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Residential Satisfaction for a Continuum of Households: Evidence from European Countries[§]

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Abstract

Residential satisfaction depends on housing and neighborhood conditions in addition to housing cost affordability. To determine the relative importance of these factors, their average effect is usually estimated using sample data, eventually split in sub-samples in order to represent social classes. A concern about the division of households into groups is that, as groups are modified or group assignment change, results of quantitative analysis applied to such data can dramatically change.

This paper follows a subjective well-being approach to study residential satisfaction. We propose a novel empirical strategy independent of the concept of social class, to estimate how the effect of drivers of residential satisfaction change on continuous according to households' income.

We apply our methodology to investigate residential satisfaction in 23 European countries using 2012 EU-SILC module on housing conditions. Our results show that: *(i)* in Europe residential satisfaction is driven first by housing-specific characteristics, followed by neighborhood conditions and individual/household characteristics; *(ii)* the probability to be satisfied or very satisfied strongly differs across countries, anything else being equal; *(iii)* residents with different monetary resources attach importance to particular determinants of residential satisfaction.

Key Words: housing; subjective well-being; Europe; EU-SILC Survey.

JEL Codes: R11; R21.

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1. Introduction

Residential satisfaction refers to the degree to which households evaluate the place in which they live. Satisfaction comes from having good housing, comfort, good quality of neighborhood. It is essentially a multidimensional concept, since it depends on satisfaction in different domains, mainly housing-specific features and neighborhood conditions. Presumably, the more the dwelling and the neighborhood are of high quality, the highest are housing-related expenditures. Residential satisfaction is then the result of a balance between benefits arising from housing and neighborhood facilities and expenditures entailed by them.

In the economic literature, to determine the relative importance of drivers of residential satisfaction, the average effect of each variable is usually estimated using sample data eventually split in sub samples in order to represent social classes. For instance, Filandri and Olagnero (2014) investigate the relationship between ownership and housing well-being by distinguishing between upper or high class, middle class and low class.[1] A concern about the division of households into groups is that as groups are modified or group assignment change, results of quantitative analysis applied to such data can dramatically change. Moreover, we wonder whether it is still suitable to analyze socio-economic phenomena in modern societies with respect to social class. Some authors claim that social class "no longer exists as a meaningful social entity" (Pakulski and Waters 1997, p. 667).

In this paper, we propose an empirical methodology to overcome the problem of estimation results depending on the way the sample is divided to take into account people's different status or economic resources. We move from the idea of dividing households into groups and propose an empirical strategy in which the effect of each determinant of residential satisfaction can change *on continuous* according to households' income. More specifically, we want to

[1] Social class is defined with the International Standard Classification of Occupations (ISCO), two digits codes.

determine how their impact changes when we consider people with different resources.

We apply our methodology to investigate what determines residential satisfaction in 23 European countries using the 2012 EU-SILC module on housing conditions.

Our results confirm a priori expectations about the sign of determinants of residential satisfaction, while they are particularly insightful to determine the relative importance of determinants depending on household monetary resources.

The remainder of the paper is structured as follows. In Section 2 we review the literature about residential satisfaction. Section 3 describes data and variables. Section 4 discusses the empirical strategy. Section 5 presents the results. The last section concludes.

2. Residential satisfaction: A view from the literature

Residential satisfaction has been conceptualized in many different ways, however it is generally considered as a multidimensional concept.[2] For instance, Francescato et al. (1986) define residential satisfaction as people‘s response to the environment in which they live. The authors provide a six-domain taxonomy of variables determining residential satisfaction: objective environmental attributes, individual characteristics, behavioral and normative beliefs, perceptions, emotions, and behavioral intentions. Such variables include not only the physical environment but also aspects such as management, community and health (Potter et al. 2001).

In the last few decades, a growing body of literature in housing has explored the determinants of residential satisfaction looking at people’s subjective (self-reported) evaluation of housing and neighborhood in which they live. Within this framework, individuals are directly asked to

[2] For of a detailed overview of the concept of residential satisfaction, see Mohit and Khanbashi Raja (2014).

rate their own residential satisfaction, either overall or with respect to specific domains. This type of analysis has been carry out mainly in North America, in particular in the United States while they have been much more rare in Europe. As for the former, Lu (1999), for instance, uses the national data from the American Housing Survey to investigate the drivers of residential satisfaction in the United States. As for the latter, Balestra and Sultan (2013) use EU-SILC survey on European countries and the Gallup World Poll data on OECD countries to explore the link between households' residential satisfaction and a number of variables related to individuals, the households to which they belong, and the characteristics of the dwelling and neighborhood where they live.

These works highlight different issues related to residential satisfaction: Lu (1999) emphasizes the policy implications empirical analysis. The latter indeed represent a tool for policy makers to deeply understand perceptions and preferences of residents and to design more effective housing programs. James (2008) and Huang and Du (2015) focus on residential satisfaction with public housing with the aim to assess whether public housing meet needs of low-income groups. More specifically, James (2008) looks at the size of public housing project and at its effects on residential satisfaction; Huang and Du (2015) evaluate the efficiency of public housing allocation scheme.

Finally, an increasing number of studies merge the literature about mobility with the literature on residential satisfaction. The aim of these studies is to analyse the impact of residential satisfaction on mobility decision. The idea is that the quality and the perception of place where people leave affect the mobility propensity of households, once their income resources are taken into account. For example, Van Ham and Feijten (2008) analyse the role of neighbourhood characteristics in individual residential moving behaviour in the Netherlands. Diaz-Serrano and Stoyanova (2010) investigate the relationship between residential mobility and housing satisfaction in 12 European Union countries. They focus on observed mobility rather than the

commonly used indicators based on intention to move. Moreover, their study is based on panel data, which allows to observe variations in the determinants of housing mobility when this event occurs.

3. Data and Variables

Data are taken from EU-SILC which released a specific module on housing conditions in 2012 for the European countries. We restrict our analysis to 23 countries for which information is complete.[3]

The satisfaction for the dwelling is based on the following question "How satisfied are you with your dwelling?" The response is measured on a four-point Likert scale:

1. Very dissatisfied;
2. Dissatisfied;
3. Satisfied;
4. Very satisfied

We consider four groups of factors determining residential satisfaction: *(i)* housing-specific conditions; *(ii)* neighborhood conditions; *(iii)* housing cost affordability; *(iv)* individual and household attributes.

As for housing-specific conditions, we consider:

- Type of dwelling, measured by a dummy variable equal to 1 whether the housing unit is detached or semi-detached; it is equal to 0 whether the housing unit is an apartment;

[3] The countries considered are the following: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Portugal, Slovak Republik, Spain, Sweden, United Kingdom.

- an interaction variable between a dummy variable identifying the degree of urbanization and the type of dwelling. A detached or semi-detached home is expected to have a greater impact on satisfaction in a densely populated area than in a thinly populated area.
- Overcrowding, measured by a dummy variable equal to 1 whether the dwelling is overcrowded; 0 otherwise. Following Eurostat (2016), a dwelling is overcrowded if the number of rooms available is lower than the number of rooms needed, taking into account the household's size, as well as its members' ages and family situation.
- Dwelling lacks, such as dampness in the walls or dwelling too dark, without enough day-light. Lacks are measured by a discrete variable ranging from 0 (absence of lacks) to 2 (both lacks in the dwelling).
- Material deprivation in terms of lack of: *(i)* a shower unit or a bathtub for sole use of the household in the dwelling; *(ii)* an indoor flushing toilet for sole use of the household in the dwelling; *(iii)* eating. Material deprivation is measured by two dummy variables, one for moderate deprivation, and the other for severe deprivation. The first dummy variable is equal to 1 whether housing is deprived on 1 or 2 items; 0 otherwise. The second dummy variable for severe material deprivation is equal to 1 whether housing is deprived on all three items.

As for neighborhood conditions, we consider:

- Accessibility of basic needs, such as grocery services, banking service, postal service, public transport, primary health care services, compulsory schools. It is measured by a discrete variable ranging from 0 (no accessibility) to 6 (accessibility of all basic needs);
- Environmental problems, such as *(i)* noise from neighbors or from street; *(ii)* pollution, grime. These problems are measured from a discrete variable ranging from 0 (no environmental problem) to 2 (both problems).
- Crime violence or vandalism in the area, measured by a dummy variable equal to 1 whether

the respondent feels crime, violence or vandalism to be a problem for the household.

Housing costs include: mortgage interest payments; rent payments; structural insurance, mandatory services and charges (sewage removal, refuse removal, etc.); regular maintenance and repairs; taxes, cost utilities (water, electricity, gas and heating). They are expressed as percentage of total disposable household income. The latter is net of income taxes and includes social security contributions. Housing costs to income ratio is a suitable measure for evaluating the cost component of housing affordability (Gabriel et al., 2005).

Individual and household attributes include: gender; age; education level (up to lower secondary education; upper secondary education; tertiary education); employment status (dummy variable equal to 1 whether the respondent is employed; 0 otherwise); household type (single; single with children; couples without children; couples with children). In addition to these variables, we consider the tenure status, distinguishing between outright owner; owner paying mortgage; tenant or subtenant paying rent at prevailing or market rate; tenant or subtenant paying rent at a reduced rate (lower than the market price); accommodation provided for free (there is no rent to be paid because the accommodation comes with the job, or is provided rent-free from a private source). Table 1 provides summary statistics of variables used in the analysis.

Variable	Measure	Mean	Std.Dev.	Min.	Max.
Dependent variable					
Satisfaction with the dwelling	4-point measure	3.168	0.705	1	4
Housing-specific characteristics					
Type of dwelling	dummy variable	0.581	0.493	0	1
*Type of dwelling*Urbanization*	dummy variable	0.131	0.337	0	1
Overcrowding	dummy variable	0.124	0.330	0	1
Dwelling lacks	discrete variable	0.208	0.466	0	2
Moderate material deprivation	dummy variable	0.054	0.225	0	1
Severe material deprivation	dummy variable	0.0004	0.019	0	1
Neighborhood conditions					
Accessibility	discrete variable	5.103	1.514	0	6
Environment	discrete variable	0.289	0.587	0	2
Crime	dummy variable	0.114	0.318	0	1
Housing costs					
Ratio of housing cost over income	continous variable	0.2049	0.145	0	0.8498
Individual and household attributes					
Gender	dummy variable	0.565	0.496	0	1
Age	discrete variable	55.09	15.44	24	81
Education (up to lower secondary)	dummy variable	0.305	0.448	0	1
Education (upper secondary)	dummy variable	0.393	0.459	0	1
Education (tertiary)	dummy variable	0.302	0.452	0	1
Employed	dummy variable	0.496	0.500	0	1
Single without children	dummy variable	0.252	0.434	0	1
Single with children	dummy variable	0.041	0.198	0	1
Couples without children	dummy variable	0.413	0.492	0	1
Couples with children	dummy variable	0.295	0.456	0	1
Outright owner	dummy variable	0.532	0.499	0	1
Owner paying mortgage	dummy variable	0.231	0.421	0	1
Tenant paying rent at market rate	dummy variable	0.132	0.338	0	1
Tenant paying rent at a reduced rate	dummy variable	0.055	0.229	0	1
Accommodation provided for free	dummy variable	0.050	0.219	0	1
Income	continuous variable	39220	36337	-9690	3945000

Table 1: Summary statistics of variables

The overall distribution of satisfaction with the dwelling is slightly skewed towards higher satisfaction.[4] About 58 per cent of sample members live in detached or semi-detached homes. 13.1% of those are located in densely populated areas.

A minority of people live in crowded houses (12.4%), in homes with some lacks (20.8%), or in houses with either a moderate degree or a severe degree of material deprivation (5.4% and 0.04%, respectively).

On average, sample households have access to 5 services out of 6. Around 29 per cent of

[4] Higher levels of satisfaction are in Northern countries, and in France, United Kingdom, Austria.

dwellings are located in areas with environmental problems, while 11.4 per cent of respondents claim to live in areas exposed to crime or vandalism. The average percentage of household resources devoted to housing expenditures is 20.49%.

About 56 per cent of respondents are female and the mean age is 55. We consider adult respondents, aged 24 and above. Respondents are quite evenly distributed across educational levels with a slight majority for the upper secondary educational level. About 49 per cent of respondents are employed. More than 70 per cent of respondents live in couple and more than 50 per cent are outright owners. Overall, we consider 175,642 respondents distributed across 23 European countries.

4. Empirical Framework

We use a proportional-odds cumulative logit model (Agresti, 2002) to evaluate the impact of factors determining residential satisfaction on the probability to be satisfied with the dwelling. The dependent variable, denoted by *Y*, and measuring the level of satisfaction with the house, is defined on *J* ordered categories.

The proportional odds model assumes that the cumulative logits are expressed as a function of a linear combination of the set of explanatory variables, denoted by $\boldsymbol{x} = (x_1, \dots, x_K)$, according to the following equation:

$$logit[P(Y \geq j|\boldsymbol{x})] = \alpha_j + \boldsymbol{\beta}'\boldsymbol{x}, \qquad j = 2, \dots, J. \tag{1}$$

Each cumulative logit describes the log-odds of two cumulative probabilities, namely the probability of not being below a certain category *j* of the response variable and the probability of being below this category. Each equation has its own intercept α_j representing the log-odds of falling into or above category *j* when the continuous variables are zero and the categorical

variables are equal to their baseline-category. The parameter β_k describes the effect of x_k on *Y*: β_k is the increase of the log-odds of falling into or above any category of *Y* due to a one-unit increase in x_k, holding all the other variables in the model constant. A positive slope, hence, indicates a tendency of the satisfaction to increase as the explanatory variable increases.

To assess residential satisfaction in European countries, the model considered above has been extended to include potential nonlinear effects of continuous variables. To simplify notation, we assume that only continuous predictors are included in the model. Equation (1) can be rewritten as

$$logit[P(Y \geq j)] = \eta_j(\boldsymbol{x}), \quad j = 2, \dots, J \qquad (2)$$

where $\eta_j(\boldsymbol{x})$ is an unknown function representing the nonlinear effects of the covariates $\boldsymbol{x} = x_1, \dots, x_p$. Maintaining the assumption of proportionality, this function can be specified by $\eta_j(\boldsymbol{x}) = \alpha_j + \eta(\boldsymbol{x})$, and, preserving the additive nature of the effects, we obtain

$$\eta_j(\boldsymbol{x}) = \alpha_j + f_1(x_1) + \cdots + f_p(x_p)$$

where $f_s(x_s)$, $s = 1, \dots, p$, represents the effect of variable x_s on logit *j*.

In this paper a spline approach has been employed to approximate the unknown functions $f_s(x_s)$, $s = 1, \dots, p$. More specifically, a cubic B-spline specification has been used to approximate each function $f_s(x_s)$. A spline function is a piecewise polynomial function in the variable x_s. Polynomials are joined at certain values of the variable, called the knots, in such a way that the spline is regular at the places where the pieces meet. Indicating by $B_{s1}(x_s), \dots, B_{sk_s}(x_s)$ a set of third degree polynomials, named the basis functions, and by $\beta_{s1}, \dots, \beta_{sk_s}$ a vector of coefficients, the B-spline representation of $f_s(x_s)$ is $\sum_{m=1}^{k_s} \beta_{s,m} B_{s,m}(x_s)$. Replacing this representation in equation (2) the model turns into

$$logit[P(Y \geq j)] = \alpha_j + \sum_{m=1}^{k_1} \beta_{1,m} B_{1,m}(x_1) + \cdots + \sum_{m=1}^{k_p} \beta_{s,m} B_{s,m}(x_p), \quad j = 2, \dots, J.$$

This model is linear in the new set of covariates obtained by transforming the original set of variables through the function bases, hence adding other categorical or numerical explanatory variables to the linear predictor is straightforward. This representation is extremely convenient since ordinary estimating procedures (i.e. the maximum likelihood) can be adopted to estimate the parameters of the regression model.

As mentioned above, B-splines are constructed from polynomial pieces joined at the knots. The choice of knots is a key point in spline modelling since too many knots lead to overfit the data and to unstable estimates whereas to few knots lead to too smooth estimates and poor fit. A possible way around the problem is to use a relatively large number of knots and prevent overfitting by including a penalty when estimate the regression on the data. The P-spline approach (Eilers and Marx 1996) relies on a penalty based on the difference of the coefficients of adjacent components of the B-splines basis. These constrains can be included in the usual estimation procedures in a relative simple way. Yee (2010) described how this procedure can be applied to a large class of multivariate models, so-called vector generalized additive models, including the proportional odds model presented above. In this paper the VGAM library of R (Yee, 2010) has been employed to estimate the model. Technical details of model fitting can be found in Yee (2015).

Since the aim of the paper is to estimate how the effect of each determinant of residential satisfaction changes according to household monetary resources, we have proceeded as follows: the ordered logit is estimated separately for each income quartile: We obtain four estimated coefficients associated with each covariate, one per quartile. The four estimated values are interpolated by a smooth function to obtain a continuous pattern of the effect of each covariate depending on income.

To strengthen our methodology, we developed two types of robustness checks: first, the composition of the four quartiles has been perturbed by swapping a minor percentage of

households from a group to the adjacent one; second alternative partitions of income distribution is considered in alternative to quartiles.

5. Results

Estimation results of the benchmark model in which regressors enter linearly in the specification of model (1) are shown in Table 2. The logit regression is run separately for each quartile of the income distribution. Estimations, obtained by maximum likelihood, are mostly significant and have the expected sign. Regressors include housing-specific conditions, neighborhood conditions, housing costs, individual and housing attributes as described in the Section 3. We also added in the specification a country fixed effect representing factors specific to each country such as societal standards or rules for life conditions. The latter are known as housing cultural norms (Lu, 1999). In the UK, for example, a single-family home or a semi-detached home with a private garden is prescribed as by the mainstream culture as the housing norm.[5]

As we will see in detail at the end of this section, housing-specific characteristics are the most important factors in explaining the variability of the probability to be satisfied, followed by neighborhood conditions and individual or household attributes. For this reason, we show in detail the results for the first two blocks of variables, while estimated effects of individual and housing attributes are graphically shown in Appendix.

[5] From an econometric perspective, the country fixed effects allow us to control for time-invariant unobserved factors, so reducing endogeneity issues.

Variable	Q1		Q2		Q3		Q4	
Housing-specific characteristics								
Type of dwelling	0,20	***	0,23	***	0,35	***	0,32	***
	(0,0299)		(0,0291)		(0,0299)		(0,0355)	
Urbanization	-0,03		-0,09	**	-0,02		0,03	
	(0,0305)		(0,0297)		(0,0314)		(0,0382)	
*Type of dwelling*Urbanization*	0,13	**	0,07		0,04		0,00	
	(0,0499)		(0,0455)		(0,0436)		(0,0457)	
Overcrowding	-0,50	***	-0,54	***	-0,52	***	-0,46	***
	(0,0311)		(0,0326)		(0,0349)		(0,0433)	
Dwelling lacks	-0,79	***	-0,73	***	-0,74	***	-0,65	***
	(0,0199)		(0,0226)		(0,0236)		(0,0256)	
Moderate material deprivation	-0,49	***	-0,29	***	-0,24	***	-0,21	**
	(0,0339)		(0,0489)		(0,0617)		(0,0770)	
Severe material deprivation	-1,30	***	-1,83	**	NA		NA	
	(0,2705)		(0,6108)					
Neighborhood conditions								
Accessibility	0,10	***	0,11	***	0,10	***	0,09	***
	(0,0065)		(0,0069)		(0,0072)		(0,0076)	
Environment	-0,21	***	-0,27	***	-0,33	***	-0,34	***
	(0,0188)		(0,0181)		(0,0177)		(0,0184)	
Crime	-0,33	***	-0,23	***	-0,21	***	-0,13	***
	(0,0340)		(0,0332)		(0,0319)		(0,0330)	
Housing costs								
Ratio of housing costs over income	-0,23	**	0,49	***	0,29	*	0,31	*
	(0,0724)		(0,1062)		(0,1287)		(0,1501)	

Note: Logit estimates by quartile; standard deviations are reported in parentheses. * Significance at the 0.10 level; ** significance at the 0.05; *** significance at the at 0.01.

Table 2: Estimation results of model (1)

Variable	Q1		Q2		Q3		Q4	
Individual and household attributes								
Age	0,01	***	0,01	***	0,01	***	0,01	***
	(0,0009)		(0,0009)		(0,0010)		(0,0011)	
Gender	0,10	***	0,05	*	0,07	***	0,08	***
	(0,0229)		(0,0212)		(0,0204)		(0,0201)	
Upper secondary education	0,15	***	0,15	***	0,12	***	0,19	***
	(0,0265)		(0,0269)		(0,0270)		(0,0306)	
Tertiary education	0,31	***	0,31	***	0,29	***	0,41	***
	(0,0345)		(0,0317)		(0,0296)		(0,0304)	
Single with children	-0,07		-0,40	***	-0,25	***	-0,28	**
	(0,0530)		(0,0481)		(0,0545)		(0,0950)	
Couples without children	-0,03		-0,18	***	-0,10	**	-0,01	
	(0,0255)		(0,0277)		(0,0316)		(0,0502)	
Couples without children	0,05		-0,16	***	-0,21	***	-0,12	*
	(0,0400)		(0,0355)		(0,0353)		(0,0515)	
Employed	0,11	***	0,05	.	0,02		0,01	
	(0,0284)		(0,0257)		(0,0248)		(0,0265)	
Owner paying mortgage	0,24	***	0,06	.	0,11	***	0,09	***
	(0,0480)		(0,0336)		(0,0284)		(0,0267)	
Tenant paying rent at market rate	-0,44	***	-0,62	***	-0,59	***	-0,60	***
	(0,0415)		(0,0392)		(0,0389)		(0,0435)	
Tenant paying rent at a reduced rate	-0,40	***	-0,51	***	-0,51	***	-0,62	***
	(0,0457)		(0,0459)		(0,0489)		(0,0649)	
Accomodation provided for free	-0,09	*	-0,07		-0,14	*	-0,19	**
	(0,0457)		(0,0463)		(0,0548)		(0,0695)	
Country fixed effect	Yes		Yes		Yes			
Intercept : 1	4,12	***	3,82	***	3,78	***	3,29	***
	(0,1233)		(0,1073)		(0,1065)		(0,1191)	
Intercept : 2	2,50	***	2,46	***	2,70	***	2,55	***
	(0,1213)		(0,1050)		(0,1044)		(0,1176)	
Intercept : 3	-1,30	***	-1,12	***	-0,71	***	-0,52	***
	(0,1208)		(0,1042)		(0,1033)		(0,1165)	
	N = 43,911		N = 43,910		N = 43,910		N = 43,910	
	F = 106.75	***	F =96.22	***	F =95.33	***	F=87.12	***

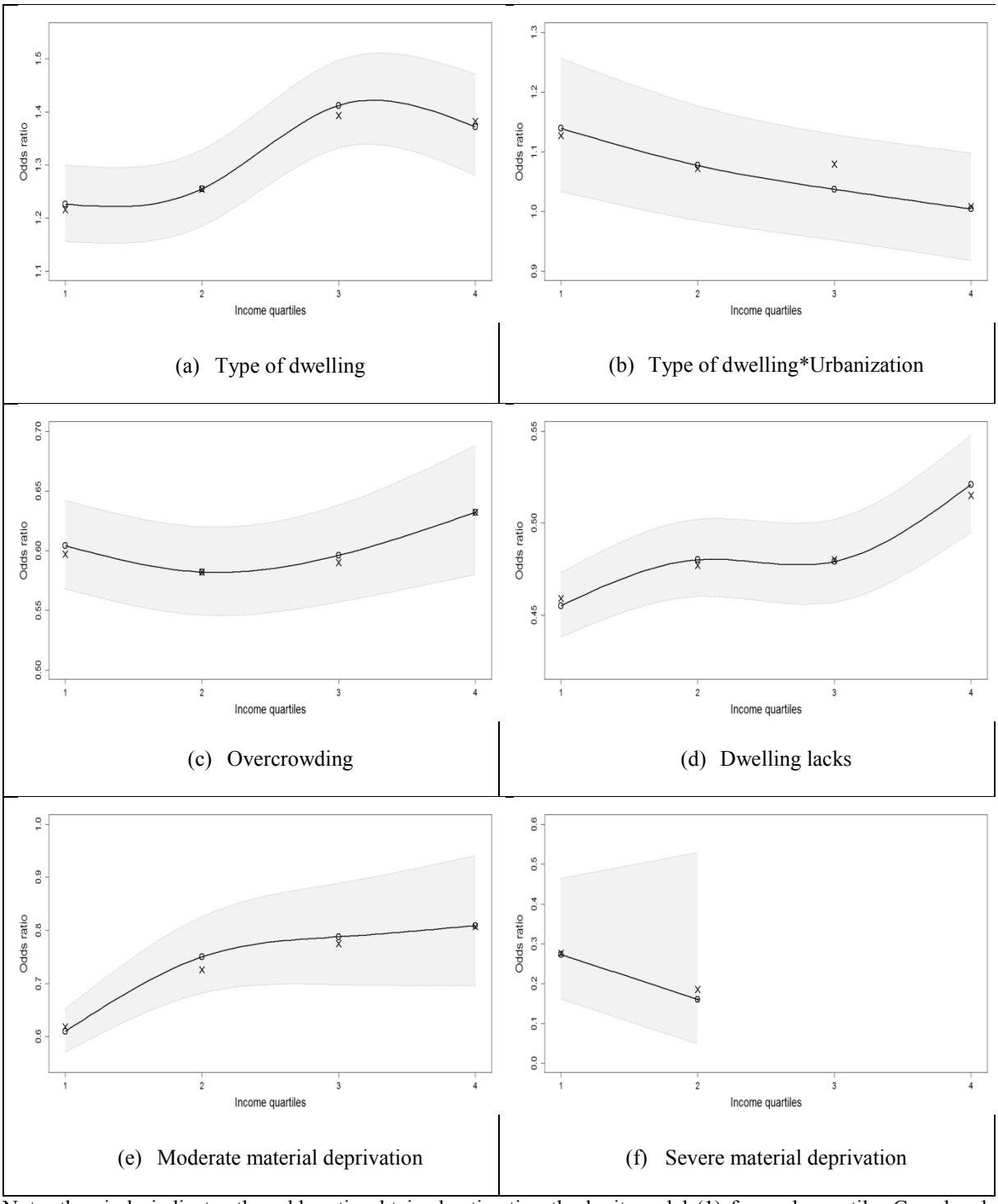
Note: Logit estimates by quartile; standard deviations are reported in parentheses. * Significance at the 0.10 level; ** significance at the at 0.05; *** significance at the at 0.01.

Table 2 cont.: Estimation results of model (1)

Looking at the housing-specific characteristics, Figure 2 shows the path of the odds ratio with income on the horizontal axis. An odds ratio hither than 1 means that, anything else being equal, a marginal increase in the covariate implies an increased likelihood of being satisfied with the dwelling, whereas an odds ratio lower than 1 indicates a decreased likelihood. An odds ratio

equal to 1 means that an increase in the covariate is not related to a variation in the likelihood of being satisfied. In figure below, the circle indicates the odds ratio obtained estimating the logit model (1) for each quartile. The four odds ratio have been interpolated as explained in Section 4. Gray bands represent the 95% confidence interval of the parameter of interest. The cross indicates the odds ratio obtained by estimating the same model after having perturbed the four income categories. Ten per cent of observations of each category nearer to the category boundaries were swapped from a group to the adjacent ones. For all covariates, it turns out that perturbing the quartile composition induces a somewhat negligible variation in the parameter estimates that, however, remain well inside the confidence band of the corresponding parameter.

Households living in detached houses or semi-detached houses are more likely to express higher levels of satisfaction than households living in apartment. Such positive effect is stronger if the dwelling is located in high-dense urban areas and if it is owned by less wealthy households. Poor quality and inadequate housing – overcrowded, with lacks or characterized by a moderate degree or a severe degree of deprivation – have a negative impact on residential satisfaction. The effect of these factors are quite stable across the income distribution, except for moderate material deprivation, whose effect is stronger for poor households; and severe material deprivation, whose effect is absent for half of the richest households since their dwellings do not suffer from the lack of a shower unit, an indoor flushing toilet and from the lack of eating.

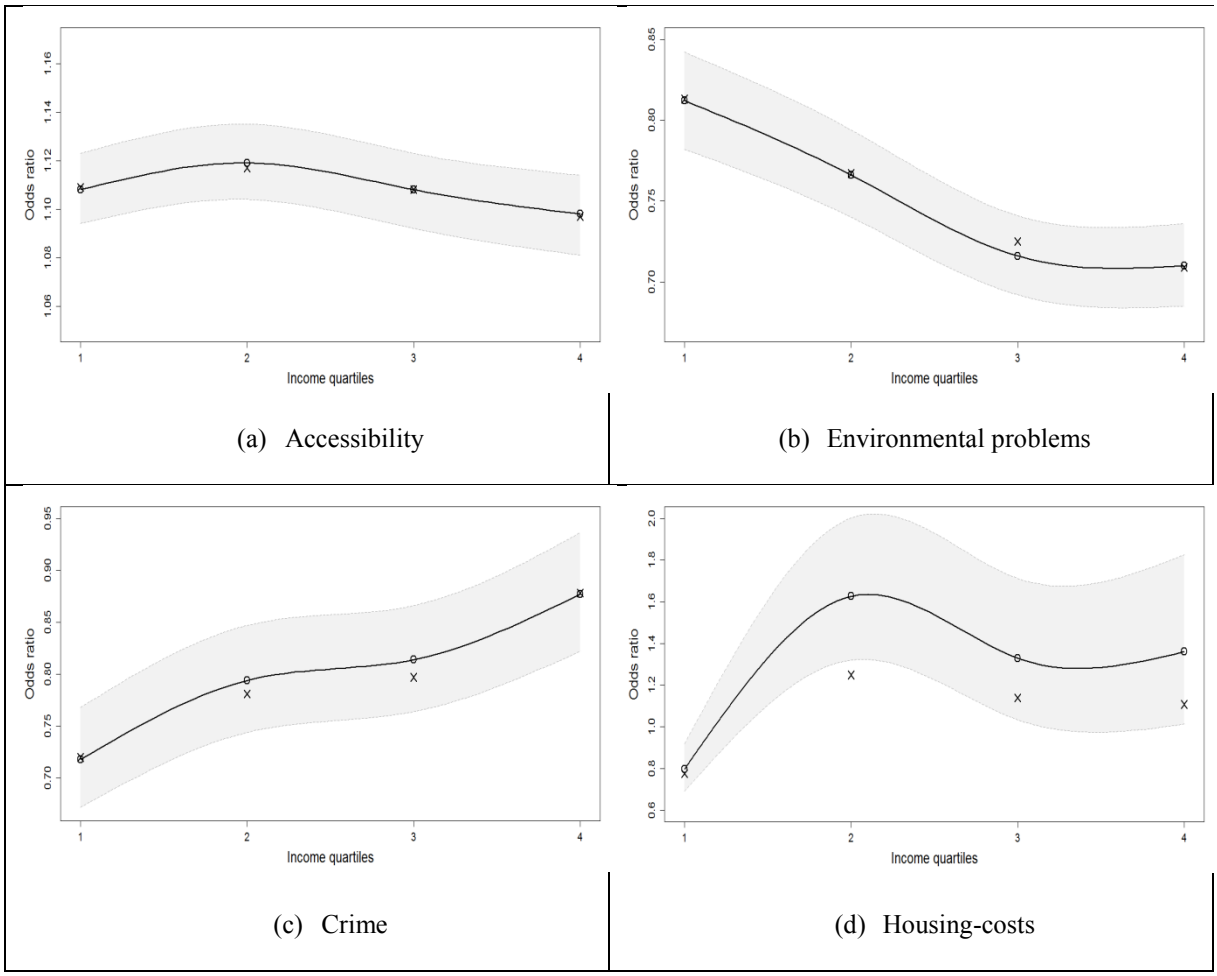


Note: the circle indicates the odds ratio obtained estimating the logit model (1) for each quartile. Gray bands represent the 95% confidence interval of the parameter of interest. The cross indicates the odds ratio obtained by estimating the same model after having perturbed the quartiles as explained in Section 4. Ten per cent of observations near the thresholds were swapped from a group to the adjacent ones.

Figure 2: Odds ratio of housing-specific conditions across household income distribution.

The effect of neighborhood conditions are shown in Figure 3. Accessibility of basic needs has a positive effect on residential satisfaction; this effect is quite stable across household income distribution. Environmental problems and crime have a negative effect on residential satisfaction: while the latter is a concern especially for poor households, the former plays a negative role especially for rich households. Our findings on crime are consistent with previous results; Rainwater (1966), for example, shows that the poor have a greater concern with crime than the rich. To our knowledge, we are indeed the first to provide an estimation for the effect of environment on residential satisfaction when monetary resources may change across households. Our result about environmental problems reflects the idea according to which "*environmental quality is very much like leisure time: as people become wealthier they demand more of it, mostly because they can better afford it*" (Boudreaux, 2008 p. 26).

The last chart of Figure 3 shows the pattern for housing costs over household disposable income. They are negatively related to satisfaction only for about 30 per cent of the poorest households (the odds-ratio is equal to 1 at the twenty-ninth percentile). Then housing costs have a positive effect at an increasing rate up to the fifty-first percentile; beyond that, the effect remains positive but a decreasing rate. Higher income households have greater capacity to bear housing costs. Part of these costs may be needed to maintain a comfortable housing, proper to the socio-economic status of owners. Housing costs, on the other hand, are a burden for low-income households with negative consequences on satisfaction with the dwelling.



Note: the circle indicates the odds ratio obtained estimating the logit model (1) for each quartile. Gray bands represent the 95% confidence interval of the parameter of interest. The cross indicates the odds ratio obtained by estimating the same model after having perturbed the quartiles as explained in Section 4. 10% of observations near the thresholds were swapped from a group to the adjacent ones.

Figure 3: Odds ratios of neighborhood conditions and housing costs across household income distribution.

Turning to individual and household characteristics, these variables allow to control for possible differences in the assessment of same housing and neighborhood conditions by individuals with different attributes or household background (Lu, 1999). Their effect is shown in Appendix, Figure A1. Age has a positive effect, which is quite stable across household income distribution. We find a similar result for women, who are more likely to be satisfied with the dwelling than man. This is explained by the persistence in Europe of social norms regarding gender

stereotypes with the consequence that housing activities are still largely allocated to women.[6] The result according to which housing ensures a greater satisfaction to those who dedicate more time and attention to routine housework seems to be plausible.

Education and employment are positively related with satisfaction. As for the former, the positive effect is stronger for individuals at the top of income distribution with college education than those with an upper secondary education (the reference being lower secondary education or less). As for the latter, the positive effect is stronger for people at the bottom of income distribution up to the median. Beyond that, being employed does not significantly affect residential satisfaction everything else being equal. The positive effect of education may be due to the fact that, everything else being the same, households with higher education are better able to find better housing than less-educated people (Fredrickson et al. 1980).

Looking at the household composition, single and couples with or without children are less likely to be satisfied with the dwelling compared to single without children, which is the reference. The negative effect is stronger for single with children. Once we control for housing costs and overcrowding, a possible explanation of this result is that single-parent households tend to express lower levels of overall subjective well-being, which might in turn translate into lower levels of housing satisfaction (see Balestra and Sultan, 2012 and references therein). Similarly, couples with or without children may express a lower level of satisfaction than single without children since sharing daily life in the same housing requires a capacity of adaptation and tolerance, which is not needed to singles.

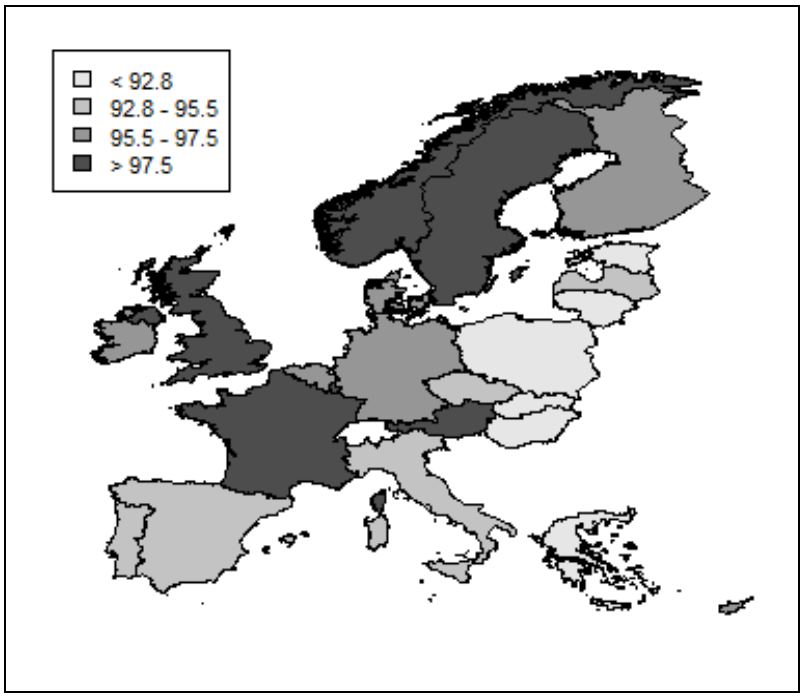
The last feature of respondents we consider is tenure status. While owners paying mortgage are more likely to be satisfied with the dwellings than owners *tout court* (the latter being the reference), tenants paying rents at a market price or at a reduced rate, or living in a dwelling

[6] According to Eurostat (2017), in European Union countries 79 per cent of women are involved in household chores every day, compared with 34 per cent of men.

provided for free are more likely to be less satisfied than owners. This result confirms previous studies in the literature, as Deurloo et al. (1994); Parkes et al. (2002), Diaz-Serrano (2009).

In Appendix, Figures 2A and 3A, we also show the results obtained by considering a spline term for the two continuous covariates included in the specification: the ratio of housing costs over income and age. As for the former, the effect is negative for the first quartile, while it becomes positive for the other quartiles and with exhibits some non linearities as the ratio increases. As for the latter, the effect is positive at an increasing rate for all quartiles.

Finally, we find evidence of geographic differences in households' assessment of residential satisfaction. Figure 4 shows the probability to be satisfied or very satisfied with the dwelling for a same profile of households across countries. We consider a woman, 55 years old, with upper secondary education, employed, living in couple without children, owner of a detached or semi-detached house in a not densely populated area. The house is not overcrowded, does not suffer of any problem (neither lacks/deprivation, nor crime/pollution), and ensures access to 5 out of 6 basic needs. The housing cost over income ratio is 0.2049. The only source of variability in the predicted value of residential satisfaction is the estimated coefficient associated with the country dummy variable. Everything else being the same, living in Sweden rather than in Lithuania rises the probability of being satisfied or very satisfied of almost 9 percentage points. Residents in Sweden are more likely to be satisfied or very satisfied with their dwellings, followed by people from the United Kingdom, Austria, Luxembourg, France and Norway. The less likely to be satisfied are residents in Eastern countries: Lithuania, Estonia, Hungary, Poland, Greece, Slovak republic. These different probabilities by country may be explained by: *(i)* marked differences in national housing markets in Europe (Diaz-Serrano 2005a, 2005b); *(ii)* the heterogeneity of European citizens by country; *(iii)* differences in social welfare systems, more structured and generous in some countries, less in others.



Note: Residential satisfaction of a woman, 55 years old, with upper secondary education, employed, living in couple without children, owner of a detached or semi-detached house in a not densely populated area. The house is not overcrowded, does not suffer of any problem (neither lacks/deprivation, nor crime/pollution), and ensures access to 5 out of 6 basic needs. The housing cost over income ratio is 0.2049.

Figure 4: Probability to be satisfied or very satisfied across countries

To determine the role of each group of variables, namely housing-specific conditions, neighborhood conditions, housing costs, and individual characteristics, we calculate by group the percentage of explained deviance over the total deviance.

We denote by M_T the fitted model (1) including all covariates; M_0 the minimal model including only the intercept; M the model including a given block of variables. The percentage by group of explained deviance over the total deviance is given by $100 \times \frac{\Delta_M}{\Delta_{MAX}}$, where $\Delta_{MAX} = \text{Dev}_{M_0} - \text{Dev}_{M_T}$ and $\Delta_M = \text{Dev}_{M_0} - \text{Dev}_M$.

The deviance of model M, Dev_M, is the quantity $-2\left[L\left(\hat{\beta}_M\right) - L\left(\hat{\beta}_{M_S}\right)\right]$ where $l\left(\hat{\beta}_M\right)$ is the maximum of the likelihood function of model M and $L\left(\hat{\beta}_{M_S}\right)$ is the maximum of the likelihood of the model including all variables.

Table 3 shows the percentages of explained deviance by group. Housing-specific characteristics

are the most important factors, accounting for about 48 per cent of total deviance. The deviance explained by housing-specific characteristics decreases as income rises. The opposite happens for neighborhood conditions whose impact rises from 15.6 per cent (1st quartile) to 20.3 per cent (4th quartile). This is mainly due to environmental conditions we have seen to become more and more important as income increases. The increasing effect of environmental conditions on residential satisfaction more than offset the decreasing effect of crime as income increases. We have separated variables about tenure status from the block of individual and household variables. The contribution in explaining variability of the latter is shown in column 3, while the contribution of the former is in column 4. While the effect of tenure status significantly increases with income, the effect of other individual variables remains quite stable across income distribution, ranging between 7.1 and 10.1. Also Parkes et al. (2002) find that neighborhood factors, especially the place and condition of neighborhood, are much more important in predicting residential dissatisfaction that are socio-demographic factors.

	Housing-specific conditions	Neighborhood conditions	Individual characteristics	Tenure status
1° quartile	56.2	15.6	7.6	2.7
2° quartile	47.0	16.2	7.1	3.8
3° quartile	48.4	18.5	10.1	9.8
4° quartile	41.4	20.3	7.2	13.4

Table 3: Percentages of explained deviance by quartile

To further test the robustness of our results, we re-estimated the logit model by considering alternative partitions of the income span obtained using the quintiles and the sextiles of income distribution. These new results[7] are similar to those presented in this section. This suggests that the conclusions we have drawn do not appear to be overly sensitive to a particular partition of

[7] They are available upon request.

households ordered by income. It should be noted, however, that the division in groups generates a trade-off: on one hand, a partition of population in a greater number of groups increases the detail of results in the sense that a greater number of points are interpolated by a smooth function. The latter is then drawn with a greater accuracy. On the other hand, as the number of groups increases, the degree of freedom decrease, reducing reducing the stability of the estimation coefficients hence the informative power of estimates.

6. Conclusion

The aim of the paper has been to investigate how factors of different nature shape residential satisfaction of households ordered by income. Our results have shown that in Europe residential satisfaction is driven first by housing-specific characteristics, followed by neighborhood conditions and individual/household characteristics. Moreover, the results indicate that, anything else being equal, the probability to be satisfied or very satisfied strongly differs across countries. Finally, we have seen that residents with different monetary resources attach importance to particular determinants of residential satisfaction. Looking, for example, at neighborhood conditions, low-income residents are more concerned by crime, while high-income residents pay more attention to environmental conditions.

The results in this paper have some important policy implications. First, they allow to modulate some important aspects from the policy maker's point of view such as the relative importance of different drivers of residential satisfaction across income distribution. Second, the comparison of residential satisfaction across countries provides information that is particular relevant to inform the debate on gaps in living standards in Europe, while also indicating specific directions for housing, urban and environmental policy. Third, the analysis highlights the importance for local, national and supranational governments.to establish information

systems for monitoring the determinants of residential satisfaction. This would significantly improve one's ability to detect disparities in satisfaction across regions or countries and identify appropriate policy actions.

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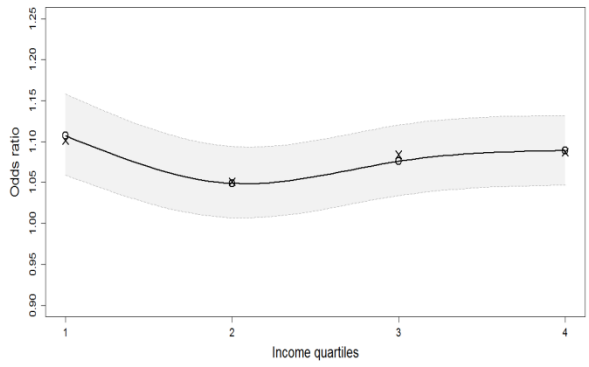
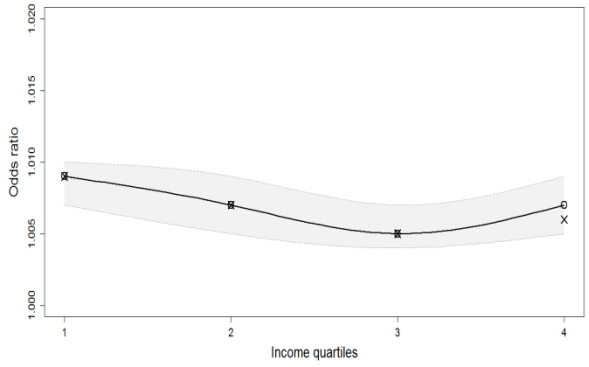
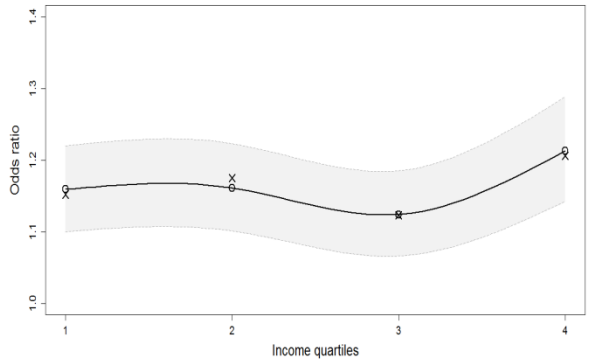
Appendix



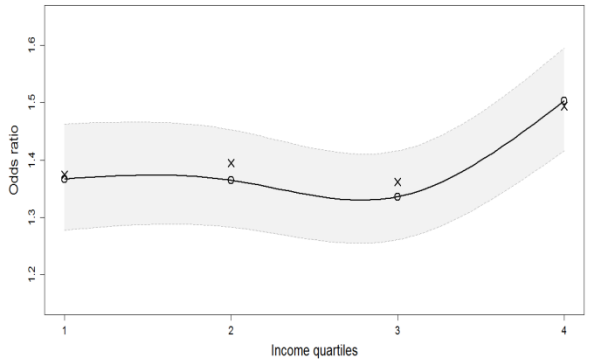
(a) Gender



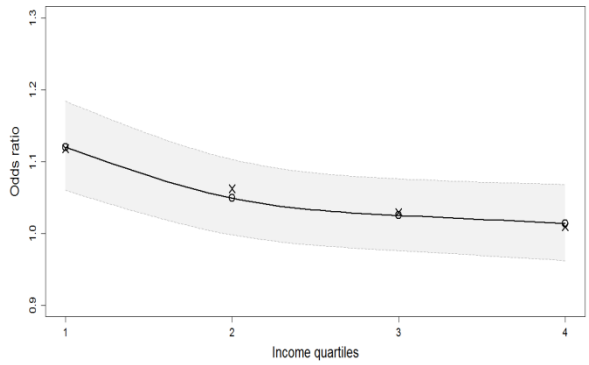
(b) Age



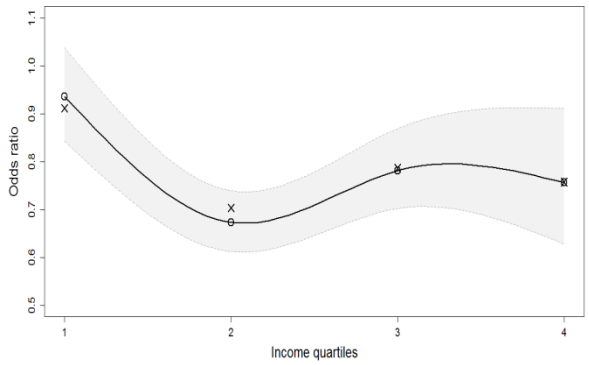
(c) Upper secondary education



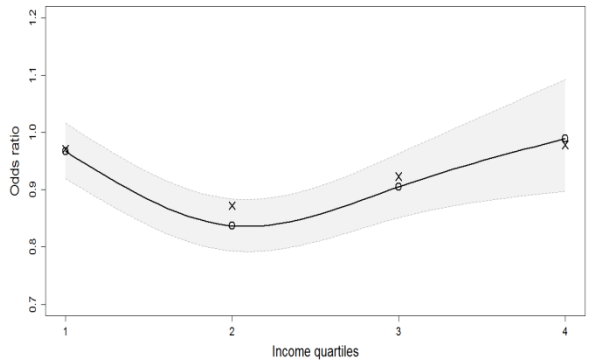
(d) Tertiary education



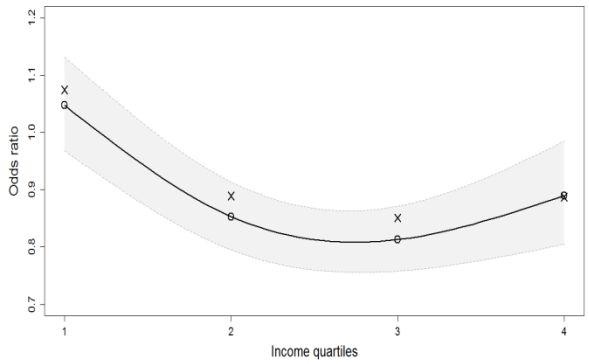
(e) Employed



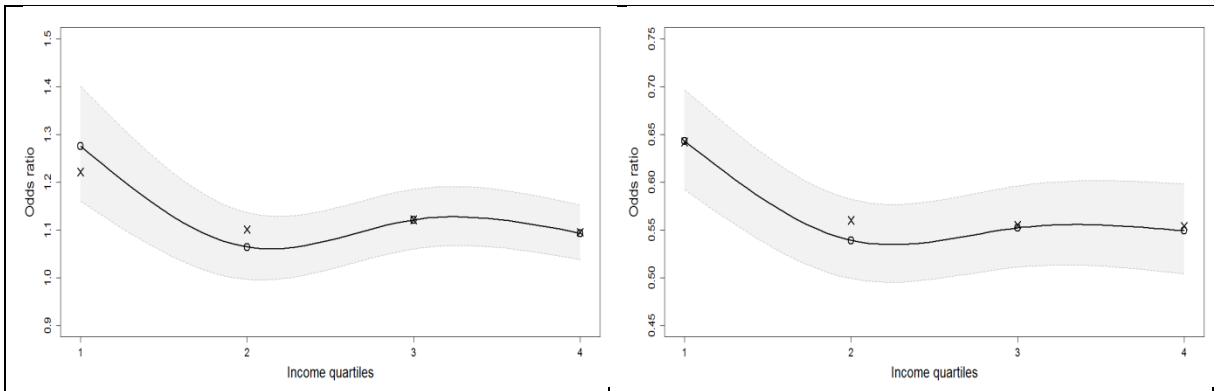
(f) Single with children



(g) Couples without children

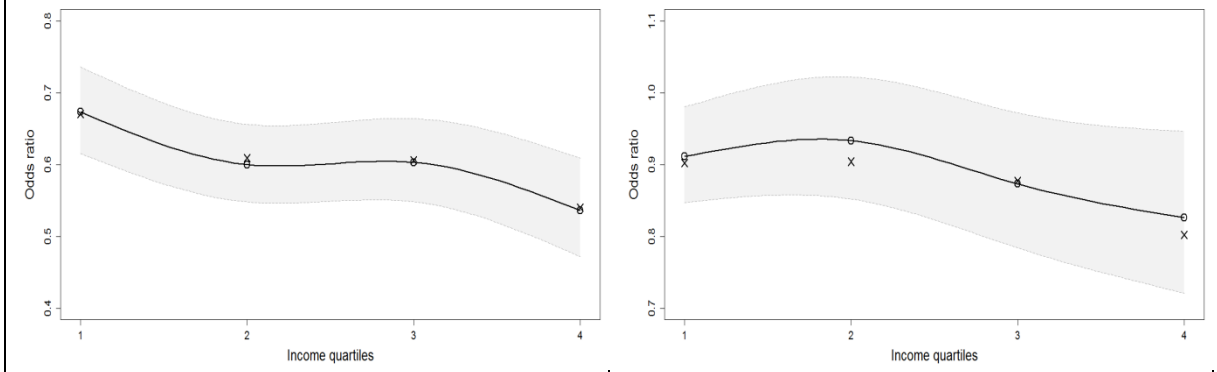


(h) Couples with children



(i) Owner paying mortgage

(j) Tenant paying rent at market rate



(k) Tenant paying rent at a reduced rate

(l) Accomodation provided free

Figure A1: Odds ratios of individual and household characteristics across household income distribution.

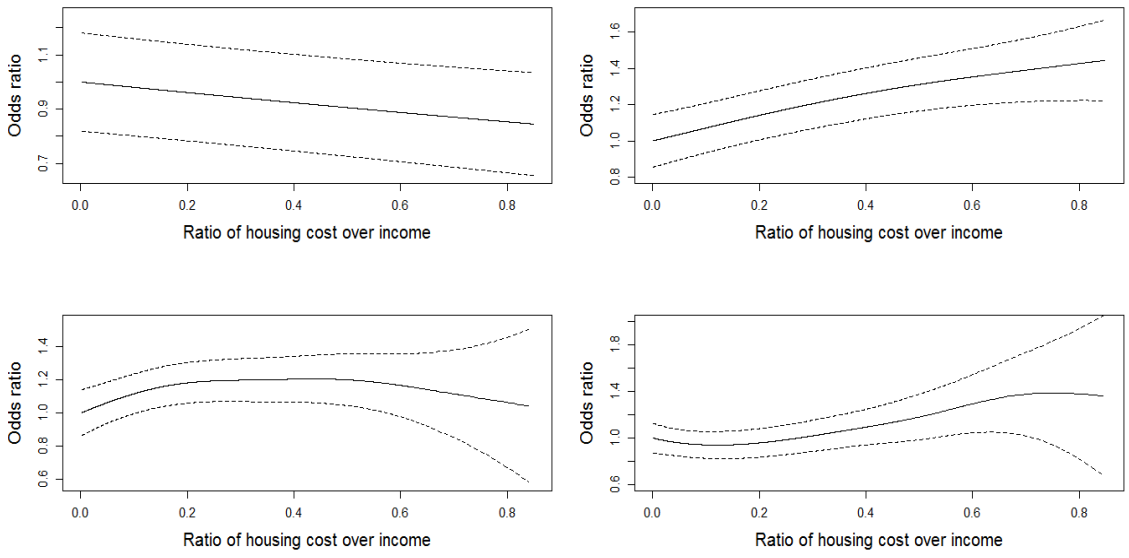


Figure A2: Odds ratios by quartile of housing costs over income estimated by a spline term.

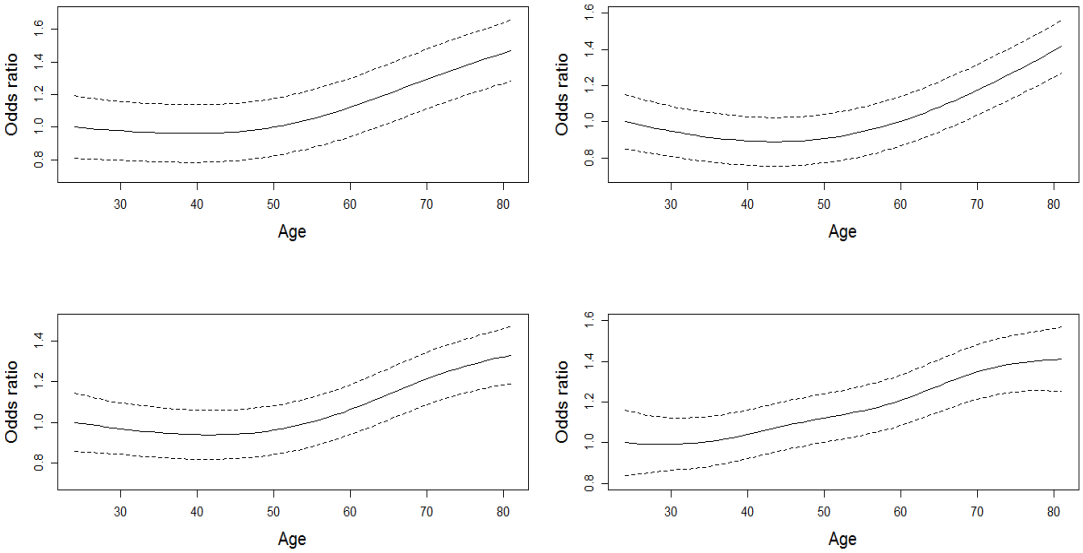


Figure A3: Odds ratios by quartile of age estimated by a spline term.