend using US data as one of the best practices for purposes of estimating VSL values, and the overwhelming majority of hedonic wage regression studies focus on the US (Banzhaff 2021). The conventional wisdom is that European labor markets are more rigid than their US counterpart. Labor mobility is a less important adjustment, and the temporary response of the unemployment rate to shocks is larger and more persistent in the European regional labor market than in the US due to its greater rigidity (Beyer and Smets 2015). However, even in the UK, which according to the classification of Siebert (1997) has a labor market more similar to the US in terms of low level of rigidity, we do not find any of the indicators of mortality risks or workplace disamenities to be statistically positively associated with wages (Appendix A.3).

Alternative measures of risk. We re-estimate the baseline equation using the alternative measures of risk in the EWCS presented above. The results of these analyses are shown in columns 2 to 7 of Table 4. The supplementary measures of risk allow us to test the validity of our results and address some of the concerns raised by the conventional measures of mortality risks. Risk perception (column 2) shows a negative and statistically significant association with wages, which is coherent with the results of the main regression and at odds with expectations from hedonic wage models. The results are robust to the inclusion of both, objective and subjective measures of job risk simultaneously (column 3), and to the inclusion of the most comprehensive set of risk-related variables comprising, in addition, the level of risk information and the workers' days of absence due to accidents at work (column 4).

In the case of risk information, the estimated coefficient is positive, suggesting that workers who are better informed about the health and safety risks related to the performance of their job are able to negotiate higher wages. We explore the importance of risk information in explaining the negative relationship between wages and risks in columns (5)-(7). In column 5, we include an interaction between mortality risk and risk information to the set of explanatory variables. Mortality risk and risk information still have a negative and positive association with wages, respectively. Interestingly, the interaction term exhibits a positive sign, suggesting that information about risks mitigates the negative effect of mortality risk on wages. When we split the sample roughly in half, between those who consider themselves to be very well informed about their job risks and those who do not, we observe that the negative relation between job mortality risks and wages seems to be driven by those less informed about those risks. However, even for those very well informed about the risks, the evidence of a monetary compensation for assuming risks is weak. Finally, please note that the additional controls for employee, employer and workplace characteristics are robust across specifications.

The absence of compensating differentials is robust to an alternative specification that addresses a potential selectivity bias per Garen's (1984, 1988) correction. Like Machin and Wadhwani (1991), Woessmann and West (2006), Cornelissen et al. (2011), Bilanakos et al. (2018) or Baktash et al. (2022) we use instruments for job risk based on the idea of aggregation, that is, we compute the mean fatality and nonfatal injury risk of individuals in the same country, economic activity and occupation as instruments for a worker's choice of risks. The results of a two-stage estimation confirm that higher risks are significantly associated with lower wages (Appendix A.4, column 1). The same pattern of results holds in a conventional two-stage least squares estimation using the same instruments (Appendix A.4, column 2).[6]

5.2 Job satisfaction regressions

Our results are consistent with the view that conventional hedonic wage regressions are not suitable in a European context. On the other hand, as shown in equation (7), a job satisfaction regression can provide an empirical estimate of $-U_r/U_w$. In Table 5, we show the results of a job satisfaction regression like the one described in equation (6). [Results for the full set of regressors are shown in appendix A.5, and results from the ordered probit regression in appendix A.6.]

We estimate different versions of equation (6) for alternative indicators of job risks, with and without controlling for wages. The presence of compensating wage differentials can be examined in a *JS* equation where wage is *not* included by testing whether the hypothesis γ_1=0 holds (Böckerman and Ilmakunnas, 2006). A significant negative

[6] These instruments are likely to satisfy the relevance condition that they be correlated with the endogenous variable. One could argue that employees with similar characteristics make similar risk choices, or that they are influenced by the decisions of their peers. This intuition is reinforced by the large value of the F-statistics obtained in the relevance test for both instruments (results available upon request).

coefficient for the risk variable (i.e. rejecting the null) would be evidence against compensating differentials, since it would indicate that wages do not fully compensate for the risk, which retains a negative, residual effect on *JS*.

In the first two columns of Table 5, the objective indicators of mortality risk, which are instrumented using the aggregation method described in the previous section, are negative and statistically significant at a 5% level (which becomes a 10% level when wages are included). In the next two columns, risk perception is negatively associated with *JS*, a result that is robust to including objective risks in the regressions, and to incorporating the number of leave days because of a work accident—itself negative and statistically significant at a 10% level– and the risk information variable.

Perceiving health and safety risks at one's workplace is associated with a reduction in *JS* of a fourth of a *JS* category and the results are similar independently of whether wages are controlled for in the regressions. In fact, the estimated coefficients for all the risk variables are virtually identical in regressions that include wages (in which coefficients on wages are significantly positive) and in those that omit them. This reinforces the results from the hedonic regressions further suggesting that wages are not compensating for risks in the workplace. Similarly, experiencing bad conditions (vibrations, noise, high/low temperatures, smoke or vapors, chemicals, or infectious substances) is negatively associated with *JS* – an increase in the bad conditions score reducing *JS* by a tenth of category– independently of whether wages are controlled for.

Table 5: Determinants of Job Satisfaction

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mortality risk	-0.005**	-0.005*			-0.003	-0.003	-0.003	-0.002
	(0.003)	(0.003)			(0.002)	(0.002)	(0.003)	(0.003)
Non-fatal risk	-0.00002	-0.00002			-0.00002	-0.00001	-0.00002	-0.00002

	(0.00002)	(0.00002)			(0.00002)	(0.00002)	(0.00002)	(0.00002)
Risk perception			-0.257***	-0.256***	-0.257***	-0.256***	-0.241***	-0.241***
			(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Accidents Leave							-0.001*	-0.001**
							(0.0005)	(0.0005)
Risk Info							0.171***	0.169***
							(0.005)	(0.005)
Bad conditions	-0.106***	-0.105***	-0.071***	-0.069***	-0.071***	-0.069***	-0.062***	-0.061***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Log real wage		0.092***		0.089***		0.089***		0.079***
		(0.010)		(0.010)		(0.010)		(0.010)
Hours worked	-.0003***	0.00002	-.0003***	0.00003	-0.0003***	0.00003	-0.0004***	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Obs.	33,827	33,827	33,827	33,827	33,827	33,827	33,827	33,827
R-squared	0.188	0.191	0.208	0.211	0.208	0.211	0.236	0.238

Notes: In columns (1)-(2), and (5)-(8) mortality risk and non-fatal risks are instrumented using the mean fatality and nonfatal injury risk of individuals in the same country, economic activity, and occupation. All regressions include controls for employee, employer and workplace characteristics (see Appendix A.5 for full set of results), dummies for occupation (28), economic activity (88), country (30), country-year interactions and weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Conforming to economic theory and intuition, *JS* is positively related with wages, as already noted, and negatively related to the number of hours worked (Clark and Oswald 1996, Krekel et al. 2019), with the latter becoming statistically insignificant when we control for wages, suggesting that wages do compensate for the time spent at work. The results for other controls are also consistent with previous literature and discussed in Appendix A.5.

How large are the willingness to pay estimates to reduce job risks derived from the *JS* regressions? In a result that is robust across specifications in Table 5, perceiving health and safety risks at one's workplace is associated with a reduction of a fourth of a *JS* category. Because it is a subjective risk indicator, it is not directly comparable with the many estimates coming from hedonic wage regressions. Nevertheless, it can still provide valuable insights into the value workers place in the reduction of the perceived risks to health and safety at the workplace. For an average hourly real wage of €9.760, plugging the estimates from column (8) in Table 5 into equation (7), workers would trade off about €30 per hour (three times the average wage) to eliminate perceived health and safety risks and keep their *JS* constant. Assuming 2,000 hours of work per year, this amounts to €60,000 per year.

The VSL numbers estimated in hedonic regressions are expressed as WTP for a reduction in a fatality rate. Therefore, they are more directly comparable to the objective mortality risk variable from ESAW, which is expressed as the number of fatal accidents per 10,000 workers. Plugging in the estimates from column (2) in Table 5 into equation (7), workers would trade off €0.53 per hour to reduce that risk, which assuming 2,000 year-hours of work and multiplying times 10,000 yields a point estimate for the VSL comparable with that of hedonic wage estimates at about €10.6 million. This estimate is statistically significant at a 10% level.

More generally, these results should be interpreted with caution. Wages, whose coefficient appears in the denominator of the VSL estimate in equation (7), may be endogenous with job satisfaction. Workers who are happier at their job may also be more productive and earn higher wages. One solution would be to use an instrumental variable for wages. A good instrument should be correlated with wages (i.e. it should be relevant) and affect job satisfaction only through its effect on wages (i.e. it should satisfy the exclusion restriction). Lyndon and Chevalier (2002) acknowledge the difficulty of finding a variable that meets the exclusion restriction. They used the wage of the respondent's partner or spouse as an instrument for the worker's own earnings. Unfortunately, the closest variable available in our dataset is whether the worker lives with a partner who is employed, and although this instrument is significantly correlated with the job satisfaction of the individual in Table A.5, it is not a relevant instrument for wage in the first stage regression. Another potential instrument that is (negatively) significantly correlated with wages, as shown in Table A.2, and not statistically associated with *JS* (in Table A.5 regressions that control for wages) is sex –being a female. Somewhat reassuringly, Appendix A.7 shows a second stage estimate suggesting (only) slightly larger income effects (p = 0.10).

6. Discussion and conclusions

This is the first paper that examines the potential of job satisfaction regressions to provide willingness to pay estimates for the reduction of job risks. When labor markets are not perfectly competitive because labor is not perfectly mobile, workers are not fully informed about the working conditions before they accept a job, or they misperceive their outside options, hedonic wage regressions provide biased estimates of the willingness to pay for job risk reductions as wages do not fully capitalize job risks (or other job characteristics).

In a conventional hedonic wage regression using data from European workers, variables capturing job risks and disamenities exhibit a sign opposite to what the theory of compensating differentials would predict. Higher risks are associated with lower wages. The results are robust across alternative indicators of job risk, both objective (incidence rates of fatal accidents) and subjective (self-reported perceived health and safety risks). Increased exposure to bad conditions (vibrations, noise, smoke, high/low temperatures, infectious substances) is also associated with lower wages. Our results, however, also suggest that workers' information about job risks mitigates some of those effects. The negative association between job risks and wages is observed only for those workers who do not feel very well informed about those risks. Interestingly, even for those who feel very well informed about job risks, bad conditions are associated with lower wages, suggesting that wages are not capitalizing workplace disamenities.

Workers who are very well informed about job risks are, apparently, able to negotiate larger wages. While it is true that better informed workers are also better educated, more senior, and tend to work in unionized and larger firms, we note that the regression results are conditional on these characteristics and a broad set of workers' and firms' observables. A logical implication deriving from this result is the recommendation to promote initiatives that inform workers about their health and safety risks to reduce information asymmetries at their workplace.

Results from a job satisfaction regression offer an additional test that wages do not compensate for job disamenities. Conditional on wages, job risks and bad workplace conditions should not affect job satisfaction if wages compensate for those job disamenities. In our sample of European workers, perceived job risks and exposure to bad conditions are negatively related to job satisfaction and the magnitude of the estimates is independent on whether we condition for wages.

Our evidence points at a lack of equalization of workers' utilities across industries and occupations in European labor markets which, compared to the US, are notoriously rigid. There are frictions to labor mobility. Switching jobs is not costless. Workers may be misinformed. For example, in recent research, Jäger et al (2021) show that German workers wrongly anchor their beliefs about outside options on their current wage, with low-paid workers underestimating their wages elsewhere.

In this context, hedonic wage regressions cannot provide reliable estimates of the implicit price of non-monetized working conditions (such as risk), but the job satisfaction approach proposed in this paper might. Workers may not be able to easily switch jobs, but they can be their own judges of their overall satisfaction at their current job given their working conditions. In contrast to hedonic regressions, results from job satisfaction regressions suggest that workers in Europe do place a substantial value on the reduction of mortality risks (and other adverse conditions) at work. Taken at face value, our estimates indicate that on average, workers would have to be compensated with about €30 per hour (three times the average wage) to eliminate all the health and safety risks they perceive at work to keep their *JS* constant. When looking at the WTP for a reduction in the fatality rate the estimated VSL is about €10.6 million. Future work with more precise mortality rates might yield more precise estimates. This number, however, is in the ballpark of the central estimates employed by several US Federal agencies, as reported by Banzhaf (2021): $10.4m ($2019) by the US Department of Health and Human Services, with low and high values of $4.9m and $15.8m, respectively; $10.4m ($2016), by the Department of Transportation (with a range "for illustrative purposes" of $5.8m to $14.5m representing the broader literature); and $9.4m ($2020) by the US Environmental Protection Agency, with a 90% confidence interval of $1.3m to $22.9m. The OECD (2012) reports a mean VSL of 7.4 m (and a median of 2.4 m. in $2005) for a metanalysis of a large number of studies around the world.

In Europe, like in the US, the VSL is an important input for the assessment of health benefits and mortality reductions in the benefit-cost analysis of public investment decisions, with stated preference and revealed preference techniques being the preferred method for its estimation (European Commission 2015). In this paper we present an additional approach that can be used to complement and test the robustness of existing approaches. Subjective well-being data have already been employed for non-market environmental valuation of, *inter alia*, noise (van Praag and Baarsma, 2005), air quality (Luechinger 2009), or natural disasters (Luechinger and Raschky 2009, Ahmadiani and Ferreira 2021), offering “a promising new way of valuing non-market goods” (OECD 2018, p. 173). The present study is the first exploration of job satisfaction data for the valuation on job risks.

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Appendix A.1: Definition of Variables

Variable	Definition	Units/Scale
Dependent variables		
Real Hourly Wages	Logarithm of hourly net earnings deflated by purchasing power parity (in €2015)	Continuous variable
Job Satisfaction	Satisfaction with working conditions in main paid job	1 = Not at all satisfied 2 = Not very satisfied 3 = Satisfied 4 = Very satisfied
Risk-related Variables		
Mortality Risk	Number of fatal accidents per 10,000 persons in employment in country, industry (88 categories) and year (ESAW data).	Continuous variable
Non-fatal Risk	Number of non-fatal accidents per 10,000 persons in employment in country, industry and year (ESAW data).	Continuous variable
Risk Perception	If respondent think their health or safety is at risk because of his/her work	0 = No 1 = Yes
Risk Information	How well-informed respondent is about health and safety risks related to the performance of his/her job	1 = Not at all well informed 2 = Not very well informed 3 =Well informed 4 = Very well informed
Accident Leave	Days of absence at work attributable to accident at work.	
Bad Conditions	Degree of exposure to bad working conditions: vibrations, noise, high or low temperatures, smoke or vapors, chemicals, and infections substances. Mean value of 9 items measured on a 1 (Never) to 7 (All of the time) scale	Continuous variable
Individual characteristics and human capital variables		
Female	Gender of the employee	0 = Male 1 = Female
Age	Age of the employee (in years)	Continuous variable
Education	Highest level of education successfully completed by the employee (measured using 1997 International Standard Classification of Education levels)	0 = Pre-primary 1 = Primary 2 = Lower secondary 3 = Upper secondary 4 = Post-secondary 5 = First stage of tertiary 6 = Second stage of tertiary
Seniority	Years in current company or organization	Continuous variable
Children	Number of children living in the household	Continuous variable
National (ethnicity)	Respondent and both parents born in the country	0 = No 1 = Yes
Partner	Spouse/partner living in the household	0 = No 1 = Yes
Health	Perception about general health status	1 = Very bad 2 = Bad 3 =Fair 4 = Good 5 = Very good
Training	Training paid by respondent or on-the-job during the past 12 months.	0 = No 1 = Yes
Salary Increase	Respondents' salary has increased during the last 12 months	0 = No 1 = Yes

Workplace and job characteristics		
Workplace Size	Number of employees in the workplace	1 = 1 employee 2 = 2–9 3 = 10–249 4 = 250 or more
Unionization	Employees in the company or organization are represented by a trade union, works council, or similar committee	0 = No 1 = Yes
Private	Respondent works in the private sector	0 = No 1 = Yes
Self-employed	Respondent is self-employed	0 = No 1 = Yes
Indefinite contract	Respondent has a contract of unlimited duration	0 = No 1 = Yes
Work Speed	Job involves working at very high speed	1 = Never 2 = Almost never 3 = Around ¼ of the time 4 = Around half of the 5 = Around ¾ of the time 6 = Almost all of the time 7 = All of the time
Quality Standards	Main paid job involves meeting precise quality standards	0 = No 1 = Yes
Overtime Work	Number of times in a month respondent works more than 10 hours a day	Continuous variable
Piece Rates	Earnings from the main job include piece rate or productivity pay	0 = No 1 = Yes
Group Pay	Earnings from the main job include payments based on the performance of the group.	0 = No 1 = Yes
Profit Sharing	Earnings from the main job include profit sharing	0 = No 1 = Yes
Shares Pay	Earnings from the main job include income from company shares	0 = No 1 = Yes
Overtime Pay	Earnings from the main job include payments for additional hours of work/overtime	0 = No 1 = Yes
Bad Conditions Pay	Earnings from the main job include payments for bad conditions	0 = No 1 = Yes
Sunday Work Pay	Earnings from the main job include payments for Sunday work	
Hours worked	Hours worked per month	Continuous variable
Occupation	2-digit ISCO-88 occupations	28 dummy variables
Industry	2-digit NACE industries (Rev. 2.2)	88 dummy variables
Country	Country dummies	30 dummy variables

Appendix A.2: Determinants of Log Real Hourly Wages (Full set of results)

	(1)	(2)	(3)	(4)	(5)	(6) Risk inf.<4	(7) Risk inf. = 4
Mortality Risk	-0.003**		-0.003*	-0.003*	-0.026**	-0.005**	0.003
	(0.001)		(0.001)	(0.001)	(0.011)	(0.002)	(0.003)
Non-fatal Risk	-0.00005***		-0.00005***	-0.00005***	-0.00006***	-0.00004**	-0.0007***
	(0.00001)		(0.00001)	(0.00001)	(0.00001)	(0.00002)	(0.00002)
Risk Perception		-0.014**	-0.014**	-0.013**	-0.013**	-0.024***	0.000
		(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)
Accidents Leave				0.0001	0.0001	0.00004	0.0003
				(0.0002)	(0.0002)	(0.0003)	(0.0003)
Risk Information				0.013***	0.011***		
				(0.003)	(0.003)		
Risk Information x Mortality Risk					0.001**		
					(0.000)		
Bad conditions	-0.022***	-0.020***	-0.020***	-0.019***	-0.019***	-0.017***	-0.023***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
Female	-0.099***	-0.099***	-0.099***	-0.099***	-0.099***	-0.094***	-0.105***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)
Age	0.014***	0.014***	0.014***	0.014***	0.014***	0.011***	0.019***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Age2	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00003)	(0.00003)
Partner	0.030***	0.030***	0.030***	0.030***	0.030***	0.021***	0.042***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)
Children	0.012***	0.012***	0.012***	0.012***	0.012***	0.014***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
National	0.029***	0.029***	0.029***	0.028***	0.028***	0.034***	0.020**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.010)
Health	0.036***	0.034***	0.034***	0.033***	0.033***	0.029***	0.038***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
Seniority	0.007***	0.007***	0.007***	0.007***	0.007***	0.007***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Seniority2	-0.00007***	-0.00007***	-0.00007***	-0.00007***	-0.00007***	-0.00004**	-0.00006*
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00003)	(0.00003)
Training	0.001	0.002	0.002	0.001	0.001	-0.001	0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)
Education:							
Primary education	-0.030	-0.029	-0.030	-0.032	-0.032	-0.021	-0.066
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.046)	(0.053)
Lower secondary	0.034	0.036	0.034	0.031	0.031	0.052	-0.025
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.042)	(0.050)
Upper secondary	0.084**	0.087***	0.085**	0.081**	0.082**	0.107**	0.020
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.042)	(0.050)
Post-secondary	0.115***	0.118***	0.115***	0.112***	0.112***	0.135***	0.051
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.044)	(0.051)
First stage of tertiary	0.232***	0.235***	0.233***	0.230***	0.230***	0.252***	0.168***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.043)	(0.051)
Second stage tertiary	0.391***	0.394***	0.391***	0.389***	0.389***	0.423***	0.313***
	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.051)	(0.061)
Salary Increase	0.027***	0.028***	0.027***	0.027***	0.027***	0.026***	0.027***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)
Workplace Size:							
2-9 employees	0.050***	0.050***	0.050***	0.049***	0.049***	0.053**	0.041
	(0.018)	(0.018)	(0.019)	(0.018)	(0.018)	(0.024)	(0.029)

10-249 employees	0.094***	0.094***	0.094***	0.093***	0.093***	0.090***	0.095***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.024)	(0.029)
250+ employees	0.118***	0.118***	0.118***	0.117***	0.117***	0.116***	0.114***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.025)	(0.030)
Union	0.019***	0.019***	0.019***	0.018***	0.018***	0.023***	0.013
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)
Private	0.014*	0.014*	0.014*	0.014*	0.014*	0.017*	0.007
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.010)	(0.011)
Indefinite Contract	0.066***	0.066***	0.067***	0.066***	0.066***	0.052***	0.089***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.012)
Work Speed	0.002	0.002	0.002	0.001	0.001	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Quality Standards	0.016***	0.016***	0.016***	0.015***	0.015***	0.012*	0.021**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.009)
Overtime	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.009***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Piece Rates	0.041***	0.042***	0.041***	0.041***	0.041***	0.031***	0.057***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.012)
Group Pay	0.061***	0.061***	0.061***	0.061***	0.061***	0.058***	0.063***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)
Profit Sharing	0.053***	0.053***	0.053***	0.052***	0.052***	0.053***	0.052***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
Shares Pay	0.042***	0.042***	0.042***	0.041***	0.040***	0.041*	0.042**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.021)	(0.019)
Overtime Pay	0.026***	0.025***	0.026***	0.025***	0.026***	0.029***	0.020**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)
Bad Conditions	0.050***	0.051***	0.051***	0.050***	0.050***	0.046***	0.053***
Pay	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)	(0.013)
Sunday Work Pay	0.018***	0.018***	0.018***	0.018***	0.018***	0.031***	0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)
Year 2015	-0.004	-0.002	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)
Obs.	33,914	33,914	33,914	33,914	33,914	18,900	15,014
R-squared	0.783	0.782	0.783	0.783	0.783	0.785	0.784

Notes: All regressions are estimated using OLS, and include dummies for occupation (28), economic activity (88), country (30), country-year interactions and sample weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

This appendix presents the full set of results of the estimation of equation (5), and discusses additional controls for employee, employer and workplace characteristics. Estimated coefficients are coherent with previous literature (see Cotton and Tuttle (1986) for an early review). Wages present an inverted U-shaped relation with both, age and seniority (Hurd 1971), are positively related to living with a partner, having children, educational level, and health status, and negatively related with being a foreign citizen. There is also a gender pay gap. The European Commission reports that females in the EU earned on average 14.1% less per hour than men in 2020 (Eurostat, 2020). Consistent with this gender pay gap, in our sample females earn 10% less than their male counterparts. Those having experienced a salary increase earn more. Employees earn more in large, private companies, when they are represented by a union and when they have indefinite contracts. Those in jobs that require meeting quality standards earn more but those in jobs that require overtime earn less. All incentive payments are positively linked to wages (Cotton and Tuttle, 1986).

Appendix A.3: Determinants of Real Hourly Wages (Logarithm) and Job Satisfaction in the UK

	Dependent variable: Log wage	Dependent variable: Job Satisfaction
Mortality Risk	0.332	-0.160
	(0.241)	(0.425)
Non-fatal Risk	-0.000	0.001
	(0.001)	(0.001)
Risk	0.029	-0.269***
Perception	(0.041)	(0.055)
Risk	-0.024	0.242***
Information	(0.020)	(0.033)
Accidents	-0.002	-0.003
Leave	(0.002)	(0.004)
Bad Conditions	-.018	-.099***
	(.019)	(.030)
Log Real		0.021
Hourly Wage		(0.041)
Obs.	1443	1440
R-squared	0.434	0.294

Notes: Regressions include individual characteristics and human capital variables, workplace and job characteristics (including Hours Worked in the Job Satisfaction regression), dummies for occupation (28), economic activity (88), year (2015), and sample weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Appendix A.4: Determinants of Real Hourly Wages: Two-stage estimations

	Garen's methodology	2SLS
Mortality Risk	-.003	-.005*
	(.003)	(.003)
Non-fatal Risk	-.00007***	-.00006***
	(.00002)	(.00002)
Risk Perception	-.013**	-.013*
	(.006)	(.006)
Risk Information	.013***	.013***
	(.003)	(.003)
Accidents Leave	.0001	.0001
	(.0002)	(.0002)
Bad Conditions	-.019***	-.019***
	(.003)	(.003)
Obs.	33914	33914
R-squared	.783	.783

Notes: Regressions include individual characteristics and human capital variables, workplace and job characteristics, dummies for occupation (28), economic activity (88), country (30), year (2015), country-year interactions and sample weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Appendix A. 5: Determinants of Job Satisfaction.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mortality risk	-0.005**	-0.005**			-0.003	-0.003	-0.002	-0.001
	(0.002)	(0.002)			(0.002)	(0.002)	(0.003)	(0.003)
Non-fatal risk	-0.00002	-0.00001			-0.00002	-0.00001	-0.00002	-0.00002
	(0.00002)	(0.00002)			(0.00002)	(0.00002)	(0.00002)	(0.00002)
Risk perception			-0.257***	-0.256***	-0.257***	-0.256***	-0.241***	-0.241***
			(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Accidents Leave							-0.001*	-0.001**
							(0.0005)	(0.0005)
Risk Info							0.171***	0.169***
							(0.005)	(0.005)
Bad conditions	-0.106***	-0.105***	-0.071***	-0.069***	-0.071***	-0.069***	-0.062***	-0.061***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Log real wage		0.092***		0.089***		0.089***		0.079***
		(0.010)		(0.010)		(0.010)		(0.010)
Hours worked	-.0003***	0.00002	-.0003***	0.00003	-0.0003***	0.00003	-0.0004***	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Female	-0.017*	-0.004	-0.017*	-0.004	-0.017**	-0.004	-0.014*	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)
Age	-0.012***	-0.014***	-0.012***	-0.014***	-0.012***	-0.014***	-0.012***	-0.014***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age2	0.0002***	-.0003***	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(0.00003)	(0.0001)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)
Partner	0.023***	0.020**	0.022***	0.019**	0.022***	0.019**	0.018**	0.016**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Children	0.010**	0.009**	0.011***	0.011***	0.011***	0.011***	0.011***	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
National	0.055***	0.053***	0.053***	0.051***	0.053***	0.051***	0.050***	0.048***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Health	0.217***	0.213***	0.191***	0.188***	0.191***	0.188***	0.172***	0.169***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Seniority	-0.001	-0.001	0.0003	-0.0004	0.0003	-0.0003	-0.0004	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Seniority2	0.00002	0.00002	-0.000008	-0.0000005	-0.000008	-0.0000005	-0.000009	0.00002
	(0.00004)	(0.00004)	(0.00004)	(0.00004)	(0.00004)	(0.00004)	(0.00003)	(0.00003)
Training	0.040***	0.039***	0.043***	0.043***	0.043***	0.043***	0.031***	0.030***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Education:								
Primary	0.091	0.097	0.100	0.105	0.100	0.105	0.062	0.067
	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.068)	(0.068)
Lower sec.	0.054	0.054	0.060	0.060	0.060	0.059	0.014	0.014
	(0.068)	(0.068)	(0.068)	(0.067)	(0.068)	(0.067)	(0.065)	(0.065)
Upper sec.	0.043	0.037	0.050	0.044	0.049	0.043	-0.002	-0.007
	(0.068)	(0.067)	(0.068)	(0.067)	(0.068)	(0.067)	(0.065)	(0.065)
Post-sec.	0.011	0.002	0.021	0.013	0.021	0.013	-0.034	-0.040
	(0.069)	(0.068)	(0.069)	(0.068)	(0.069)	(0.068)	(0.066)	(0.066)
Tertiary	0.020	-0.000	0.030	0.011	0.029	0.010	-0.021	-0.038
	(0.068)	(0.068)	(0.068)	(0.068)	(0.068)	(0.068)	(0.066)	(0.065)
Tertiary +	-0.013	-0.052	-0.015	-0.052	-0.015	-0.053	-0.053	-0.086
	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.075)	(0.075)
Salary	0.090***	0.086***	0.090***	0.086***	0.090***	0.086***	0.081***	0.078***
Increase	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Workplace Size:								
2-9	-0.007	-0.011	-0.009	-0.013	-0.009	-0.013	-0.016	-0.019

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
10-249	-0.063***	-0.071***	-0.062**	-0.070***	-0.062***	-0.070***	-0.069***	-0.077***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
250+	-0.085***	-0.097***	-0.083***	-0.094***	-0.083***	-0.094***	-0.096***	-0.106***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.025)
Union	0.007	0.005	0.012	0.010	0.012	0.010	-0.004	-0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Private	-0.010	-0.011	-0.010	-0.011	-0.010	-0.011	-0.009	-0.010
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Indefinite	0.053***	0.043***	0.056***	0.047***	0.056***	0.047***	0.043***	0.035***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)
Work Speed	0.044***	0.044***	0.038***	0.038***	0.038***	0.038***	0.035***	0.035***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Quality Std	0.044***	0.042***	0.045***	0.044***	0.045***	0.044***	0.028***	0.026***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Overtime	-0.005***	-0.006***	-0.003***	-0.004***	-0.003***	-0.004***	-0.003***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Piece Rates	0.005	0.002	0.004	0.001	0.004	0.001	0.006	0.003
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)
Group Pay	0.037***	0.031***	0.038***	0.032***	0.038***	0.032***	0.032***	0.027***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Profit Sharing	0.069***	0.063***	0.064***	0.059***	0.064***	0.058***	0.056***	0.051***
	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Shares Pay	0.092***	0.088***	0.081***	0.077***	0.081***	0.077***	0.071***	0.067***
	(0.022)	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Overtime Pay	0.042***	0.039***	0.043***	0.040***	0.043***	0.040***	0.041***	0.039***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Bad conditions	0.006	0.002	0.026*	0.022	0.026*	0.022	0.014	0.011
Pay	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Sunday Pay	-0.017*	-0.018*	-0.009	-0.010	-0.009	-0.010	-0.014	-0.015
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Year 2015	0.006	0.006	0.004	0.004	0.004	0.004	0.005	0.005
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)
Obs.	33,827	33,827	33,827	33,827	33,827	33,827	33,827	33,827
R-squared	0.188	0.191	0.208	0.211	0.208	0.211	0.236	0.238

Notes: In columns (1)-(2), and (5)-(8) mortality risk and non-fatal risks are instrumented using the mean fatality and nonfatal injury risk of individuals in the same country, economic activity, and occupation. All regressions include dummies for occupation (28), economic activity (88), country (30), country-year interactions and weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

This appendix presents the full set of results of the estimation of equation (6), and discusses additional controls for employee, employer and workplace characteristics. In accordance with previous studies, JS is U-shaped in age (Clark et al. 1996) and positively related to having a spouse or partner living in the household, having children, being a national of the country, and reporting good health (Clark et al. 1996; Oswald 2002). Training opportunities at the workplace are positively valued by employees. Working at larger companies is negatively correlated with JS. Pay for performance schemes are linked to higher JS (Green et al. 2008), but not overtime pay, which has the opposite effect. Workers value stability at work as captured by having an indefinite contract (De Witte and Naswall 2003), but do not seem to care about being represented by a union.

Appendix A.6: Determinants of Job Satisfaction. Ordered probit estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mortality Risk	-0.005	-0.005			-0.003	-0.002	-0.002	-0.002
	(0.004)	(0.004)			(0.004)	(0.004)	(0.004)	(0.004)
Non-fatal Risk	-0.00002	-0.00002			-0.00003	-0.00002	-0.00003	-0.00003
	(0.00004)	(0.00004)			(0.00004)	(0.00004)	(0.00004)	(0.00004)
Risk Perception			-0.444***	-0.443***	-0.444***	-0.443***	-0.426***	-0.425***
			(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Risk Information							0.318***	0.316***
							(0.010)	(0.010)
Accidents Leave							-0.001*	-0.001*
							(0.001)	(0.001)
Bad Conditions	-.182***	-.123***	-.179***	-.120***	-.123***	-.120***	-.110***	-.107***
	(.010)	(.010)	(.010)	(.010)	(.010)	(.010)	(.010)	(.010)
Log Real Hourly Wage		0.164***		0.162***		0.161***		0.146***
		(0.018)		(0.018)		(0.018)		(0.018)
Cutoff values:								
1	24.999	26.023	17.394	18.055	16.106	17.149	22.024	22.920
	(27.147)	(27.176)	(27.044)	(27.081)	(27.126)	(27.163)	(27.017)	(27.051)
2	26.057	27.084	18.481	19.145	17.192	18.239	23.139	24.037
	(27.147)	(27.176)	(27.044)	(27.081)	(27.126)	(27.163)	(27.017)	(27.051)
3	27.986	29.016	20.439	21.106	19.151	20.200	25.142	26.043
	(27.147)	(27.176)	(27.044)	(27.081)	(27.126)	(27.163)	(27.017)	(27.051)
Obs.	33827	33827	33827	33827	33827	33827	33827	33827
R-squared	0.101	0.102	0.112	0.113	0.112	0.113	0.129	0.130

Notes: Regressions include individual characteristics and human capital variables, workplace and job characteristics (including Hours Worked in the Job Satisfaction regression), dummies for occupation (28), economic activity (88), country (30), year (2015), country-year interactions and sample weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parentheses.
**** p<0.01, ** p<0.05, * p<0.1*

Appendix A.7: Determinants of Job Satisfaction. 2SLS-IV estimations (Logarithm of hourly wage instrumented using Female)

Panel A. First-stage instrument relevance	
Instrument relevance test	*F*-statistic =678.99 ***
Excluded instrument's coefficient	-.139*** (.005)
Panel B. Second-stage estimates	
Mortality Risk	0.0001
	(0.002)
Non-fatal Risk	-0.00002
	(0.000)2
Risk Perception	-0.241***
	(0.009)
Risk Information	0.170***
	(0.006)
Accidents Leave	-0.001*
	(0.000)
Bad Conditions	-.061***
	(.005)
Log Real Hourly Wage	0.099
	(0.060)
Obs.	33,827
R-squared	0.235

Notes: Regressions include individual characteristics and human capital variables, workplace and job characteristics, dummies for occupation (28), economic activity (88), country (30), year (2015), and sample weights. The sample excludes the self-employed and is restricted to those individuals aged between 16 and 65. Robust standard errors are in parenthesis.

**** p<0.01, ** p<0.05, * p<0.1*