Workplace environmental conditions and life satisfaction in Spain

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ABSTRACT

This paper expands the research on subjective well-being and outdoor environmental conditions by considering environmental conditions indoors. Specifically, we examine the impact of self-perceived levels of air and noise pollution at the workplace, on life satisfaction. Moreover, we provide monetary valuation of these environmental conditions by using the life satisfaction approach. Our results demonstrate that poor air quality and high noise levels at the workplace markedly diminish life satisfaction. This holds even after time-invariant and time-varying unobserved heterogeneity is taken into account by using a pseudo-panel and an instrumental variable strategy, respectively.

Keywords: environmental pollution; acoustic comfort; air quality; subjective wellbeing; life satisfaction.

Highlights

Expands research on Subjective Well-Being and environment by considering conditions at workplace

High noise levels and poor air quality at the workplace diminish life satisfaction

This result holds after unobserved heterogeneity is controlled for in different ways

We provide a monetary value of environmental quality by using the Life Satisfaction approach.

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1. Introduction

It is well established that several factors, apart from income, influence subjective well-being (SWB hereafter). These factors include unemployment and inflation (Clark and Oswald, 1994; Di Tella *et al*., 2001; Oswald, 1997), health (Blanchflower and Oswald, 2008), education (Cuñado *et al*., 2012), as well as many other individual variables such as age, sex, marital and occupational status (see Dolan *et al*., 2008, for a survey). In this context, some research has focused on the potential effects of environmental conditions on human well-being, by analysing the relationship between climate and air pollution on SWB (see Welsch 2009 and Welsch and Kühling, 2009, for recent surveys). The consideration of variables reflecting quality of life, such as pollution, complements the connection between income and SWB (Ferrer-i-Carbonell and Gowdy, 2007).

While many studies have focused on the effect of outdoor environmental conditions, there exists little research on how well-being is related to environmental conditions indoors, e.g. at home or at the workplace. This line of research seems to have been restricted so far to studies on the relationship between building characteristics and health or safety of individuals, without taking into consideration more aggregated determinants of well-being. Particularly in developed countries, people spend a large part of their time indoors so that conditions at home and at the workplace are of great importance in determining general well-being and job satisfaction. In their survey on buildings and the environment, Frontczak and Wargocki (2011) conclude that when indoor environmental conditions can be controlled by employees, satisfaction improves. Conditions on thermal, visual and acoustic comfort as well as on air quality are relevant factors in shaping job satisfaction at the workplace and life-satisfaction in general. The only study to consider whether pollution, grime or other environmental problems at home influence life satisfaction - without taking outdoor environmental conditions into account - is that of Ferrer-i-Carbonell and Gowdy (2007). We believe that considering both levels of pollution (outdoors and indoors) is a promising approach. For instance, airport noise may seriously erode well-being of individuals living close to airports even if they are working in a pleasant environment. By contrast, a bar tender may live in a quiet and clean neighbourhood but spend more than a third of their daily life in a noisy workplace, with this having consequences on their assessment of SWB.

The major contribution of our paper is that it combines two strands of research: the one that considers a close association between environmental quality, climate and SWB measures; and the literature relating employees' perceptions of their firm's environment with well-being and job-satisfaction. To our knowledge, this approach has not been addressed empirically so far. The joint consideration of both aspects may provide substantial and robust results for policy-oriented measures, both at the aggregate national level, in the belief that environmental conditions influence present and future SWB (Ferreira *et al*., 2013; Welsch, 2009); and at the firm or workplace level, since an evaluation of working conditions may help in the adequate design of the management of human resources and in stimulating productivity. In this context, it is of great importance to learn more about the determinants of SWB, especially those which are under regulation, since there exist a number of EU Directives, on the one hand, limiting the concentration of different pollutants; and, on the other hand, establishing the minimum requirements in terms of occupational safety and health at the workplace (noise, visibility, etc…).[1]

A final contribution of our paper is that, by following the life satisfaction approach, we are also able to provide a monetary value of environmental quality both at the overall and workplace level. Reported SWB can be considered as the empirical approximation to individual welfare, thus the regression of SWB measures on income, environmental conditions and other characteristics, are the base for valuation of public goods in welfare terms. On its own, the estimated coefficient for the environmental good offers a direct value in terms of SWB. But also, the estimated coefficients for the environmental good and income can be used to calculate the implicit willingness-to-pay; that is, the increase in income that an individual would receive in order to compensate for a given loss in environmental quality (see Frey *et al*., 2010, for a comprehensive review of the life-satisfaction approach). This allows us to compute the relative value between two different characteristics expressed in unit terms. Ferreira and Moro (2010), Welsch (2007, 2009) and Welsch and Kühling's (2009) survey, describe and compare the standard methods for environmental valuation, including the life-satisfaction approach, which has been used in empirical studies aiming to provide monetary value of environmental conditions (Cuñado and Pérez-Gracia, 2013; Levinson, 2012; Luechinger, 2009; Welsch, 2002, 2007).[2]

This paper expands the research on SWB and outdoor environmental conditions by considering environmental conditions indoors. Specifically, we examine the impact of

[1] http://ec.europa.eu/environment/air/quality/legislation/existing_leg.htm and http://ec.europa.eu/environment/noise/home.htm for the former and https://osha.europa.eu/en/legislation/index_html for the latter.
[2] The life satisfaction approach has also been used for monetary valuation of airport noise (van Praag and Baarsma, 2005) and climate change (Rehdanz and Maddison, 2005).

self-perceived levels of air and noise pollution at the workplace, on life satisfaction. To do this, we study the case of Spain, a country with rich datasets on subjective information. We use the Quality of Working Life Survey (*Encuesta de Calidad de Vida en el Trabajo*, ECVT hereafter) which is the most informative dataset related to life and job-satisfaction in Spain. We match diverse measures obtained from national statistics in order to take into account air pollution, climate and other regional variables. Both objective measures of air quality and subjective information of environmental conditions at the workplace are included in this study. Moreover, we address the fact that unobserved characteristics of individuals, such as pessimism or optimism, may affect both variations in life satisfaction and self-perceived levels of air and noise pollution at the workplace. We do this in various ways, first by including individual psychological traits, second by building a pseudo-panel that takes unobserved cohort heterogeneity into account, and third by employing an instrumental variable strategy. Our results demonstrate that high noise levels and poor air quality at the workplace markedly diminish life satisfaction. This holds even after time-invariant unobserved heterogeneity and/or time-varying unobserved heterogeneity are taken into account.

The remainder of the paper is structured as follows. Section 2 briefly surveys previous literature on well-being and environmental conditions. Section 3 describes the data set. Section 4 discusses the empirical model on life satisfaction and outdoor environmental conditions and extends the model further by including an individual's self-perceived valuation of workplace environmental conditions. Section 5 concludes.

2. Literature review

Following Easterlin's (1974) claim that human well-being does not depend exclusively on income has led researchers to consider a wide range of factors that may affect SWB, such a concern for outdoor environmental conditions, a topic which has gained popularity in economic studies in recent years.[3] One of the first studies on the topic, Frijters and van Praag's (1998) analyses the impact of changes in climate variables on the well-being of Russian individuals. However, most of the research has

[3] Recent surveys on the relationship between economic factors and SWB are, Bruni and Porta (2007), Di Tella and McCulloch (2006) Frey and Stutzer (2002) and MacKerron (2012). Some other studies explicitly address the consideration of environmental conditions affecting SWB (Di Tella and MuCulloch, 2008; Ferrer-i-Carbonell, 2013). Surveys that are exclusively devoted to review the literature on the relationship between environmental conditions and SWB are Welsch (2009) and Welsch and Kühling (2009).

been concerned with air quality or pollution.[4] The typical finding is that indicators of air pollution (e.g. PM_{10}, SO_2, and CO_2) are negatively correlated with measures of SWB. At the international, cross-country level some studies such as Welsch (2002, 2003, 2006 and 2007) and Menz and Welsch (2010) use aggregate data from the World Database of Happiness and find a negative relationship between national average happiness and some pollution indicators. Welsch (2002, 2007) uses cross-sectional information for 54 countries, whereas the other studies focus on a more reduced panel of OECD countries. With the same database, Rehdanz and Maddison (2005) explain differences in self-reported levels of happiness using climate variables (temperature and precipitation). They found that higher mean temperatures in the coldest month increase happiness while higher mean temperatures in the hottest month decrease happiness, with precipitation not significantly affecting happiness.[5] Also from an international perspective, but using individual level data, Di Tella and MacCulloch (2008), Luechinger (2010) and Ferreira *et al*., (2013) find that air pollution decreases life satisfaction.

Other papers use more spatially disaggregated pollution data along with individual-based measures of SWB concentrating on just one country or area: Cuñado and Pérez-Gracia (2013) for Spain; Brereton *et al*., (2008) and Ferreira *et al*., (2006) for Ireland; Ferrer-i-Carbonell and Gowdy (2007) for the UK; Levinson (2012) for the US; Luechinger (2009) and Rehdanz and Maddison (2008) for Germany and MacKerron and Mourato (2009) for the London area. The finding is similar to that of the studies that use aggregated data; degradation in air quality is associated with lower SWB. Van Praag and Baarsma (2005) and Rehdanz and Maddison (2008) are the only studies that incorporate another form of pollution, noise pollution, in their analyses. Rehdanz and Maddison (2008) use individual level data from the German socio-economic panel (GSOEP) to study the link between perceived levels of noise and air pollution in an individual's residential area and self-reported happiness. By estimating their model with ordered probit techniques their findings suggest that high noise levels and poor air quality diminish SWB. Additionally, by applying the hedonic model that values environmental conditions, they find that differences in the perceived levels of these environmental conditions are not capitalised into house prices. MacKerron and Mourato

[4] There are also several studies relating SWB with other different factors such as climate or weather (Brereton *et al*., 2008; Rehdanz and Maddison, 2005), noise (van Praag and Baarsma, 2005) and natural hazards (Carroll et al., 2009; Luechinger and Raschky, 2009).

[5] A similar result is obtained in Brereton *et al*., (2008) using data disaggregated at the individual and local levels.

(2009) analysed the connections between self-reported happiness of a non-representative sample of Londoners and environmental conditions using both perceived and measured data on London's air quality, at a very high spatial resolution. Their ordinary least squares (OLS) results suggest that happiness is negatively correlated with both subjective and objective measures of air pollution. Ferrer-i-Carbonell and Gowdy (2007) study the effect of environmental awareness on individual well-being with data from the British Household Panel Survey. Their ordered probit estimates show that environmental concern affects happiness even after controlling for personality traits. Levinson (2012) finds that happiness in the US is related to air quality and weather indicators at the date and place individuals are surveyed. After that, and by using the life satisfaction approach, the author computes respondents' implicit willingness to pay for improved air quality. Luechinger (2009) is probably the most complete study since it combines individual information in panel data form from the GSOEP with matched pollution data, using an instrumental variable approach based on a natural experiment. He finds a negative effect of pollution on well-being that is larger than conventional non-instrumented estimates. Additionally, he applies the life satisfaction approach supplemented by hedonic house price regression techniques to calculate total willingness-to-pay.

Regarding indoor environmental conditions, McCaughey *et al.*, (2014) find that employees' perceptions of workplace environmental conditions have a relationship with individual level outcomes, such as well-being and job performance. Meta-analysis studies confirm that the generalized beliefs about an organization's environment influence and guide subsequent behaviour and specific attitudes such as job satisfaction (Carr *et al.*, 2003; Parker *et al.*, 2003). In their survey of the literature on building and environment, Frontczak and Wargocki (2011) conclude that outdoor climate and season influence comfort at the workplace, and thus are relevant factors affecting job-satisfaction, whereas personal characteristics are of less importance. Gupta and Kristensen (2008) obtain that having a satisfactory job environment is at least as important as income or socio-economic status for health, which is in turn an important determinant of SWB and satisfaction at the workplace.

In the case of Spain, there is only one previous study, Cuñado and Pérez-Gracia, (2013). Their results show a negative correlation between pollution indicators and happiness. Additionally, after controlling for most of the socio-economic variables affecting happiness, there still remain significant regional differences in SWB, with climate and air pollution variables playing a significant role in explaining these regional differences in happiness. By following the life satisfaction approach they also calculate the monetary value of air quality and climate. Our work is different in several aspects. First, our study considers not only global environmental conditions but also environmental conditions at the workplace. Second, we use a different dataset, the ECVT, which is representative at both the national and regional levels and provides a rich amount of objective and self-reported information regarding the workplace. There is another, more important distinction, we take into account observed and unobserved characteristics by adding personality traits, including cohort fixed effects, and providing exogenous variation in noise valuation by means of an instrumental variable approach.

3. Data

Our empirical analysis employs four different data sources. First, the ECVT, an annual periodical household-based survey on individuals, who are selected on a national representative basis from the employed population olden than 16, for the period spanning 2007 to 2010. The survey provides a sample of repeated cross-sections which is representative at the national and regional levels.[6] Its objective is to provide a tool for gathering substantive information concerning employed people's social relations, situations, attitudes, and values at the workplace. It comprises variables about personal and job characteristics, including some workplace environmental conditions such as individual self-perceived valuation of workplace characteristics.[7] Moreover, it provides some self-reported variables that we include in the estimations in order to control for personality traits, reverse causation and unobserved heterogeneity (Brown and Kasser, 2005; Mackerron, 2012). Second, we match this data to temperature and precipitation data from the State Meteorological Agency (AEMET), pollution data from the Spanish Ministry of Agriculture, Food and the Environment (MAFE) and GDP per capita from National Accounting (NA). All variables from these three are disaggregated at a 17-region and year level (NUTS II), except CO_2 emissions, which are defined at the industry-year level.

We select a subsample from the ECVT corresponding to employees in the private sector, and containing 19,105 observations. Table 1 presents the variables' definitions and means. Whereas most of the definitions are self-contained, some variables referring to subjective information are worth explaining. In many studies, individuals are asked to

[6] They are repeated cross-sections and do not adopt the form of panel data.
[7] The use of subjective information has been previously applied in research on the topic, e.g. Ferrer-i-Carbonell and Gowdy (2007); MacKerron and Mourato (2009); Rehdanz and Maddison (2008).

report how happy they feel. In the survey that we employ, as well as in other data sets, individuals are asked about their satisfaction with life. Whereas the former term refers to the individual's current situation, and is supposed to capture "affect"; the latter, refers to the individual's perception of how their life has been so far, showing a more evaluative character (Frey *et al*., 2010). Both terms are often used interchangeably in the economics literature, encompassed in the more general term of SWB. This is commonly considered as the empirical proxy of what Kahneman *et al*., (1997) called "experienced utility", as opposed to decision utility.[8]

According to Ferrer-i-Carbonell and Frijters (2004) three main general assumptions are often made when interpreting the answers to life-satisfaction questions. The most general is that reported life-satisfaction corresponds to a general concept of welfare. A second more restrictive assumption is that of interpersonal ordinal comparability, which implies that there is a common wisdom across individuals about what happiness is.[9] A third assumption, and further more restrictive, is that of cardinality.[10] Therefore, when studying the relationship between happiness and environmental quality, the former three factors must be considered (Ferrer-i-Carbonell, 2013): the availability of information on individual characteristics; the assumption (or not) of interpersonal cardinal comparability; and the availability of disaggregated information on the distribution of environmental quality indicators across the area under analysis. Ferrer-i-Carbonell and Frijters (2004) find that in the studies on happiness, the assumption of cardinality or ordinality does not qualitatively change the results, but the treatment of unobserved individual heterogeneity does. They conclude that it is important "to take individual fixed effects into account or to include time-invariant personality traits as regressors". The former has been shown to "have a large influence on life-satisfaction".[11] Tackling all these problems at a time is quite complicated due to the unavailability of data allowing for their simultaneous consideration (see Ferreira *et al*., 2013). Recent studies have progressively tried to address all these issues as long as the availability of richer databases has made it possible.

So far, we have been referring to SWB in the general description of the topic and in the review of the literature, since measures of both happiness and life-satisfaction have

[8] For more detailed explanations on these concepts, see Diener *et al*., (1999); Frey *et al*., (2010); Kahneman *et al*., (1999); Kahneman and Krueger (2006); and MacKerron (2012).

[9] This is a quite common assumption among economists. For some evidence on this, see Diener *et al*., (1999); Frey and Stutzer (2002); Frey *et al*., (2010); Kahneman (2000).

[10] This is not generally an assumption made by economists. Ng (1997) is an exception.

[11] Personality traits may capture between 50% and 80% of total variability in life-satisfaction (Diener *et al*., 1999; Lykken and Tegellen, 1996; Tegellen *et al*., 1988).

been employed in the different studies. From now on, we use the term life-satisfaction since this notion is more suitable to adequately answer the questions in the dataset we employ: *Please, rate between 0 (not satisfied at all), and 10 (very satisfied), your degree of satisfaction with your personal life*. The rest of the self-reported variables used in our work are also rated from 0 to 10 (see Table 1). Specifically, our variables of interest indicate each worker's self-evaluation regarding air quality and acoustic comfort at the workplace, ranging from 0 (*very bad*) to 10 (*excellent*). Given the information provided in the AEMET, and in order to disaggregate the information geographically as much as possible, we construct indicators of concentration of PM_{10}[12] by region, year and type of residence: urban, suburban or rural.[13] In the case of CO_2, the measure is computed for each year in per capita equivalent terms for each activity.[14]

4. Empirical model

We follow the standard approach of regressing SWB on different personal and job characteristics at the individual level as well as relevant factors at the regional level. To do this, we estimate the equation below which combines individual- and regional-level information:

$$LS_{ijt} = \alpha + \lambda_t + \tau_j + \beta X_{ijt} + \gamma Z_{jt} + \delta W_{ijt} + \varepsilon_{ijt} \qquad (1)$$

where the self-reported life satisfaction, *LS*, of individual *i*, in region *j*, in year *t* depends on the year dummies (λ_t), region dummies (τ_j), a vector of individual socio-demographic and economic characteristics (X_{ijt}) and the characteristics of the region where the individual resides, which include annual indicators of pollution, climate, and GDP (Z_{jt}).[15] One of our main interests is the set of subjective variables that includes self-evaluation of different conditions at the workplace as well as attitudes toward diverse aspects of the job (W_{ijt}). More specifically, we are most interested in those capturing job environmental conditions, such as air circulation and noise nuisance.

[12] PM_{10} are those particles with an aerodynamic diameter smaller than 10mm. For more information see Cuñado and Pérez-Gracia (2013).
[13] An alternative applied elsewhere (Luechinger, 2009, MacKerron and Mourato, 2009) is interpolating data captured from different stations through GIS techniques. However, as highlighted by Redhanz and Maddison (2008), interpolating may create errors of its own. In the case of Spain, Cuñado and Pérez-Gracia (2013) take averaged regional values from different regional stations. They claim that their constructed values correlate close to 1 with series constructed using GIS techniques.
[14] It divides emissions in tons of CO_2 per the number of workers in each of the 30 sectors of the Spanish National Activities Classification.
[15] In a first stage, we also consider other economic indicators at the regional level, such as the unemployment rate, but it is often correlated with GDP per capita. Note that the CO_2 indicator is included in the set of variables Z, but it is not computed regionally, but at the industry level.

Using self-reported measures of workplace environmental quality makes possible that these reported individuals' attitudes are affected by individuals' psychological characteristics, rather than reflecting objective environmental characteristics (Ferrer-i-Carbonell and Gowdy, 2007; MacKerron, 2012). That is, we are concerned about whether pollution generates a reduction in SWB or whether the less happy individuals become especially concerned and affected by pollution. Additionally, it is likely that some variables such as optimism, pessimism or both affect both pollution valuation and SWB. Since our data are repeated cross-sections, we cannot control for individual heterogeneity through panel data estimation. Following Ferrer-i-Carbonell and Gowdy (2007), we include as additional regressors a battery of self-perceived variables evaluating different workplace conditions and diverse attitudes towards the job. A first subset of variables expresses the evaluation that the employee makes of certain characteristics to refer to his/her job, such as the degree of risk, monotony, stress or effort exerted. These variables are directly related to life- and job-satisfaction but may also capture attitudes toward work and life in general. For example, lazy individuals may find their jobs more demanding than active individuals. Similarly, those more risk-averse, more bored or stress-prone individuals may feel that their jobs are riskier, more monotonous or more stressful than objective conditions may indicate. Additionally, we use measures of the willingness of working as a self-employed and in the public sector as indicators of individuals' involvement in their job, given that in our data we only consider wage-earners in the private sector. Since we control for these variables that aim to capture some personality traits, we are confident that the individual assessment of workplace environmental quality is not totally determined by individual traits.[16]

Eq. (1) can be estimated by OLS or, given the ordinal nature of the dependent variable, life satisfaction, by using either ordered probit or ordered logit models. Tables 2 and 3 show OLS and ordered probit results, respectively. As it is usual in the empirical literature, we find little qualitative difference between the results of both approaches (see e.g., Ferrer-i-Carbonell and Frijters, 2004). In all the regressions, standard errors are clustered at the regional level to account for biases arising from different individuals living in the same region (Moulton, 1990). Results are discussed in Section 5 below. In our dataset, there is no information reported by individuals about their health status. This variable is customarily found to be much correlated with life satisfaction and happiness. Notwithstanding that, previous studies have shown that

[16] An alternative approach has been used in Redhanz and Maddison (2008) by comparing individuals' statements in different locations.

when comparing estimates both including and excluding health variables, the estimated values for the rest of the covariates remain more or less unchanged, even if the health variables are statistically significant in determining happiness or life satisfaction (Levinson 2012; Ferreira *et al*., 2013). This makes us feel confident about the reliability of our estimates, which very likely do not suffer from omitted variable bias.

A final exercise in the paper is the monetary valuation of non-market goods: pollution variables and environmental conditions at the workplace, as well as the direct comparison between both magnitudes. To this end, we rewrite eq. (1) as

$$LS_{ijt} = \alpha + \lambda_t + \tau_j + \beta_0 \tilde{\tilde{X}}_{ijt} + \beta_1 \ln Y_{ijt} + \gamma_0 \tilde{\tilde{Z}}_{jt} + \gamma_1 PM_{10} + \gamma_2 CO_2 + \delta_0 \tilde{\tilde{W}}_{ijt} + \delta_1 AIRCIR_{ijt} + \delta_2 NOISE_{ijt} + \varepsilon_{ijt} \quad (2)$$

where Y is the income indicator, and environmental variables, both at the aggregate and at the workplace levels, are put aside from $\tilde{\tilde{X}}$, $\tilde{\tilde{Z}}$, $\tilde{\tilde{W}}$, respectively. We can derive the average marginal rate of substitution (MRS) between income and general air quality or between income and environmental conditions at the workplace as:

$$MRS_{\Pi}^{Y} = -\frac{\partial LF / \partial \Pi}{\partial LF / \partial Y} = -\frac{\gamma_k}{\beta_1} Y \qquad MRS_{\Sigma.}^{Y} = \frac{\partial LF / \partial \Sigma}{\partial LF / \partial Y} = \frac{\delta_h}{\beta_1} Y \qquad (3)$$

where Π = PM_{10}, CO_2 and k = 1, 2; Σ = AIRCIR, NOISE and h = 1, 2

Although our previous estimation indicates that the individual assessment of workplace environmental quality is not totally determined by psychological traits, an endogeneity problem due to reverse causation or omitted variables may be likely to remain and lead to biased estimates. Moreover, selection into jobs is likely to be non-random. Thus, happier individuals may be more likely to get better jobs and these are likely to have better environmental conditions. In addition to including individual personality traits as Ferrer-i-Carbonell and Gowdy (2007), we would like to explore the potential biases that may remain. Therefore, we deal with time invariant unobserved heterogeneity by constructing a pseudo-panel and with time varying unobserved heterogeneity, by pursing an instrumental variable strategy, which are discussed in turn.

For the pseudo-panel, we divide the sample in homogeneous groups (cohorts). For our first cohort definition we take a five year bracket of year of birth where the last group includes those aged 65 and above in the first period. Our second cohort definition is formed by age cohort, gender, education level and civil status. We construct sample means of the cohorts for each definition in order to form a panel structure of the data

(Deaton, 1985; Blundell *et al.,* 1994). These sample means act as proxies of the population means if the sample size is large enough.

$$LS_{cjt} = \alpha + \lambda_t + \tau_j + \beta_0 \bar{X}_{cjt} + \beta_1 \ln \bar{Y}_{cjt} + \gamma_0 \bar{Z}_{cjt} + \gamma_1 \bar{PM}10 + \gamma_2 \bar{CO}2 + \delta_0 \bar{W}_{cjt} + \delta_1 \bar{AIRCIR}_{cjt} + \delta_2 \bar{NOISE}_{cjt} + \bar{\varepsilon}_{cjt} \quad (4)$$

In the IV strategy, we use a noise prevention reform as a source of exogenous variation in noise valuation. That is, we use as exclusion restriction in the second-stage the effect of a noise prevention reform for treated workers. The standard identifying assumption is that the chosen instrumental variable is both relevant and validly excluded. The relevance condition requires that there is a correlation between this reform for the treatment group and noise valuation $E[DD, NOISE] \neq 0$. With respect to the validity condition, our assumption is that our instrument affects life satisfaction only through its effect on noise valuation but not directly $E[DD, \varepsilon] = 0$.

We present OLS, and IV estimates of the effect of noise valuation on worker's life satisfaction based on the following specification:

$$LS_{ijt} = \alpha + \lambda_t + \tau_j + \beta_0 X_{ijt} + \beta_1 \ln Y_{ijt} + \gamma_0 Z_{jt} + \gamma_1 PM_{10} + \gamma_2 CO_2 + \delta_0 W_{ijt} + \delta_2 NOISE_{ijt} + \nu_{1ijt} \quad (5)$$

$$NOISE_{ijt} = \pi_0 + \phi_t + \varphi_j + \pi_1 DD + \pi_2 X_{ijt} + \pi_3 \ln Y_{ijt} + \pi_4 Z_{jt} + \pi_5 PM_{10} + \pi_6 CO_2 + \pi_7 W_{ijt} + \nu_{2ijt} \quad (6)$$

where the parameter δ_2 in equation (5) provides the effect of noise self-evaluation $NOISE_{ijt}$ on life satisfaction LS_{ijt}. $NOISE_{ijt}$ is an ordinal categorical variable, which takes values from 0 if the individual considers that acoustic conditions at the workplace are very bad, up to 10 if the individual's perception of acoustic comfort is excellent.

Equation (6) provides the relationship between our noise valuation variable and the noise prevention law that was passed in one Spanish region, Castilla-Leon, in 2009.[17] DD is a dummy variable that takes the value of unity for the treatment group after the reform was implemented and zero before implementation. The treatment group for the 2009 reform corresponds to workers in Castilla-Leon and the control group is comprised of workers in the rest of the Spanish regions. As a result, the coefficient π_1 is interpreted as the increase in the number of noise valuation units attributable to the legal change in Castilla-Leon versus that of workers in the rest of the regions.

[17] http://noticias.juridicas.com/base_datos/CCAA/cl-15-2009.html. Law on Noise, 5/2009 Castilla-Leon, 4th of June 2009.

5. Results

First, we compare the ordered probit and OLS results and second we focus on the OLS results, as their interpretation is more straightforward. We then carry out additional exercises to gain robustness in assessing the relevance of the environmental conditions. Table 2 shows the marginal effects for the highest levels of life satisfaction reported (9 and 10) and obtained from an ordered-probit estimation. We consider three different specifications. The first one includes all the regressors but the two variables capturing workplace environmental conditions. The second specification adds the variable of self-perceived air quality at the workplace, with the third specification adding instead the variable of self-perceived noise at the workplace. Table 3 follows the same structure, but with OLS estimates.

The first important result is that workplace environmental variables are found to be statistically significant. Their inclusion improves, albeit only slightly, the goodness of fit of the model, with the rest of the coefficients remaining unchanged when these variables are added. By comparing Tables 2 and 3, it can be seen that results are qualitatively similar; this is generally found in the literature (Ferrer-i-Carbonell and Frijters, 2004). As a consequence, in what follows, we refer to the OLS results which, if the assumption of cardinality holds, are more straightforward to interpret.

Estimated results follow the same pattern observed in the empirical literature. That is, men are found to be more satisfied with their life than women, but the difference is not statistically significant. Age variables present the typical U shape, indicating that, in the early years, satisfaction declines and then it increases (after 50 years old). Native workers are more satisfied than foreign workers. Post-compulsory education is associated with higher job satisfaction, even though higher education does not significantly improve satisfaction relative to those with non-compulsory secondary education. The family structure and the need to balance family and work responsibilities are found to be relevant elements in shaping life satisfaction. Thus, being married is associated with higher satisfaction, but a bigger family size, taking care of dependents or the existence of only one income earner in the household, all lead to lower life satisfaction.

Regarding the work-related variables, it must be noted that most of the results are as expected. We introduce the number of weekly hours worked by introducing different dummy variables. Taking the typical 35-40 hours per week as reference, working fewer hours is associated with higher job satisfaction, whereas working more than 45 hours results in lower satisfaction. Higher income is positively associated with greater life satisfaction. Labour stability and tenure both lead to increases in life satisfaction. A first job has an inverse significant relationship with job satisfaction, as does over-education, that also strongly reduces the level of job satisfaction. Having a stressful, monotonous or high-risk job, or one that requires physical effort or a night-shift reduces life satisfaction. A non-split workday has no significant relationship with job satisfaction. Firm size associated with the highest level of job satisfaction corresponds to that of 51-250 workers. Being willing to work in the public sector or be self-employed reduces job satisfaction. In sum, we find that life satisfaction increases with some personal and job characteristics, the most relevant being: married, in a higher income level, working in a job matching the educational level attained, working in less stressful and less monotonous jobs, and holding a permanent contract. GDP and the climate variables are not statistically significant. Regarding the environmental variables, PM_{10} is significant at the 10% level and CO_2 is significant in the second estimation only. In Table 2, the latter variables are significant in all estimations. The observed negative effects confirm the evidence found everywhere. Thus, results on PM_{10} concentration are in line with those by Cuñado and Perez-Gracia (2013) and Levinson (2012).

Focusing now on variables capturing workplace environmental conditions, estimated coefficients are positive and significant, showing that a higher score on conditions at the workplace in air ventilation or noise, are conducive to higher life satisfaction. These results are as expected in the light of previous studies (Wargocki *et al*., 2012). The inclusion of these two variables barely affects the other covariates' estimated coefficients, especially those of indicators of air pollution. These results confirm that including indicators of environmental conditions at the workplace is very useful in order to obtain a better understanding of the determinants affecting satisfaction. If high life satisfaction spurs effort and productivity, and reduces absenteeism, personnel policies favouring better conditions in the workplace may result in clear improvements in job performance and eventually higher profits.

An additional contribution of our paper is the valuation of both regional and workplace environmental variables estimating the willingness-to-pay (WTP) for a specific attribute, under the assumption that reported life satisfaction can serve as a measure of an individual's utility (Kahneman *et al*., 1997). In this framework, marginal WTP for the environmental attributes can be computed as the marginal rate of substitution between income and the environmental attribute - see equation (3). To compute the monetary valuation of the WTP for an improvement in environmental conditions, we need to express the income variable in a continuous form. Therefore, we take the log of the mean value in each income interval. Results are shown in Table 4, where only the estimated coefficients for the income variable and the environmental conditions are included to save space. The income variable follows the pattern of previous estimates, it is positively associated with life satisfaction. The estimated coefficients of the rest of the covariates remain more or less unchanged (results for non-environmental variables are available upon request). It suggests that defining income in a different way hardly affects the other variables' estimated coefficients.

The bottom part of Table 4 shows the WTP for each of the environmental attributes. An individual is willing to pay, on average, between 38 and 44 € per year in order to reduce by one the number of days with an excess of PM_{10}.[18] An individual is willing to pay, on average, about 200 € per year to reduce CO_2 concentration by one ton per worker. Regarding the environmental attributes at the workplace, the marginal rate of substitution measures the willingness to pay for an increase in one level at the life satisfaction scale. Thus, an employee is willing to pay on average 3,020 € per year for a one-point improvement in air quality at the workplace, and 1,415 € per year in the case of the noise scale valuation. Standard errors of the WTP are calculated using the delta method. Although outdoor and indoor values are not directly comparable, since they are measured in different units, it seems that employees are less reluctant to pay for improving conditions at the workplace.

Table 5 presents pseudo-panel estimates of the effect of outdoor and indoor environmental conditions on life satisfaction. Point estimates are very similar to those obtained using individual data. Most importantly, when we take into account time invariant unobserved heterogeneity using cohort fixed effects estimations, there is still a negative and significant effect of CO_2 on life satisfaction. However, we can also observe that a better perception of air ventilation and noise conditions at the workplace increases satisfaction.

Table 6 corresponds to our IV estimation. The first stage results indicate that workers in Castilla-Leon improved their perception of noise conditions at the workplace by 5.9 points in the scale versus that of workers in the rest of the Spanish regions, due to the noise reform that the government of Castilla-Leon passed in 2009. The effect of which is used to provide exogenous variation in self-perceived noise conditions at the

[18] Using the same approach for Spain, Cuñado and Pérez-Gracia (2013) obtain a value of 325€ per year. A closer result to ours appears in Levinson (2012). He obtains a valuation between 63 and 122$ when reducing one day the level of PM_{10} in 50 $\mu g/m^3$.

workplace in order to be able to identify the effect of subjective noise conditions at the workplace on life satisfaction. The IV estimate is 0.0190 (SE 0.0066) which is smaller than the OLS estimated regression coefficient of 0.0364 (SE 0.0051). This indicates that some of the bias, caused by optimism/pessimism or time varying variables affecting both life satisfaction and self-perceived noise conditions at the workplace, is reduced.

6. Conclusions

There is ample literature which shows that SWB does not depend exclusively on income but on a wide range of factors. Among these factors, the concern about outdoor environmental conditions has progressively augmented over the last years although there is still a lack of evidence on how well-being is related to environmental conditions indoors. This paper expands the research on SWB and outdoor environmental conditions by considering environmental conditions indoors. Specifically, we examine the impact of self-perceived levels of air and noise pollution in the workplace, on life satisfaction. Our results demonstrate that poor air quality and high noise levels at the workplace markedly diminish life satisfaction, with variables capturing environmental pollution outdoors also showing a negative relationship with life satisfaction. This confirms the need to include indicators of environmental conditions both outdoors and indoors in order to get a more realistic view about how well-being is associated with life quality.

These results hold even after time invariant and time varying unobserved heterogeneity is taken into account by using a pseudo-panel and an instrumental variable strategy, respectively. Our IV estimates are smaller than our OLS results. When estimating the effect of an individual’s noise valuation at the workplace, on life satisfaction, some of the bias, caused by omitted variables, is reduced when we use a noise prevention law to generate exogenous variation in noise pollution.

Additionally, we provide monetary valuation of environmental conditions outdoors and indoors by using the life satisfaction approach. Similar to studies in other countries, an individual is willing to pay about 40€ and 200€ per year in order to reduce, by one, the number of days with an excess of PM_{10} and CO_2 concentration by one ton per worker, respectively. The WTP for a one-point improvement in the air quality and in acoustic comfort at the workplace is much more elevated, around 3,000€ and 1,400€ per year, respectively. Since outdoor environmental conditions are measured using objective indicators, and indoor environmental conditions are expressed in subjective terms, we cannot make direct comparisons about the large differences observed in both types of valuation. The main conclusion drawn is that individuals would be better-off if environmental conditions were improved.

Even if both types of pollution (outdoors and indoors) do have an impact on individual wellbeing, the implications of these valuations for future policy applications may be very different. Although reducing pollution would result in an increase in SWB of individuals, it may also generate additional costs to firms, if satisfying regulatory norms and legislation on the matter implies efficiency losses. Whereas in the case of outdoor pollution, these additional costs borne by firms are understood as a way of internalizing negative externalities; in the case of indoor pollution, the possible increase in firm costs due to the improvement in workplace environmental conditions may be counterbalanced by higher profits through workers' higher productivity as a consequence of greater effort, lower absenteeism and turnover, and absence of conflict with unions. From the point of view of a cost-benefit analysis, it may be the case that improving working conditions is a rational decision for firms in order to be more efficient, even if laws are not so restrictive.

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Table 1. Variable definitions and mean values

Variable	Source	Definition	Mean
Life satisfaction	ECVT	Satisfaction with personal life (0: not satisfied, 10: very satisfied)	7.44
Personal characteristics			
Gender	ECVT	1: Male, 0: Female	0.54
Age	ECVT	Age in years	40.14
$Age^2/100$	ECVT	Age squared divided by 100	17.25
Nationality	ECVT	1: Spanish, 0: foreign	0.87
Education 1	ECVT	Compulsory education	0.39
Education 2	ECVT	Post-compulsory secondary education	0.38
Education 3	ECVT	Higher Education	0.23
Married	ECVT	1: Married, 0: Otherwise	0.64
Family size	ECVT	Number of family members	3.07
Care	ECVT	1: Taking care of children or elderly people; 0: Otherwise	0.06
Single-earner	ECVT	1: He/she is the only income earner in the family; 0: Otherwise	0.44
Job characteristics			
Hours ≤ 25	ECVT	Up to 25 hours worked per week	0.10
Hours 26-35	ECVT	Between 26 and 35 hours worked per week	0.10
Hours 36-40	ECVT	Between 36 and 40 hours worked per week	0.56
Hours 41-45	ECVT	Between 41 and 45 hours worked per week	0.10
Hours >45	ECVT	More than 45 hours worked per week	0.14
Income1	ECVT	Up to 600 euro per month (net)	0.08
Income2	ECVT	Between 600 and 1,000 euro per month (net)	0.26
Income3	ECVT	Between 1,001 and 1,200 euro per month (net)	0.23
Income4	ECVT	Between 1,201 and 1,600 euro per month (net)	0.22
Income5	ECVT	Between 1,601 and 2,100 euro per month (net)	0.12
Income6	ECVT	More than 2,100 euro per month (net)	0.09
Permanent	ECVT	Permanent contract: 1, fixed-term contract: 0	0.80
Tenure <1	ECVT	Tenure less than 1 year	0.13
Tenure 1-5	ECVT	Tenure between 1 and 5 years	0.37
Tenure 6-10	ECVT	Tenure between 6 and 10 years	0.19
Tenure 10	ECVT	Tenure longer than10 years	0.31
First job	ECVT	1: This is the first job	0.22
Overeducation	ECVT	1: higher-than-required qualification	0.20
Workday	ECVT	Non-split Workday: 1; split workday: 0	0.53
Stress	ECVT	Self-evaluation of the degree of stress in job (0-10)	5.66
Monotonous	ECVT	Self-evaluation of the degree of monotony/routine in job (0-10)	5.05
Risk	ECVT	Self-evaluation of the degree of risk in job (0-10). Recoded to 0 (low) if <5; 1 (high) if >4	0.36
Effort	ECVT	Self-evaluation of the degree of physical effort in job (0-10).	4.30
Night shift	ECVT	Work more than three hours, or at least one third of the year workload is between 10 pm and 6 am	0.14
Firm_size 1	ECVT	Firm size lower than 10 employees	0.27
Firm_size 2	ECVT	Firm size between 11 and 50 employees	0.23
Firm_size 3	ECVT	Firm size between 51 and 250 employees	0.17
Firm_size 4	ECVT	Firm size higher than 250 employees	0.33
Willingness self-employed	ECVT	If I could choose, I would prefer to work as self-employed	0.23
Willingness public sector	ECVT	If I could choose, I would prefer to work in the public sector	0.52
Regional			
GDP	NA	Gross Domestic Product per capita, by region and year (in euros)	24485.22
January min temp.	AEMET	Mean of daily min. temperature in January (ºC) by region and year	-2.03
July max temperature	AEMET	Mean of daily max. temperature in July (ºC) by region and year	35.72
Mean annual precipitation	AEMET	Annual mean precipitation (mm)	588.42
Pollution			
CO_2	MMA	CO_2 emissions in tons per industry, worker and year	2.77
PM_{10}	MMA	Number of days per year that average daily PM_{10} concentration	22.47

		exceeds 50 $\mu g/m^3$, per region, residence area and year.	
Environmental Job Conditions			
Air quality (AIRCIR)	ECVT	Self-evaluation of air quality at job (0 vary bad-10 excellent).	7.18
Noise valuation (NOISE)	ECVT	Self-evaluation of acoustic comfort at job (0 vary bad-10 excellent).	6.24

ECVT stands for Quality of Working Life Survey (http://www.empleo.gob.es/estadisticas/ecvt/welcome.htm); AEMET stands for Spanish National Meteorological Agency (http://www.aemet.es/es/portada) and MAFE stands for the Spanish Ministry of Agriculture, Food and Environment (http://www.magrama.gob.es). Regions are defined at the NUTS2 level (17 regions). Residence area is defined at rural, suburban and urban levels.

Table 2. Effect of outdoor and indoor environmental conditions on life satisfaction (Ordered probit). Probability of reporting a satisfaction level of 9 or 10

	With pollution variables		With pollution variables and air quality		With pollution variables and noise	
	(1)		(2)		(3)	
	Coef	Marginal effect	Coef	Marginal effect	Coef	Marginal effect
Gender	0.0233	0.0243	0.0197	0.0242	0.0266	0.0242
	(0.0183)		(0.0183)		(0.0183)	
Age	-0.0507***	-0.016	-0.0507***	-0.0158	-0.0507***	-0.0159
	(0.0052)		(0.0052)		(0.0052)	
$Age^2/100$	0.0495***		0.0487***		0.0494***	
	(0.0061)		(0.0061)		(0.0061)	
Nationality	0.2385***	0.0128	0.2574***	0.0129	0.2438***	0.0126
	(0.0281)		(0.0281)		(0.0281)	
Post-compulsory secondary	0.0384**	0.0223	0.0476***	0.022	0.0341*	0.0222
	(0.0184)		(0.0184)		(0.0184)	
Higher education	0.0198***	0.0334	0.0370	0.0334	0.0126	0.0333
	(0.0251)		(0.0251)		(0.0251)	
Married	0.3591***	0.0969	0.3670***	0.097	0.3604***	0.0968
	(0.0183)		(0.0183)		(0.0183)	
Family size	-0.0273***	0.007	-0.0288***	0.007	-0.0281***	0.0069
	(0.0071)		(0.0071)		(0.0071)	
Care	-0.1064***	-0.0472	-0.1056***	-0.0473	-0.1061***	-0.0474
	(0.0326)		(0.0326)		(0.0326)	
Single-earner	-0.1120***	-0.0454	-0.1133***	-0.0452	-0.1141***	-0.0453
	(0.0165)		(0.0165)		(0.0165)	
Hours ≤ 25	0.1070***	-0.0113	0.0984***	-0.0118	0.1063***	-0.0113
	(0.0351)		(0.0351)		(0.0351)	
Hours 26-35	0.0698**	0.0131	0.0684**	0.0133	0.0695**	0.0132
	(0.0281)		(0.0281)		(0.0281)	
Hours 41-45	0.0190	0.0115	0.0171	0.0114	0.0171	0.0114
	(0.0252)		(0.0252)		(0.0252)	
Hours > 45	-0.1202***	-0.0435	-0.1201***	-0.0434	-0.1210***	-0.0433
	(0.0224)		(0.0224)		(0.0224)	
Income 600-1,000 €/month	0.1341***	0.0128	0.1285***	0.0131	0.1319***	0.0129
	(0.0375)		(0.0375)		(0.0375)	
Income 1,001-1,200 €/month	0.1911***	0.0321	0.1815***	0.0322	0.1914***	0.0321
	(0.0403)		(0.0403)		(0.0403)	
Income 1,201-1,600 €/month	0.2870***	0.0707	0.2738***	0.0708	0.2864***	0.0708
	(0.0418)		(0.0418)		(0.0418)	
Income 1,601-2,100 €/month	0.3164***	0.0882	0.3024***	0.0885	0.3143***	0.0882
	(0.0465)		(0.0465)		(0.0465)	
Income > 2,100 €/month	0.3911***	0.1156	0.3710***	0.1158	0.3826***	0.1156
	(0.0511)		(0.0511)		(0.0511)	
Permanent	0.1134***	0.0543	0.1176***	0.0544	0.1137***	0.0541
	(0.0218)		(0.0218)		(0.0218)	
Tenure 1-5	0.0304	0.0186	0.0386	0.0187	0.0312	0.0186
	(0.0258)		(0.0258)		(0.0258)	
Tenure 6-10	0.0406	0.0353	0.0551*	0.0352	0.0439	0.0352
	(0.0306)		(0.0306)		(0.0306)	
Tenure 10	0.0541*	0.0444	0.0752**	0.0444	0.0570*	0.0443
	(0.0315)		(0.0315)		(0.0315)	
First job	-0.0391**	0.0005	-0.0391**	0.0004	-0.0379**	0.0004
	(0.0193)		(0.0193)		0.0193 ()	
Overeducation	-0.1466***	-0.0732	-0.1284***	-0.0729	-0.1387***	-0.0731
	(0.0206)		(0.0206)		(0.0206)	
Workday	0.0153	-0.0097	0.0227	-0.0098	0.0151	-0.0097
	(0.0163)		(0.0163)		(0.0163)	
Stress	-0.0323***	-0.054	-0.0295***	-0.0536	-0.0319***	-0.0537

	(0.0027)		(0.0027)		(0.0027)	
Monotony	-0.0240***	-0.0687	-0.0205***	-0.0677	-0.0235***	-0.0684
	(0.0026)		(0.0026)		(0.0026)	
Risk	-0.0419**	-0.0311	-0.0369**	-0.031	-0.0354**	-0.0312
	(0.0168)		(0.0169)		(0.0169)	
Effort	-0.0045*	-0.0501	-0.0055**	-0.05	-0.0041	-0.05
	(0.0027)		(0.0027)		(0.0027)	
Night shift	-0.0534**	-0.0307	-0.0485**	-0.031	-0.0440*	-0.031
	(0.0231)		(0.0231)		(0.0231)	
Firm size 11-50 workers	0.0333*	0.0153	0.0389**	0.0153	0.0375**	0.0152
	(0.0178)		(0.0178)		(0.0178)	
Firm size 51-250 workers	0.0428*	0.0276	0.0615***	0.0276	0.0536**	0.0275
	(0.0228)		(0.0229)		(0.0229)	
Firm size > 250 workers	0.0177	0.0251	0.0468*	0.0252	0.0265	0.0249
	(0.0276)		(0.0277)		(0.0276)	
Willingness self-employed	-0.0686***	-0.0333	-0.0661***	-0.0331	-0.0691***	-0.0333
	(0.0180)		(0.0180)		(0.0180)	
Willingness public sector	-0.0794***	-0.0335	-0.0749***	-0.0333	-0.0763***	-0.0334
	(0.0154)		(0.0154)		(0.0154)	
GDP	0.0000	-0.0115	0.0000	-0.0115	0.0000	-0.0116
	(0.0000)		(0.0000)		(0.0000)	
January min temp	-0.0068	0.0072	-0.0067	0.0069	-0.0073	0.0072
	(0.0066)		(0.0066)		(0.0066)	
July max temperature	-0.0034	-0.0196	-0.0032	-0.0196	-0.0027	-0.0194
	(0.0061)		(0.0061)		(0.0061)	
Mean annual precipitation	-0.0001	-0.0006	-0.0001	-0.0008	-0.0001	-0.0006
	(0.0001)		(0.0001)		(0.0001)	
CO_2	-0.0022*	-0.0199	-0.0031**	-0.0207	-0.0025*	-0.0193
	(0.0013)		(0.0013)		(0.0013)	
PM_{10}	-0.0005	-0.0081	-0.0005*	-0.0082	-0.0005*	-0.007
	(0.0003)		(0.0003)		(0.0003)	
Air quality (AIRCIR)			0.0437***	0.081		0.0424
			(0.0028)			
Noise valuation (NOISE)					0.0213***	
					(0.0024)	
Year dummies	Yes		Yes		Yes	
Region dummies	Yes		Yes		Yes	
/cut1	-3.1777***		-2.8928***		-3.0249***	
	(0.8205)		(0.8210)		(0.8208)	
/cut2	-3.0495***		-2.7637***		-2.8963***	
	(0.8204)		(0.8209)		(0.8207)	
/cut3	-2.8099***		-2.5225***		-2.6560***	
	(0.8203)		(0.8208)		(0.8206)	
/cut4	-2.5937***		-2.3045***		-2.4392***	
	(0.8203)		(0.8208)		(0.8205)	
/cut5	-2.3143***		-2.0230**		-2.1592***	
	(0.8202)		(0.8207)		(0.8205)	
/cut6	-1.7405**		-1.4456		-1.5842**	
	(0.8202)		(0.8207)		(0.8205)	
/cut7	-1.3303		-1.0329		-1.1730	
	(0.8202)		(0.8207)		(0.8205)	
/cut8	-0.7390		-0.4374		-0.5801	
	(0.8202)		(0.8207)		(0.8205)	
/cut9	0.0162		0.3229		0.1767	
	(0.8202)		(0.8207)		(0.8205)	
/cut10	0.4769		0.7864		0.6381	
	(0.8201)		(0.8207)		(0.8204)	
Log likelihood	-35,595		-35,478		-35,557	
Pseudo R^2	0.0231		0.0263		0.0241	
Observations	19,105		19,105		19,105	

Notes: Robust standard errors clustered at a regional level in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 3. Effect of outdoor and indoor environmental conditions on life satisfaction (OLS)

	(1)	(2)	(3)
Gender	0.0763	0.0701	0.0820*
	(0.0463)	(0.0442)	(0.0462)
Age	-0.0877***	-0.0870***	-0.0874***
	(0.0093)	(0.0097)	(0.0093)
$Age^2/100$	0.0855***	0.0835***	0.0851***
	(0.0111)	(0.0115)	(0.0110)
Nationality	0.3923***	0.4218***	0.4008***
	(0.0628)	(0.0626)	(0.0640)
Post-compulsory secondary	0.0966***	0.1117***	0.0888***
	(0.0271)	(0.0264)	(0.0263)
Higher education	0.0904***	0.1194***	0.0779***
	(0.0240)	(0.0238)	(0.0218)
Married	0.6197***	0.6293***	0.6207***
	(0.0352)	(0.0353)	(0.0345)
Family size	-0.0486***	-0.0509***	-0.0498***
	(0.0083)	(0.0083)	(0.0083)
Care	-0.1947***	-0.1921***	-0.1937***
	(0.0419)	(0.0409)	(0.0410)
Single-earner	-0.2156***	-0.2164***	-0.2187***
	(0.0315)	(0.0324)	(0.0314)
Hours $\leq$ 25	0.1903**	0.1748**	0.1888**
	(0.0719)	(0.0721)	(0.0720)
Hours 26-35	0.1072***	0.1038***	0.1065***
	(0.0339)	(0.0355)	(0.0340)
Hours 41-45	0.0242	0.0207	0.0209
	(0.0408)	(0.0409)	(0.0414)
Hours > 45	-0.2318***	-0.2304***	-0.2330***
	(0.0425)	(0.0408)	(0.0420)
Income 600-1,000 €/month	0.2668**	0.2558**	0.2627**
	(0.0919)	(0.0913)	(0.0902)
Income 1,001-1,200 €/month	0.3830***	0.3647***	0.3830***
	(0.1007)	(0.1018)	(0.0990)
Income 1,201-1,600 €/month	0.5420***	0.5161***	0.5398***
	(0.0942)	(0.0946)	(0.0936)
Income 1,601-2,100 €/month	0.5891***	0.5617***	0.5842***
	(0.1199)	(0.1191)	(0.1169)
Income > 2,100 €/month	0.7087***	0.6693***	0.6927***
	(0.1097)	(0.1088)	(0.1070)
Permanent	0.1760***	0.1817***	0.1759***
	(0.0286)	(0.0298)	(0.0287)
Tenure 1-5	0.0765*	0.0900**	0.0777*
	(0.0434)	(0.0413)	(0.0415)
Tenure 6-10	0.0995*	0.1239**	0.1051**
	(0.0473)	(0.0448)	(0.0453)
Tenure 10	0.1325***	0.1680***	0.1373***
	(0.0362)	(0.0341)	(0.0340)
First job	-0.0595**	-0.0591**	-0.0575**
	(0.0238)	(0.0246)	(0.0235)
Overeducation	-0.2784***	-0.2457***	-0.2642***
	(0.0439)	(0.0426)	(0.0442)
Workday	0.0246	0.0370	0.0241
	(0.0490)	(0.0461)	(0.0479)
Stress	-0.0550***	-0.0500***	-0.0543***
	(0.0051)	(0.0051)	(0.0051)
Monotony	-0.0390***	-0.0329***	-0.0380***
	(0.0048)	(0.0046)	(0.0047)

Risk	-0.0686*	-0.0595	-0.0570
	(0.0376)	(0.0352)	(0.0357)
Effort	-0.0093*	-0.0108**	-0.0084*
	(0.0049)	(0.0047)	(0.0047)
Night shift	-0.1123***	-0.1035**	-0.0960**
	(0.0358)	(0.0355)	(0.0354)
Firm size 11-50 workers	0.0605**	0.0696***	0.0676***
	(0.0220)	(0.0211)	(0.0224)
Firm size 51-250 workers	0.0912**	0.1226***	0.1097**
	(0.0405)	(0.0417)	(0.0420)
Firm size > 250 workers	0.0342	0.0833**	0.0497
	(0.0359)	(0.0318)	(0.0352)
GDP	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)
Willingness self-employed	-0.1316***	-0.1268***	-0.1324***
	(0.0426)	(0.0409)	(0.0415)
Willingness public sector	-0.1391***	-0.1309***	-0.1335***
	(0.0426)	(0.0429)	(0.0432)
January min temp	-0.0099	-0.0098	-0.0107
	(0.0118)	(0.0120)	(0.0119)
July max temperature	-0.0034	-0.0032	-0.0023
	(0.0064)	(0.0072)	(0.0069)
Mean annual precipitation	-0.0002	-0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0002)
CO_2	-0.0044	-0.0059*	-0.0049
	(0.0029)	(0.0030)	(0.0031)
PM_{10}	-0.0010	-0.0011*	-0.0011*
	(0.0006)	(0.0005)	(0.0006)
Air quality (AIRCIR)		0.0740***	
		(0.0047)	
Noise valuation (NOISE)			0.0364***
			(0.0051)
Constant	7.8516***	7.3299***	7.5748***
	(1.8298)	(1.7610)	(1.7716)
Year dummies	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
Observations	19,105	19,105	19,105
R-squared	0.088	0.099	0.092

Notes: Robust standard errors clustered at a regional level in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 4. Monetary value of outdoor and indoor environmental pollution

Variable	Coef. (SE)	Coef. (SE)	Coef. (SE)
Log (Income)	0.4037***	0.3796***	0.3956***
	(0.0474)	(0.0463)	(0.0468)
CO_2	-0.0043	-0.0059*	-0.0049
	(0.0029)	(0.0030)	(0.0031)
PM_{10}	-0.0010*	-0.0011*	-0.0011*
	(0.0006)	(0.0005)	(0.0006)
Air quality (AIRCIR)		0.0738***	
		(0.0046)	
Noise valuation (NOISE)			0.0361***
			(0.0051)
Adjusted R^2	0.088	0.099	0.092
Observations	19,105	19,105	19,105
WTP for a thousand of tones per worker reduction in CO_2	166.39 €	242.08 €**	191.18 €
	(110.3794)	(120.2522)	(118.9575)
WTP for a 50 μg/m^3 reduction in PM_{10} for one day	38.54€ *	43.69€ *	43.01€ *
	(22.8461)	(23.0908)	(23.1815)
WTP for a one point scale reduction on ventilation		3,019.74€ ***	
		(338.6955)	
WTP for a one point scale reduction on noise			1,415.03€ ***
			(197.3565)

Notes: All other controls as per Tables 2 and 3 are included but not reported. Estimated values of the income variable are calculated with the log of the mean value in each income interval. Robust standard errors clustered at a regional level in parentheses. Standard errors of the WTP (willingness-to-pay) are calculated using the delta method. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 5. Pseudo-panel estimates of the effect of outdoor and indoor environmental conditions on life satisfaction (OLS and cohort FE)

Panel A: Cohort (job cohort)						
	OLS			Cohort FE		
	(1)	(2)	(3)	(1)	(2)	(3)
CO_2	-0.0267***	-0.0302***	-0.0280***	-0.0334**	-0.0376***	-0.0338**
	(0.002)	(0.002)	(0.002)	(0.013)	(0.013)	(0.013)
PM_{10}	-0.0018***	-0.0016***	-0.0015***	-0.0029	-0.0025	-0.0026
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)
Air quality (AIRCIR)		0.0683***			0.0971***	
		(0.005)			(0.029)	
Noise (NOISE)			0.0587***			0.0474**
			(0.004)			(0.022)
Observations	695	695	695	695	695	695
R-squared	0.242	0.249	0.250	0.219	0.233	0.225
Number of cohorts				11	11	11

Panel B: Cohort (job cohort, gender, education level and civil status)						
	OLS			Cohort FE		
	(1)	(2)	(3)	(1)	(2)	(3)
CO_2	-0.0100***	-0.0111***	-0.0110***	-0.0097**	-0.0113**	-0.0109**
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)
PM_{10}	-0.0014***	-0.0014***	-0.0014***	-0.0006	-0.0006	-0.0007
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Air quality (AIRCIR)		0.0791***			0.0783***	
		(0.005)			(0.010)	
Noise (NOISE)			0.0438***			0.0476***
			(0.004)			(0.008)
Observations	5,087	5,087	5,087	5,087	5,087	5,087
R-squared	0.178	0.188	0.182	0.076	0.088	0.083
Number of cohorts				127	127	127

Notes: All other controls as per Tables 2 and 3 are included but not reported. Robust standard errors clustered at a regional level in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 6. IV estimates of the effect of noise valuation on life satisfaction

Panel A: OLS estimates of the effect of noise valuation on life satisfaction	
OLS	0.0364***
	(0.0051)
Observations	19105
R-squared	0.092
Panel B: IV Estimates of the effect of noise valuation on life satisfaction	
First-stage: the effect of the noise reform in Castilla-Leon on noise valuation	
DD	5.9742***
	(1.3893)
Observations	19105
R-squared	0.109
Partial R-squared	0.0007
F-test of excl.	18.49
p-value	0.0006
Second-stage: the effect of noise valuation on life satisfaction	
Noise valuation (NOISE)	0.0190***
	(0.0066)
Observations	19105
R-squared	0.053

Notes: All other controls as per Tables 2 and 3 are included but not reported. Robust standard errors clustered at a regional level in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.