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Valuing the Impact of Air and Noise Pollution and the Extra Costs on Health Status in Turkey

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Abstract

This study explores the determinants of health status and the effects of the air and noise pollution on health status in Turkey during the period 2006-2012. The additional costs associated with their impact on health status are estimated. A pseudo panel data created based on age and region cohorts and two and three stage least squares instrumental variables approaches are followed using wind direction and regional complaint rates on air and noise pollution as instruments. Based on the favoured estimates the additional costs for individuals who reported problems with air and noise pollution are 20.00-25.00 Turkish Liras (TL) per month[1].

Keywords: Air pollution, Environmental valuation, Health Status, Noise Pollution, Pseudo-Panel

JEL Codes: I31, Q51, Q53, Q54

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1. Introduction

Noise and air pollution and its influence on the environment, health and life quality of human beings has become a major topic in scientific research. Air pollution leads to worst health outcomes and increased death probability (Currie and Neidell, 2005). Noise is another environmental pollutant which has been increased due the expansion of industrial activities, motorway traffic in the city centres and noise from airport are usual daily phenomena and part of the modern life (Okuguchi et al., 2002; Griefahn, 2002). Noise pollution affects the human health physically and psychologically. In the last century, and especially in the last 50 years, a huge movement of population to greater cities took place. This phenomenon disordered the planned city development and also led to huge increase of traffic volume which resulted in production of high levels on noise pollution and created other environmental problem, such as air pollution.

The aim of this study is to explore the relationship of self-reported air and noise pollution, including other determinants, with self-reported health status and chronic illnesses. The analysis uses detailed micro-level data, derived from the cross sectional Income and Living Conditions Survey (ILCS) in Turkey during the period 2006-2012. Then, the additional costs of air and noise pollution on health status are calculated.

In the analysis the population of interest is the non-movers sample- those who have not changed location and residence, in order to limit the endogeneity because the decision to move may be correlated to air and noise pollution level. However, also instrumental variables using two stage and three stage least squares are applied.

The paper is organized as follows. Section 2 presents a short literature review. Section 3 describes the theoretical and econometric framework. In section 4 the data and the research sample design are provided. In section 5 the results are reported, while in section 6 the concluding remarks are presented.

2. Literature Review

In this section previous studies of the air and noise pollution effects on health are presented. The association between health and air pollution has long been studied, especially in the epidemiology. One of the first studies is by Dockery et al. (1993) found a significant association between air pollution and mortality from cancer and cardiopulmonary disease. Since then many epidemiological studies explored the effects of the air pollution on health outcomes. These studies found various associations between air pollutants and physiological functions and clinical symptoms, including premature births and deaths, stroke, brain injury and asthma among others (Naeher et al*.,* 1999; Laden et al., 2000; Janssen et al., 2002; O'Neill et al., 2004; Preutthipan et al., 2004).

Previous studies have been carried out to determine the noise pollution level especially in major cities in Turkey, which has been recognized as an important risk factor of health and well-being (Yilmaz and Ozer 2005; Doygun et al., 2008; Ozyonar and Peker, 2008; Erdogan and Yazgan, 2009; Ozer et al., 2009; Sisman and Unver 2011). However, the aim of these studies the examination of the adverse health effects of noise pollution and not the estimation WTP. Tanrıvermiş (1998) examined the WTP in Turkey using data for Cankaya district in Ankara. The reason of using the specific district based on the author's arguments is that it represents the socio-economic characteristics of Ankara province. Tanrıvermiş (1998) collected data form surveys on 564 households and 2,220 industrial firms and the WTP questions were related to consumer and producer preferences about environmental taxes and charges. The findings show that both consumers and producers are not willing to pay for additional taxes or charges for environmental quality improvement because the majority of the respondents argued that government makes an inefficient usage of its revenues for these purposes. Tekeşin and Shihomi (2014) examined the WTP for mortality risk reduction from four causes -lung cancer, other type of cancer, respiratory disease, traffic accident- are estimated using random parameter logit model with data from choice experiment for the Afsin-Elbistan, Kutahya-Tavsanli, Ankar regions in Turkey. The value of statistical life (VSL) has been found to be ranging between 0.35-0.56 million adjusted in 2012 US dollars (USD).

This study tries to add to the previous literature review by estimating the additional costs of the air and noise pollution impact on health status, which has not yet explored in Turkey using a detailed micro-level data survey.

3. Methodology

3.1 Theoretical Framework

One of the first simple theoretical models examining the effects of air pollution on health has been proposed by Gerking and Stanley (1986). However, we extend the model by including also leisure. The utility function is:

$$U = U(X, L, H) \tag{1}$$

, where X is a bundle of consumption goods, L is leisure and H is the Health status. Health is produced by the individual via the following health production function:

$$H = H(M, E, A) \tag{2}$$

The inputs to health production include a vector of medical treatment -care M, vector E includes environmental factors as air pollution and noise pollution, while A denotes the averting behaviour, where in the case examined is defined by the residential mobility and the moving status of the respondent. From (2) is derived that $H(H_M>0, H_E<0$ and $H_A>0)$, the term H_E is negative as air pollution has negative effects on health. In this study both general health status and whether the respondent suffers from a chronic illness are examined. For this reason the health production function (2) becomes:

$$H = H(M(I), I(E, A)) \tag{3}$$

, where (3) shows that medical care M depends on diseases I, while air, noise pollution and avoidance behaviour determine these diseases. The person also faces a budget constraint:

$$w(H)[T - L] + N = P_X X + P_M M \tag{4}$$

, where w is the wage, N is the non-labour income, T is the total time endowment, P_X and P_M denote the prices for X and M respectively. By combining the two constraints into a full-budget constraint, it is obvious that the cost of health production is the monetary price of health care inputs and the opportunity cost of the time used to produce health. The individual maximizes a utility function subject to a health production function and a full-budget constraint. Also wage is a function of health and labour productivity is increased with health at decreasing rate. The Lagrangian function is as follows:

$$\begin{aligned} &\max\ V = U[H(M, E; \delta), X, L] + \\ &\lambda[w(H)[T - L] + N - P_X X - P_M M] \end{aligned} \tag{5}$$

The first order conditions are:

$$\frac{\partial V}{\partial X} = \partial U / \partial X - \lambda P_X = 0 \tag{6a}$$

$$\frac{\partial V}{\partial L} = \partial U / \partial L - \lambda w = 0 \tag{6b}$$

$$\partial V / \partial A = \partial U / \partial H\big((\partial H / \partial M)(\partial M / \partial I)(\partial I / \partial A) + (\partial H / \partial I)(\partial I / \partial A)\big)$$
$$- \lambda\big(P_A + \partial w / \partial H\big((\partial H / \partial M)(\partial M / \partial I)(\partial I / \partial A) + (\partial H / \partial I)(\partial I / \partial A)\big)[T - L]\big)$$

(6c)

$$\partial V / \partial M = (\partial U / \partial H)(\partial H / \partial M) - \lambda[P_M + (\partial U / \partial H)(\partial H / \partial M)[T - L]]$$

(6d)

Equations (6a)-(6b) show the trade-off between leisure and labour. Taking the total derivative of (3) it will be:

$$\frac{dH}{dE} = \left(\frac{\partial H}{\partial M}\frac{\partial M}{\partial I} + \frac{\partial H}{\partial I}\right)\left(\frac{\partial I}{\partial E} + \frac{\partial I}{\partial A}\frac{\partial A}{\partial E}\right) \tag{7}$$

Relation (7) shows that pollution depends on two components. The expression in the first parenthesis shows how health diseases are translated in poor health status. The first term *(∂H/∂M)*(*∂M/∂I*) shows the negative effects of pollution on health and the medical care treatment necessary for it. The second term *(∂H/∂I*) shows the health diseases caused by air pollution, which are untreated or the individuals ignore treatment. The expression in the second parenthesis shows the relationship between air pollution and health status or illness. The first term *(∂I/∂E*) indicates the effects of air pollution on health diseases, while the second term *(∂I/∂A*)(*∂A/∂E*) show the role of the avoidance behaviour to avert bad health or illness by limiting contact with noise and air pollution. This is captured by considering movers and non-movers sample. This basic model can serve as a guide for policy makers. Denoting the costs of regulation P_R necessary to reduce the negative impacts of pollution should be equal to:

$$\frac{\partial H}{\partial R}P_R = \frac{\partial w}{\partial H}\frac{dH}{dE} + \frac{\partial U}{\partial H}\frac{dH}{\lambda dE} + \frac{\partial M}{\partial E}P_M + \frac{\partial A}{\partial E}P_A \tag{8}$$

, where the first term on the right hand side of relation (8) reflects the impact of pollution on wage, the second term show the direct disutility from pollution, the third term the medical treatment-care expenditures driven by pollution and the last term expresses the avoidance costs. The second term is estimated through the econometric modeling discussed in the next section. Furthermore, in this study the first term is used to estimate the effects of individuals with poor health on wage.

3.2 Econometric Framework

3.2.1 Ordered Probit Cross- Sectional Data

The first part of this section describes the methodology applied for the health status. The following model of health status for individual *i*, in region *j* at time *t* is estimated:

$$HS_{i,j,t} = \beta_0 + \beta_1 e_{j,t} + \beta_2 \log(y_{i,t}) + \beta' z_{i,j,t} + l_j + \theta_t + l_j T + \varepsilon_{i,j,t} \quad (9)$$

$HS_{i,j,t}$ is the health status. $e_{j,t}$ is the self-reported environmental variable. More specifically, two self-reported variables are examined. The first variable is *noise pollution* coming from car traffic, trains, airplanes, factories, neighbours and bar-restaurants and discos. The second is the self-reported *air pollution* variable which includes, fine dust, ozone, grime and fume. The self-reported answers are binary yes and no. $log(y_{i,t})$ denotes the logarithm of household income and *z* is a vector of household and demographic factors, discussed in the next section. Set l_j is controls for region, 12 regions particularly presented in the data part, and θ_t is a time-specific vector of indicators for the year, while l_jT is a set of area-specific time trends. Finally, $\varepsilon_{i,j,t}$

expresses the error term which we assume to be *iid*. Standard errors are clustered at the area-specific time trends.

3.2.2 Pseudo Panel Fixed Effects Models

In the case examined the Income and Living Conditions Survey (ILCS) of Turkey is based on repeated cross-sectional, where a random sample is taken from the population at consecutive points in time as it is described in data section. One important limitation of the cross-section data is that it is impossible to follow the same individual over the time and thus do not allow for fixed effects estimates. On the other hand, cross-section data do not present the common problems of panel data such as non-response and attrition.

Previous studies used repeated cross-sectional data into a pseudo panel data framework. One approach followed by Deaton (1985) is to group into cohorts, those individuals, who share some common characteristics, usually the year of birth. Then averages within the cohorts are treated as observations in a pseudo panel and model (9) can be written as:

$$\overline{H}_{c,j,t} = \bar{a}_{ct} + \beta_1 \bar{e}_{ct} + \beta_2 \log(\bar{y}_{ct}) + \beta' \bar{z}_{ct} + l_j + \theta_t + l_j T + \varepsilon_{c,j,t} \tag{10}$$

Based on the ILCS design the cohort used in this study consists respondent belonging in the same age group and same location area and having the same sex. The resulting data set is a pseudo panel or synthetic panel with repeated observations over T periods and C cohorts. The main problem with estimating beta coefficients from (10) is that $\bar{a}_{ct}$ depends on t, is unobserved, and is likely to be correlated with the other covariates. Therefore, treating $\bar{a}_{ct}$ as part of the random error term is likely to lead to inconsistent estimators. In this case, $\bar{a}_{ct}$ is treated as fixed unknown parameters using fixed effects. Model (10) in a panel framework can be estimated by Ordered Logit and Probit random effects. Since these models so not allow for fixed effects estimations, alternative econometric methods are applied. The first approach is the adapted Probit OLS proposed by van Praag and Ferrer-i-Carbonell (2004) where the dependent ordinal variable is converted in continuous variable assigning z-scores. Van Praag and Ferrer-i-Carbonell (2004; 2006) show in several applications that Probit OLS can be identical to the ordered probit analysis (see Van Praag and Ferrer-i-Carbonell, 2004 for more details on the approach).

The second approach is the "Blow-Up and Cluster" (BUC) estimator proposed by Baetschmann et al. (2014). Another estimator is the FCF developed by developed by Ferrer-*i*-Carbonell and Frijters (2004); however, Baetschmann et al. (2014) provide reasons that, in general, FCF estimator is inconsistent as the way that by choosing the cutoff point based on the outcome, produces a form of endogeneity, as well as it uses only individuals who move across the cut-off point resulting in a large loss of data leading to measurement errors as they may well become a large source of residual variation (Ferrer-*i*-Carbonell and Frijters, 2004). Therefore, the BUC estimator is also applied in this study (see Baetschmann et al., 2014 for technical details and working example). The BUC method performs similarly well and even outperforms the FCF estimator if the number of categories on the ordered scale is large. However, linear fixed effects model in some cases can deliver essentially the same results as the more elaborate binary recoding schemes, as the results section presents.

Having pseudo-panel data allows us to identify the model within cohorts rather than between cohorts, reducing in this way the possible endogeneity bias in the estimates since regional related unobservable characteristics can be correlated with the pollution and health status. Thus, using fixed effects these unobservable characteristics are eliminated. To further limit endogeneity issue coming from residential mobility the population of interest is limited to non-movers, which allows us to capture unobservable characteristics of the region that may be correlated with pollution and health status that are fixed over time. Non-mover status is to be preferred, since this indicates whether the individual has moved in comparison with its location at the last 5 years.

3.2.3 Two Stage and Three Stages Least Squares

In this study two and three stage leas square estimates take place. The main reasons why an instrument variable approach might be necessary is because the endogeneity coming from plausible reverse causality between self-reported air and noise pollution and health status or by omitted variables might be an issue. Even though, the sample is restricted to non-movers in order to limit endogeneity, which comes from residential mobility, or by using fixed effects to account for omitted variables, an instrumental variable approach is followed. Another issue is that the endogeneity may arise because of the subjective rating or self-reporting; thus regional air and noise pollution complaint rate is used as a candidate instrument variable. Moreover, wind direction is used as an additional instrument. It is well known that air and noise pollution are correlated with wind direction; however wind direction might have indirect effects on health status through air and noise pollution. Moreover, while the remained weather conditions, such as sunny days, temperature and wind speed associated with low temperature can be observed at local or small area and there is there is adequate information for them. Thus, people can move in order to choose or to avoid places with bad weather conditions. However, wind direction is a regional phenomenon and there is not enough information or observation about it.

In parallel with the two stage least squares, three stage least squares are applied too. In the case examined in this study separate regressions for noise and for air pollution are estimated.

Furthermore, regressions including both self-reported pollutants are taking place as well; but since the air and noise pollution are correlated it might be difficult to disentangle their effects. Therefore, as a number of equations are to be estimated simultaneously and a problem with endogeneity might be existed, for the reasons mentioned above, a three-stage least square approach will be used. Three-stage least square is a combination of seemingly unrelated regression developed by Zellner (1962) and two-stage regression with instrument variables (Zellner and Theil, 1962). In a multiple equation system, like in the case examined in this study, where the same data set is used, the independent variables differ between the equations, the errors may be correlated between the equations. Therefore, three-stage least squares may be more efficient (Madansky, 1964; Belsley, 1988; Greene, 2008). In the case that self-reported air and noise pollution are endogenous simple OLS regression will produce spurious estimates. In the case where self-reported air and noise pollution are endogenous, ordinary least square regression or seemingly unrelated regression may produce spurious results; thus, using the instrumental variable approach may avoid this bias if the instrument variables are valid (Murray, 2006). The instrument for individual subjective ratings on air and noise pollution problems are constructed by taking the average complaint rates on NUT 1 level finding evidence of a downward bias, indicating that the marginal willingness to pay for improvements may be is underestimated.

Wind direction can be used as an instrument, because it is correlated with noise and air pollution, while it may have an indirect impact on health. The effects of wind direction differ in rural and urban areas, where in the former areas is mainly generated by farming equipment, while in the latter areas is it produced mainly by road traffic and human sources. (Aecom, 2011; Ovenden et al., 2011; Fraser and Eng, 2012). While wind direction has no direct effects on heath the rest of the weather factors have been found to be directly associated with health outcomes, including temperature, wind speed and humidity. Thus, these weather factors are not taken as instruments, but are considered as additional controls in robustness checks.

4. Data

Income and Living Conditions is a cross-sectional survey which started since 2006 and the last survey took place in 2012 and the respondents are aged 15 and older. All settlements and these have been stratified into urban – rural areas, where an area is defined as urban if the population is over 20,000 while settlements with a population less than 20,000 are defined as rural. The annual sampling size is around 13,000 households in respect of the estimation, objectives and targeted variables of the study. The regions employee in the survey are coded according to the Nomenclature of Territorial Units for Statistics (NUTS) as NUTS level 1 classification and are: TR1-Istanbul, TR2-West Marmara, TR3-Aegean, TR4- East Marmara, TR5-West Anatolia, TR6- Mediterranean, TR7-Central Anatolia, TR8-West Black Sea, TR9-East Black Sea, TRA-North-east Anatolia, TRB-Central east Anatolia, TRC- Southeast Anatolia (Turkish Statistical Institute, 2013).

Following the previous literature (Gerking and Stanley, 1986; Chay and Greenstone (2003a, 2003b; Luechinger, 2009), the individual and household variables of interest are household income[2], the type of the household, employment status, house tenure, marital status, education level, the industry code of the job occupation, type of the fuel mostly used in the dwelling for heating, piped water system in the dwelling, indoor toilet, house size and NUTS 1 regions. The principal health outcome is self-assessed health (SAH) defined by a response to the question "What is your general health status; very good/good/fair/bad/very bad?". The second dependent variable used is a binary variable yes or no answering on whether the individuals suffer from chronic (long-standing) illness or condition.

[2] The analysis was also conducted using individual level income; however this is affected by labour force participation which we do not explicitly model here.

In table 1 the summary statistics for four different samples are reported. The average household income is around 21,300 Turkish Liras for the total sample, while the average is slightly higher for movers. The self-reported responses for air and noise pollution complaints are similar among all samples where the 25 and 17 per cent claim that there are problems about air and noise pollution respectively, while the 75 and 82 per cent declares no problems.

The 25 per cent of the sample reports that it suffers from a chronic illness, while the rest 75 per cent declares no. The statistics show that almost all the households in the sample have available piped water in the dwelling at 96 per cent. Regarding the self-reported health status table 1 show that 11.88 and 52.73 per cent report very good and good health respectively, the 20.74 reports fair health status, while 12.81 and 2.04 per cent report respectively bad and very bad health status. Non movers sample report a slightly higher proportion of bad health at 13.17 per cent, while the movers for environmental or other reasons, presented in panels C and D, report slightly higher proportions of very good and good health, as well as, lower proportions of bad and very bad health.

In table 2 the correlation matrix between household income, self-reported air and noise pollution problems, the dummy whether an individual suffers from a chronic disease and the self-reported ordered health status variable is presented. From table 2 the correlation between household income and health status is negative indicating that the higher income is associated with better health status, given that health status is very good for 1 and very bad for 5. Similarly, the association between income and suffering from a chronic disease is negative. Noise and air pollution are associated positively with poor health status and the probability that an individual will report that he/she suffers from chronic disease. Chronic disease self-report is positively correlated with poor health status, while income is positively associated with air and noise pollution, probably indicating that individuals with higher income are located in more polluted areas as urban areas.

In addition, the correlation between temperature and health status is -0.0151, while between temperature and chronic illness is -0.0116. Similarly the correlation of wind speed with health status and chronic illness is 0.0037 and 0.0034 respectively, while the respective values for humidity are 0.0072 and 0.0025. These results are reported as an additional regression using weather data for non-movers sample takes place.

(*Tables 1-2 around here*)

5. Empirical Results

In this section the estimation results are presented and discussed. Equation (10) is estimated separately for each pollutant in order to disentangle their effects. In table 3 the fixed effects adapted Probit-OLS estimates are presented. It should be noticed that a negative sign is associated with better health outcome levels, as the self-reported health status variable is defined as 1 for very good health and 5 for very bad health status. The self-reported air and noise complaint present the expected positive signs, while income's coefficient sign is negative respectively. Therefore a rise in air pollution increases the probability of health status deterioration occurrence. In table 3 the estimates are provided for fours samples; the total sample; the non-movers sample; the movers for environmental reasons movers and the movers for other reasons sample.

Income has a negative sign indicating that the higher income is associated with higher-better levels of health outcome. Richer people who are better educated have better health status levels than poorer, who are usually less-educated people. In addition people with higher income have access to better quality of housing, schooling, and nutrition (Deaton, 2001).

The role of education in health status is key determinants of health and living standards. Moreover, an individual's health and well-being are partly determined by their life-cycle experience and by the social roles and class - in terms of marital status, employment, parenthood status - and less by other household characteristics as fuel type used, pipe water infrastructure, while house tenure has no significant effects. Therefore, those who are single (never married) report lower levels of health status followed by separated and divorced individuals. Those who are widowed present the lowest health outcome levels amongst the other categories of marital status. Regarding education level, the reference category is the illiterate individuals. It becomes clear that higher education levels are associated with higher levels of health outcome. For example individuals who have completed the primary school report a better health outcome by 0.301, while those who have completed high school and higher education are healthier by 0.449 and 0.518 respectively. Similarly, job status is an important determinant of health status. The reference category is the full-time employees. Thus, a positive sign for the part-time employees, unemployed and retired individuals indicates a lower level of health status for these categories than for people who are full-time employed. Especially, the retired and widowed people present the lowest levels of health status, reflecting their old age which implies additional health problems. More specifically, more than 40 per cent of the widowed individuals are older than 55 years old. In table 3 the results for occupation codes are reported. More specifically, there is no difference on health status between individuals who are professionals and the reference category which is managers. However, skilled workers employed in agricultural and forestry industry present lower levels of health outcomes followed by clerical support workers. Regarding household type the results are mixed. Another possible factor could be used in this case is the household size, or number of children. However, the former factor allows us to examined more detailed the effects and structure of a household, rather than taking only the size. More specifically, from table 3 it becomes clear that a couple younger than 65 years old with no dependent children and are healthier than a household which is consisted only by a single person. Similarly a household, which is consisted by two adults with one or two dependent children, present higher levels of health status than single individuals. These findings are also captured by the marital status. On the other hand, a household, which is consisted by two adults with no dependent children, but at least one of them is older than 65 years old, are less healthy than single persons, which reflects the old age of those persons, as in the case of widowed and retired people. Previous studies show evidence on the protective and beneficial role of family size and support to individuals' health outcomes (Aldwin and Greenberger, 1987; Doornbos, 2001). Therefore, household type and support can be proxies to home health care indicating this type of care may substitute the medical care obtained in the market which improves individuals' health leaving in supporting and big families.

Generally, the results overall show that education is perhaps the most basic socio-economic status (SES) component. This can be explained by the fact that education determines and shapes future labour market opportunities and earning potentials. Moreover, education provides knowledge and life skills that allow persons to gain more access to information and resources to health services and care. The general findings so far are consistent with other studies (Benzeval et al., 2000; Prus, 2001; Robert and Li 2001; Deaton, 2001; Beckett and Elliott, 2002; Bostean, 2010).

The rest of the factors have small or insignificant effects on health. More specifically, house tenure is insignificant, with the exception the movers for other reasons sample where the tenants have lower health level than the owners. This reflects two things; the owners are either individuals with higher income or are supported by the household. The rest of the determinants examined is the indoor flushing toilet and piped water in the dwelling and the type of fuel used for healing. This is the first study which explores these factors, which based on the estimate are important determinants of health status. Table 3 shows that whether there is indoor flushing toilet for sole use of the household or shared has no different impact on health; however, the individuals who answered that there is no indoor flushing toilet and no piped water in the dwelling have lower health status levels. Finally, the type of fuel used for heating in the dwelling is important for the health status. More specifically, either using wood or coal has no difference on health; however using natural gas, fuel-oil and electricity has more positive effects on individuals' health status than coal or wood. In addition, when dried cow dung is used as fuel for heating has significant negative effects on health status.

Based on table 3 the additional costs for air and noise pollution are reported. Respondents who reported that there is problem with air pollution face an additional cost of air pollution impact equal at 19.67 TL per month for total sample, 18.58 TL for the non-movers sample, 32.54 TL for the movers for environmental reasons movers and 22.82 TL concerning the movers for other reasons sample. The respective additional costs for noise pollution impact is 21.29 TL per month for total sample, 21.38 TL for the non-movers sample, 29.54 TL for the movers for environmental reasons movers and 20.77 TL based on columns (5)-(8) of table 3. Therefore, individuals who moved because of environmental or other reasons evaluate more the air pollution than noise, while the additional costs for non-movers sample are similar with those derived using the total sample. This can be explained by the fact that 76 per cent of the survey is non-movers.

(*Table 3 around here*)

The next tables 4-6 present different econometric models for the health status and the analysis is restricted to non-movers in order to limit possibly endogeneity. In table 4 the estimates using panel ordered Logit and BUC estimates are reported. The results confirm the findings described previously for the table 3 and the adapted Probit fixed effects estimates. The coefficients have the same sign, while the magnitude is higher as these methods use the Logit approach where the coefficients are roughly 4 times higher than the coefficients derived from the linear regression. Moreover, the additional costs in table 3 are very similar with those in table 4 discussed previously.

In tables 5-6 the results for the two and three stage least squares respectively are reported. The sign and the impact of the various determinants on health is similar with the previous results confirming the estimates and the importance of each factor on health. However, the additional costs in tables 5-6 are higher. More specifically, regarding the two stage least squares estimates the additional costs of air and noise pollution are 23.00 TL and 27.67 TL per month, while in the case of the adapted Probit fixed effects in table 3 and column (9) the respective additional costs are 17.63 TL and 18.17 TL. This indicates that the estimates of the fixed effects model in table 4 are biased downward and the additional costs are underestimated. Similarly, the additional costs derived from the three stage least squares and presented in table 6 are higher and equal at 20.13 TL and 24.24 TL per month, when instruments are used. In addition, when the self-reported air and noise pollution problems are considered as exogenous are still higher than the fixed effects model and the individuals face additional costs equal at 19.21 TL and 12.66 TL per month than the individuals who do not report any complain or problem with air and noise pollution. However, the additional costs, using three stage least squares, are slightly lower than those calculated based on the two stage least squares. Nevertheless, as it has been discussed in the methodology section, the former approach can be more robust for two reasons. Firstly, it is not precise to calculate additional costs and to disentangle the effects of air and noise pollution when both self-reported complains about environment are used in the regression. Secondly, there is a strong possibility that the error term between the two equations, one for each pollution question, is correlated therefore the three stage least squares method is more appropriate in this case. Generally, in rural areas the air and noise pollution has significant effects too. This can be explained by the fact that modern farms using noise equipment has replaced the old-fashioned farming type (Aecom, 2011; Ovenden et al., 2011). Also one major source of noise is traffic which comes especially from freeways, but it is also dominated in the centres of big cities. In any case since noise depends on the wind direction and speed, one plausible action of reducing the noise pollution is the construction of noise barriers next to the freeways.

(*Tables 4-6 around here*)

The next step is to present the results for chronic illnesses. More specifically, the results regarding the effects of income and air-noise pollution on chronic illness probability occurrence are reported in table 7. In panel A the estimates using a pooled binary Logit model are reported, while in panel B the fixed effects Logit results are presented for the four samples mentioned previously. The additional costs in panel A range between 16.00-18.00 TL per month, while the additional costs of noise pollution reduction are 13.74 per month in the movers for other reasons sample in column (4). However, in panel B the additional costs are significantly higher, almost doubled, than in panel A, showing the biases derived by pooled estimates. Moreover, the estimates using an instrumental binary Probit model with random effects, using the regional complaint rates and wind direction as instruments, took place where the additional costs are similar with those derived from fixed effects Logit data. The coefficients for the rest of the health status determinants are not reported as the concluding remarks are similar with those derived previously for the health status. However, what it is important is the additional costs; where in case of the individuals who suffer from specific chronic diseases are significantly higher.

Finally, in table 7 additional estimates are reported in order to calculate the first and the third term of equation (8). The estimates in panel A of table 8 show the effect of poor health status and chronic diseases on working hours lost. Individuals with poor health status on average work less by 1.3 and 1.5 hours than people with good health status for the total and non-movers sample. In addition, higher household income is associated with lower hours of work. Similarly, the individuals who suffer from chronic illness are working less by 1.3 hours than people who do not suffer. However, this does not imply that working hours lost is associated with avoidance behaviour. Nevertheless, one assumption is that individuals with poor health status might avoid attending work in order to avoid high outdoor pollution level. At the same time the estimates in panel A can be used in order calculate the third term $(\partial M/\partial E)(P_M)$, where the assumption of visiting a practitioner or hospital can be examined. In that case the P_M can be considered as zero because the hospital services in Turkey are free, if the exclusion of private services is assumed, which is not the main scope of the study but these calculation are suggested for future research. However, the assumption of 3 hours replacing P_M is taken here as an example, which included the transportation time and list queuing time for visiting a practitioner. Therefore, the third term is equal 3.9 and 4.5 less working hours for individuals with poor health status relatively to those with good health status.

Finally, the first term of equation (8) $(\partial w/\partial H)(dH/dE)$ using the estimates from table 11 and panel B, as well as the estimates from table 3 and column (9), can be calculated. The term $(\partial w/\partial H)(dH/dE)$ it is equal at 1.25 and 1.39 per cent for air and noise pollution respectively and non-movers with poor health status. Similarly, for the individuals who suffer from chronic diseases the cost is 0.92 and 1.02 per cent for air and noise respectively. Using the three stage least squares estimates from table 8 and column (2) -which are 0.1237 and 0.1489 per cent for air and noise pollution respectively- $(\partial w/\partial H)(dH/dE)$ is equal at 1.47 and 1.77 per cent for air and noise pollution respectively, while the respective values for individuals who suffer from chronic illness are 1.08 and 1.31 per cent. Thus, individuals with poor health earn wage less by 1.5-1.8 per cent cause by air and noise pollution, while the respective reduction in wage for individuals who suffer from chronic illness is 1.08 and 1.31 caused by air and noise pollution respectively.

(*Tables 7-8 around here*)

Overall, the results suggest that one of the main policies in Turkey should be education reconstruction, health promotion and income distribution focusing on SES disparities elimination and reducing income inequalities on health. Furthermore, a broad approach to the multiple determinants of SES disparities in health should be reduced or not eliminated. Therefore a new approach is needed in policy circles that would reconsider the benefit side of the cost-benefit analysis. Traditionally, these calibrations emphasize economic efficiency or possibly social justice, but they often leave out the health-promoting, and potentially cost-saving, prospects of policies that improve education or equalize resources. Finally, the results confirm the proposal by International Energy Agency (2010), which suggests that Turkey should promote fuel switching from high-sulphur lignite and coal to natural gas.

However, there are some drawbacks in this study. Firstly, the econometric methods applied as well as the relationship between health, pollution and other socioeconomic and demographic factors, seemingly require the availability of panel data. Therefore, one of the most important limitations the repeated cross-sectional data is that it is impossible to follow the same individuals across the time period examined. Nevertheless, repeated cross-sectional data suffer less from the typical problems of non-response and attrition presented in the panel data surveys. These problems can be significantly larger with increases in the number of units i.e. individuals, households or firms.

Moreover, there is additional information on whether the individuals or household have changed address during the last five years limiting in this way the endogeneity problem and examining different samples based on their moving status. Finally, another very important factor which is the main consideration in the epidemiological studies is the "unobservable" characteristics of the individuals, which are inherited at birth or genetic and that may influence the health outcomes. Ignoring these characteristics the association between income and health might not represent the true relationship. However, it is very difficult or even impossible to find appropriate variables or measures to use them as proxies for such characteristics including this survey.

Furthermore, other approaches such as Generalized Ordered Probit or Logit Latent Class models can be applied in order to account for slope heterogeneity, while robustness checks for various groups, such as income classes, rural versus urban areas can take place.

6. Conclusions

This study has used a set of repeated cross sectional and pseudo panel micro-data on self-reported health status, chronic illness and air-noise pollution from the Income and Living Conditions Survey in Turkey. Various econometric approaches have been applied for robustness checks. The results showed that the additional costs for the individual who report a problem on air and noise pollution are higher by 22-25 TL per month than the individuals who did not report. In addition, most of the determinants examined in this study have significant effects on health status, with education to be the most important one followed by job status, marital status, house size and household type. House tenure shows no significant effects on health, while this study examines additional determinants than other studies, such as piped water, indoor flushing toilet and type of fuel for heating effects on health. Moreover, various cases have been examined in, as the urban versus rural areas, gender and age groups. Finally, the costs effects of air and noise pollution on wage and working hours lost because of illness have been examined.

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Table 1. Summary Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
Panel A: Total Sample				
Panel A1: Continuous variables				
Household income	21,322.12	19,695.18	95.77	642,017.8
Panel A2: Categorical Variables				
Air Pollution Problems (Yes)	25.06	Noise Pollution Problems (Yes)	17.79	
Air Pollution Problems (No)	74.94	Noise Pollution Problems (No)	82.21	
Chronic Diseases (Yes)	25.97	Chronic Diseases (No)	74.03	
Indoor flushing toilet (Yes, for sole use of the household)	84.32	Piped water system in the dwelling (Yes)	96.48	
Indoor flushing toilet (Yes, Shared)	11.71	Piped water system in the dwelling (No)	3.52	
Indoor flushing toilet (No)	3.97	Health Status (Fair)	20.74	
Health Status (Very Good)	11.88	Health Status (Bad)	12.81	
Health Status (Good)	52.73	Health Status (Vary Bad)	2.04	
Panel B: Non-Movers Sample				
Panel B1: Continuous variables				
Household income	21,165.37	19,517.76	95.77	642,017.8
Panel B2: Categorical Variables				
Air Pollution Problems (Yes)	24.83	Noise Pollution Problems (Yes)	17.51	
Air Pollution Problems (No)	75.17	Noise Pollution Problems (No)	82.49	
Chronic Diseases (Yes)	26.53	Chronic Diseases (No)	73.47	
Indoor flushing toilet (Yes, for sole use of the household)	83.75	Piped water system in the dwelling (Yes)	96.32	
Indoor flushing toilet (Yes, Shared)	11.82	Piped water system in the dwelling (No)	3.68	
Indoor flushing toilet (No)	4.44	Health Status (Fair)	21.00	
Health Status (Very Good)	11.82	Health Status (Bad)	13.17	
Health Status (Good)	51.90	Health Status (Vary Bad)	2.11	
Panel C: Movers (For Environmental Reasons) Sample				
Panel C1: Continuous variables				
Household income	21,661.24	17,705.57	1,581.401	161,110.1
Panel C2: Categorical Variables				
Air Pollution Problems (Yes)	28.81	Noise Pollution Problems (Yes)	19.25	
Air Pollution Problems (No)	71.19	Noise Pollution Problems (No)	80.75	
Chronic Diseases (Yes)	24.19	Chronic Diseases (No)	75.81	
Indoor flushing toilet (Yes, for sole use of the household)	85.98	Piped water system in the dwelling (Yes)	96.43	
Indoor flushing toilet (Yes, Shared)	12.30	Piped water system in the dwelling (No)	3.57	
Indoor flushing toilet (No)	1.72	Health Status (Fair)	20.97	
Health Status (Very Good)	12.62	Health Status (Bad)	11.22	
Health Status (Good)	53.73	Health Status (Vary Bad)	1.47	
Panel D: Movers (For Other Reasons) Sample				
Panel D1: Continuous variables				
Household income	21,820.58	20,301.42	134.005	546,629.1
Panel D2: Categorical Variables				
Air Pollution Problems (Yes)	25.71	Noise Pollution Problems (Yes)	18.66	
Air Pollution Problems (No)	74.29	Noise Pollution Problems (No)	81.34	
Chronic Diseases (Yes)	24.20	Chronic Diseases (No)	75.80	
Indoor flushing toilet (Yes, for sole use of the household)	86.14	Piped water system in the dwelling (Yes)	97.00	
Indoor flushing toilet (Yes, Shared)	11.34	Piped water system in the dwelling (No)	3.00	
Indoor flushing toilet (No)	2.52	Health Status (Fair)	19.87	
Health Status (Very Good)	12.07	Health Status (Bad)	11.68	
Health Status (Good)	54.53	Health Status (Vary Bad)	1.85	

Table 2. Correlation Matrix

	Health Status	Chronic Illness	Household Income	Air Pollution
Chronic Illness	0.6514*** (0.000)			
Household Income	-0.1427*** (0.000)	-0.0755*** (0.000)		
Air Pollution	0.0108*** (0.000)	0.0085*** (0.0013)	0.0345*** (0.000)	
Noise Pollution	0.0083*** (0.0003)	0.0065*** (0.000)	0.0068*** (0.0008)	0.3231*** (0.000)

*** indicates significance at 1% level.

Table 3. Adapted Probit Fixed Effects

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Logarithm of Household Income	-0.1292***	-0.1330***	-0.0891*	-0.1200***	-0.1277***	-0.1317***	-0.0832*	-0.1185***	-0.1329***
	(0.0065)	(0.0075)	(0.0463)	(0.0134)	(0.0065)	(0.0075)	(0.0431)	(0.0134)	(0.0075)
Air Pollution	0.1166***	0.1142***	0.1455**	0.1231***					0.1082***
	(0.0076)	(0.0089)	(0.0689)	(0.0151)					(0.0093)
Noise Pollution					0.1248***	0.1300***	0.1407**	0.1106***	0.1115***
					(0.087)	(0.0102)	(0.0682)	(0.0172)	(0.0107)
Marital Status (Reference Married)					0.0201***	0.0205***	0.0169***	0.0192***	0.0204***
					(0.0004)	(0.0005)	(0.0055)	(0.0008)	(0.0005)
Marital Status (Single never married)	0.0293**	0.0176	0.0505	0.0671**	0.0275**	0.0153	0.0722	0.0672**	0.0406***
	(0.0134)	(0.0158)	(0.2301)	(0.0260)	(0.0135)	(0.0158)	(0.2303)	(0.0270)	(0.0158)
Marital Status (Widowed)	0.2366***	0.2299***	0.0290	0.2625***	0.2340***	0.2264***	0.0281	0.2630***	0.2277***
	(0.0320)	(0.0363)	(0.3310)	(0.0698)	(0.0321)	(0.0364)	(0.3312)	(0.0701)	(0.0363)
Marital Status (Divorced)	0.1813***	0.1769***	0.0577	0.2058***	0.1795***	0.1728***	0.0742	0.2085***	0.1750***
	(0.0270)	(0.0320)	(0.2949)	(0.0518)	(0.0270)	(0.0320)	(0.2952)	(0.0517)	(0.0319)
Marital Status (Separated)	0.1324***	0.1479***	0.3327	0.0996	0.1284***	0.1441***	0.3775	0.0931	0.1435***
	(0.0471)	(0.0552)	(0.5351)	(0.0923)	(0.0471)	(0.0551)	(0.5286)	(0.0926)	(0.0551)
Education Level (Reference Illiterate)									
Primary school	-0.2637***	-0.2631***	-0.3193*	-0.2611***	-0.2646***	-0.2638***	-0.3178*	-0.2623***	-0.2637***
	(0.0161)	(0.0183)	(0.1781)	(0.0348)	(0.0161)	(0.0183)	(0.1729)	(0.0348)	(0.0183)
High school	-0.3711***	-0.3708***	-0.4148**	-0.3658***	-0.3719***	-0.3725***	-0.4183**	-0.3633***	-0.3733***
	(0.0198)	(0.0227)	(0.1942)	(0.0416)	(0.0198)	(0.0227)	(0.1942)	(0.0417)	(0.0227)
Higher education level	-0.4177***	-0.4126***	-0.5235**	-0.4192***	-0.4160***	-0.4118***	-0.5169**	-0.4150***	-0.4151***
	(0.0213)	(0.0246)	(0.2337)	(0.0442)	(0.0213)	(0.0246)	(0.2310)	(0.0442)	(0.0246)
Job Status (Reference Empl. Full Time)									
Job Status (Employee Part Time)	0.1429***	0.1562***	0.1849	0.1163***	0.1429***	0.1563***	0.1737	0.1179***	0.1547***
	(0.0093)	(0.0153)	(0.1439)	(0.0275)	(0.0093)	(0.0153)	(0.1440)	(0.0277)	(0.0153)
Job Status (Self-Employed Part Time)	0.1459***	0.1072***	0.5474	0.1221***	0.14435***	0.1045***	0.5234	0.1232***	0.1038***
	(0.0133)	(0.0284)	(0.5837)	(0.0196)	(0.0133)	(0.0285)	(0.5740)	(0.0197)	(0.0284)
Unemployed	0.1070***	0.1083**	0.8064*	0.2211*	0.1048***	0.1077**	0.8252*	0.2202*	0.1089**
	(0.0256)	(0.0505)	(0.4454)	(0.1171)	(0.0255)	(0.0505)	(0.4743)	(0.1169)	(0.0428)
Retired	0.9031*	0.9659**	0.8178*	-0.5952***	0.9075*	0.9621**	0.8196*	-0.5641***	0.9451*
	(0.4765)	(0.4837)	(0.4180)	(0.2236)	(0.4767)	(0.4935)	(0.4182)	(0.1846)	(0.4883)
Occupation code (Reference Managers)									
Occupation code (Professionals)	-0.0185	-0.0414**	-0.0635	0.0435	-0.0194	-0.0429**	-0.0744	0.0448	-0.0435**
	(0.0165)	(0.0196)	(0.2244)	(0.0316)	(0.0165)	(0.0196)	(0.216)	(0.0316)	(0.0195)
Occupation code (Clerical Support Workers)	0.0353*	0.0236	-0.0259	0.0289	0.0355*	0.0242	-0.0243	0.0271	0.0217
	(0.0180)	(0.0211)	(0.1902)	(0.0349)	(0.0180)	(0.0211)	(0.1913)	(0.0349)	(0.0211)
Occupation code (Skilled agricultural, forestry)	0.0424***	0.0368**	0.0802	0.0580*	0.0408***	0.0345**	0.0672	0.0555*	0.0412**
	(0.0150)	(0.0173)	(0.1920)	(0.0306)	(0.0150)	(0.0173)	(0.1916)	(0.0306)	(0.0173)

Table 3 (cont.) Adapted Probit Fixed Effects

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
House Size	-0.0006***	-0.0005**	-0.0028*	-0.0009***	-0.0006***	-0.00049**	-0.0029**	-0.0009***	-0.00045**
	(0.002)	(0.00024)	(0.0016)	(0.0003)	(0.002)	(0.0002)	(0.0017)	(0.0003)	(0.00019)
Household Type (Reference Single Person)									
Household Type (2 ad., no dep, children < 65)	-0.0191	-0.0281*	0.0935	-0.1173**	-0.0186	-0.0284*	0.0849	-0.1191**	-0.0276*
	(0.0268)	(0.0147)	(0.2866)	(0.0470)	(0.0268)	(0.0147)	(0.2850)	(0.0471)	(0.0144)
Household Type (2 ad., no dep. children, at least one adult 65 years or more)	0.0735**	0.1062***	0.3065	0.0208	0.0743**	0.1072***	0.3722	0.0228	0.1048***
	(0.0330)	(0.0390)	(0.3305)	(0.0655)	(0.0330)	(0.0391)	(0.3174)	(0.0655)	(0.0390)
Household Type (2 ad. with one dep. child)	-0.0168	-0.0321*	-0.0533	-0.1094**	-0.0163	-0.0320*	-0.0338	-0.1076**	-0.0324*
	(0.0267)	(0.0166)	(0.3022)	(0.0469)	(0.0267)	(0.0166)	(0.2997)	(0.0355)	(0.0166)
Household Type (2 ad. with two dep. children)	-0.0237*	-0.0280**	-0.0339	-0.1200**	-0.0254*	-0.0282**	-0.0192	-0.1155**	-0.0285**
	(0.0123)	(0.0137)	(0.3048)	(0.0472)	(0.0128)	(0.0137)	(0.2692)	(0.0472)	(0.0138)
House Tenure (Reference Owner)									
House Tenure (Tenant)	-0.0085	0.0209**	-0.0510	0.0232	-0.0116	0.0234**	0.0588	0.0186	0.0213**
	(0.0076)	(0.0102)	(0.1064)	(0.0165)	(0.0086)	(0.0102)	(0.1076)	(0.0165)	(0.0102)
House Tenure (Lodging)	-0.0271	-0.0366	0.2373	-0.0075	-0.0278	-0.0387	0.2522	-0.0040	-0.0347
	(0.0242)	(0.0292)	(0.2967)	(0.0433)	(0.0242)	(0.0292)	(0.3087)	(0.0433)	(0.0291)
Flushing Toilet (Reference Yes for sole use of the household)									
Indoor Flushing Toilet (Yes) shared	-0.0187	-0.0301	-0.1401	-0.0199	-0.0196	-0.0307	-0.1573	-0.0196	-0.0298
	(0.0211)	(0.0292)	(0.1567)	(0.0244)	(0.0212)	(0.0292)	(0.1574)	(0.0245)	(0.0290)
Indoor Flushing Toilet (No)	0.0199*	0.0217	0.0186	0.0363	0.0197*	0.0215	0.0178	0.0360	0.0202
	(0.0120)	(0.0138)	(0.3391)	(0.0524)	(0.0119)	(0.0138)	(0.3346)	(0.0520)	(0.0132)
Type of Fuel (Reference Wood)									
Type of Fuel (Coal)	0.0021	0.0080	0.0022	-0.0171	0.0048	0.0104	0.0112	-0.0134	0.0058
	(0.0096)	(0.0110)	(0.1192)	(0.0202)	(0.0096)	(0.0110)	(0.1185)	(0.0202)	(0.0110)
Type of Fuel (Natural Gas)	-0.0234*	-0.0332**	0.2433	0.0144	-0.0239*	-0.0335**	0.2144	0.0160	-0.0328**
	(0.0129)	(0.0159)	(0.2114)	(0.0328)	(0.0129)	(0.0159)	(0.2154)	(0.0329)	(0.0159)
Type of Fuel (Fuel-Oil)	-0.0309	-0.0280	-0.4797	-0.0034	-0.0268	-0.0303	-0.5456	-0.0020	-0.0273
	(0.0421)	(0.1114)	(0.3365)	(0.0834)	(0.0421)	(0.1114)	(0.3510)	(0.0834)	(0.1193)
Type of Fuel (Electricity)	-0.0380*	-0.0553*	-0.0791*	-0.0319	-0.0382*	-0.0491*	-0.0776*	-0.0277	-0.0564**
	(0.0218)	(0.0269)	(0.0461)	(0.0440)	(0.0218)	(0.0269)	(0.0445)	(0.0443)	(0.0269)
Type of Fuel (Dried cow dung)	0.0714***	0.0631***	0.0444	0.1013***	0.0706***	0.0638***	0.0568	0.1111***	0.0651***
	(0.0180)	(0.0205)	(0.2557)	(0.0390)	(0.0180)	(0.0205)	(0.2522)	(0.0390)	(0.0205)
Piped Water (No)	0.0283*	0.0315*	0.4872*	0.0091	0.0282*	0.0316*	0.4903*	0.0124	0.0323*
	(0.0146)	(0.0163)	(0.2820)	(0.0480)	(0.0146)	(0.0163)	(0.2777)	(0.0481)	(0.0163)
Number of Observations	112,338	84,640	752	26,946	112,338	84,640	752	26,946	84,640
R Square	0.2093	0.2119	0.1854	0.2003	0.2088	0.2119	0.1822	0.1983	0.2131
Additional Costs of Pollution	19.67	18.58	32.54	22.82	21.29	21.38	29.54	20.77	(17.63;18.17)

Standard errors between brackets, ***, ** and * indicate significance at 1%, 5% and 10% level. Columns (1) and (5) refer to total sample, (2) and (6) to non-mover sample, (3) and (7) to movers for environmental reasons, (4) and (8) to movers for other reasons, while (9) refer to non movers sample when both air and noise pollution are included into the regressions

Table 4. Ordered Logit and BUC Models for Non-Movers

Variables	Panel Ordered Logit	BUC	Variables	Panel Ordered Logit	BUC
Logarithm of Household Income	-0.2924***	-0.3444***	Household Type (2 ad., no dep, children < 65)	-0.1350**	-0.0417*
	(0.0137)	(0.0211)		(0.0673)	(0.0238)
Air Pollution	0.2121***	0.2360***	Household Type (2 ad., no dep. children, at least one adult 65 years or more)	0.2194***	0.2041
	(0.0178)	(0.0267)		(0.0759)	(0.2076)
Noise Pollution	0.2382***	0.2960***	Household Type (2 ad. with one dep. child)	-0.1359**	-0.0462**
	(0.0204)	(0.0302)		(0.0676)	(0.0215)
Marital Status (Single never married)	0.1990***	0.1418***	Household Type (2 ad. with two dep. children)	-0.1335**	-0.0453**
	(0.0250)	(0.0496)		(0.0673)	(0.0221)
Marital Status (Widowed)	0.5251***	0.6434***	House Tenure (Tenant)	0.0242	0.0549**
	(0.0637)	(0.0991)		(0.0707)	(0.0255)
Marital Status (Divorced)	0.5565***	0.5017***	House Tenure (Lodging)	-0.0903	-0.0825
	(0.0576)	(0.0884)		(0.0619)	(0.0866)
Marital Status (Separated)	0.6039***	0.5114***	Indoor Flushing Toilet (Yes) shared	-0.0143	-0.0575
	(0.1033)	(0.1546)		(0.0376)	(0.0621)
Primary school	-0.6769***	-0.5379***	Indoor Flushing Toilet (No)	0.0722***	0.0659*
	(0.0282)	(0.0477)		(0.0245)	(0.0375)
High school	-0.9943***	-0.8715***	Type of Fuel (Coal)	0.0161	0.0400
	(0.0385)	(0.0622)		(0.0199)	(0.0298)
Higher education level	-1.165***	-1.042***	Type of Fuel (Natural Gas)	-0.0972**	-0.0676**
	(0.0437)	(0.0688)		(0.0395)	(0.0357)
Job Status (Employee Part Time)	0.3457***	0.3540***	Type of Fuel (Fuel-Oil)	-0.1365	-0.1606
	(0.0253)	(0.0399)		(0.1032)	(0.1579)
Job Status (Self-Employed Part Time)	0.3645***	0.2081***	Type of Fuel (Electricity)	-0.1926***	-0.1623**
	(0.0438)	(0.0751)		(0.0569)	(0.0793)
Unemployed	0.3694*	0.4228**	Type of Fuel (Dried cow dung)	0.1269***	0.1978***
	(0.1884)	(0.2059)		(0.0342)	(0.0545)
Retired	1.8682***	1.210*	Piped Water (No)	0.0636*	0.1301**
	(0.0710)	(0.6164)		(0.0382)	(0.0636)
Occupation code (Professionals)	-0.0368	-0.1130*	Number of Observations	84,640	82,796
	(0.0428)	(0.0606)			
Occupation code (Clerical Support Workers)	0.1259***	0.0837	Pseudo R Square		
	(0.0429)	(0.0626)			
Occupation code (Skilled agricultural, forestry and fishery workers)	0.1518***	0.1140**	Wald Chi Square	7,528.34	6,756.20
	(0.0338)	(0.0480)		[0.000]	[0.000]
House Size	-0.0013***	-0.0013**	Additional Costs of Pollution	(17.30;20.11)	((18.21;20.78)
	(0.00035)	(0.0005)			

Standard errors between brackets, p-value between square brackets, ***, ** and * indicate significance at 1%, 5% and 10% level.

Table 5. Two Stages Least Squares Estimates for Non-Movers

Variables	2SLS	Variables	2SLS
Logarithm of Household Income	-0.1291***	Household Type (2 ad., no dep, children < 65)	-0.0971**
	(0.0080)		(0.0468)
Air Pollution	0.1304**	Household Type (2 ad., no dep. children, at least one adult 65 years or more)	0.0809*
	(0.0594)		(0.0417)
Noise Pollution	0.1569**	Household Type (2 ad. with one dep. child)	-0.0982**
	(0.0723)		(0.0447)
Marital Status (Single never married)	0.0202	Household Type (2 ad. with two dep. children)	-0.0927**
	(0.0189)		(0.0402)
Marital Status (Widowed)	0.2242***	House Tenure (Tenant)	0.0167
	(0.0377)		(0.0152)
Marital Status (Divorced)	0.1712***	House Tenure (Lodging)	-0.0032
	(0.0341)		(0.0332)
Marital Status (Separated)	0.1257*	Indoor Flushing Toilet (Yes) shared	-0.0075
	(0.0647)		(0.0169)
Primary school	-0.2673***	Indoor Flushing Toilet (No)	0.0138
	(0.0174)		(0.0236)
High school	-0.3949***	Type of Fuel (Coal)	-0.0198
	(0.0242)		(0.0144)
Higher education level	-0.4340***	Type of Fuel (Natural Gas)	-0.0289
	(0.0273)		(0.0275)
Job Status (Employee Part Time)	0.1380***	Type of Fuel (Fuel-Oil)	-0.0887
	(0.0164)		(0.0613)
Job Status (Self-Employed Part Time)	0.0869***	Type of Fuel (Electricity)	-0.1296***
	(0.0302)		(0.0377)
Unemployed	0.1904*	Type of Fuel (Dried cow dung)	0.1092***
	(0.1064)		(0.0331)
Retired	0.6814**	Piped Water (No)	0.0484*
	(0.3455)		(0.0249)
Occupation code (Professionals)	-0.0538**	Number of Observations	60,224
	(0.0234)		
Occupation code (Clerical Support Workers)	0.0245*	R Square	0.1501
	(0.0134)		
Occupation code (Skilled agricultural, forestry and fishery workers)	0.0850***	Sargan statistic exogeneity test	1.768
	(0.0251)		[0.1837]
House Size	-0.0003***	Cragg-Donald Weak identification test Wald F-statistic	94.136
	(0.0001)		[0.000]
		Additional Costs of Pollution	(23.00;27.67)

Standard errors between brackets, p-value between square brackets, ***, ** and * indicate significance at 1%, 5% and 10% level.

Table 6. Three Stages Least Squares Estimates for Non-Movers

Variables	Exogenous	Endogenous
Logarithm of Household Income	-0.1171***	-0.1170***
	(0.0046)	(0.0046)
Air Pollution	0.1181**	0.1237**
	(0.0538)	(0.0537)
Noise Pollution	0.1392**	0.1489**
	(0.0674)	(0.0677)
Additional Costs of Pollution	(19.21;22.66)	(20.13;24.24)

Standard errors between brackets, *** and ** indicates significance at 1% and 5% level

Table 7. Pooled and Panel Conditional Fixed Effects Logit Models for Chronic Illnesses

Model	(1)	(2)	(3)	(4)
Variables	**Panel A: Pooled Logit**			
Logarithm of Household	-0.1552***	-0.1517***	-0.0964***	-0.1749***
Income	(0.0155)	(0.0177)	(0.0240)	(0.0329)
Air Pollution	0.2445***	0.2343***	0.1310*	0.2797***
	(0.0199)	(0.0230)	(0.0722)	(0.0404)
Noise Pollution	0.2448***	0.2693***	0.1507	0.1667***
	(0.0226)	(0.0263)	(0.1062)	(0.0457)
Number of Observations	112,338	84,640	747	26,937
LR Chi Square	18,192.63	13,987.61	206.32	4,147.24
	[0.000]	[0.000]	[0.000]	[0.000]
Pseudo R Square	0.1506	0.1523	0.2474	0.1479
Additional Costs of Pollution	(17.58;18.00)	(16.05;17.63)	(17.03;17.24)	(18.72;13.74)
	Panel B: Panel Fixed Effects Logit			
Logarithm of Household	-0.1548***	-0.1755***	-0.5263	-0.1102**
Income	(0.0219)	(0.0251)	(0.5739)	(0.0471)
Air Pollution	0.2582***	0.2476***	1.077	0.2955***
	(0.0273)	(0.0316)	(0.7123)	(0.0560)
Noise Pollution	0.2504***	0.2770***	-0.5442	0.1653***
	(0.0308	(0.0357)	(0.7776)	(0.0629)
Number of Observations	50,141	38,182	368	11,778
LR Chi Square	6,742.80	5,167.78	145.17	1,619.47
	[0.000]	[0.000]	[0.000]	[0.000]
Pseudo R Square	0.1774	0.1795	0.5201	0.1825
Additional Costs of Pollution	(37.07;33.51)	(29.65;32.59)	(36.49;28.67)	(56.81;32.16)

Standard errors between brackets, p-values between square brackets, *** and ** indicates significance at 1% and 5% level
In column (1) the results refer to total sample, column (2) to non-movers, column (3) to movers for environmental reasons and column (4) to movers for other reasons.

Table 8. Estimates of Poor Health Effects on Work Hours Lost and Wages

Model	Total Sample	Non-Movers	Total Sample	Non-Movers
Panel A: Fixed Effects DV Log of Working Hours Lost				
Logarithm of Household	-0.2877**	-0.2651***	-0.1929**	-0.1891***
Income	(0.1141)	(0.1010)	(0.0779)	(0.0903)
Health Status (Poor)	1.3435**	1.5516**		
	(0.6408)	(0.7141)		
Chronic Illnesses (Yes)			1.3768**	1.2939**
			(0.5377)	(0.5917)
Panel B: Fixed Effects for Wage DV Log of Wage				
Health Status (Poor)	-0.1174***	-0.1189***		
	(0.0087)	(0.0089)		
Chronic Illnesses (Yes)			-0.0872***	-0.0859***
			(0.0090)	(0.0104)

Standard errors between brackets, p-values between square brackets, *** and ** indicate significance at 1% and 5% level