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Using a choice experiment to estimate the benefits of a reduction of externalities in urban areas with special focus on electrosmog

Preliminary draft

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ABSTRACT

Noise, air pollution and electromagnetic pollution (i.e. non-ionizing radiation, also called electrosmog) are typical negative local externalities in urban areas. They are side-effects of human and economic activity (e.g. road transport, telecommunication) and affect individuals' well-being negatively without compensation. Measurements carried out in 2005 and 2006 show that in several Swiss cities the limit values of air pollution fixed in the Swiss law have often been exceeded. Moreover, in several areas of these cities also the day and night standards for the noise level were violated. Further, the increased number of mobile phone antennas in residential areas, and thus the increased intensity of radiated power, has, in recent years, aroused public concern, discussions and protests. The view of an antenna is annoying an increasing number of inhabitants. In order to solve these problems, policy-makers have to introduce new environmental instruments to improve the quality of the environment in the Swiss cities. This paper aims at giving policy-makers information on benefits generated by an improvement of local environmental quality. In two Swiss cities (Lugano and Zurich), stated choice experiment is used to estimate the benefits of a reduction of the level of the negative externalities mentioned above. Results from this choice experiment reveal that there is a positive and significant willingness to pay (WTP) for a reduction of the level of air pollution and noise to those limit values fixed by the government. In addition, this is the first study that uses a stated preference approach based on a choice experiment for the estimation of the benefit of a reduction of electrosmog.

JEL classification: C25, C93, Q51, R21

Key words: choice experiment, electrosmog, noise, air pollution.

1 INTRODUCTION

Electromagnetic pollution (i.e. non-ionizing radiation, also called electrosmog), noise and air pollution are typical negative local externalities in urban areas. They are side-effects generated by human and economic activity (e.g. road transport, telecommunication) and affect individuals' well-being negatively without compensation.

Measurements carried out in 2005 and 2006 show that in several Swiss cities the limit values of air pollution fixed in the Swiss law have often been exceeded. Moreover, in several areas of these cities also the day and night standards for the noise level were violated. Further, the increased number of mobile phone antennas in residential areas, and thus the increased intensity of radiated power, has, in recent years, aroused public concern, discussions and protests. On the other hand, measurement of the electrosmog[1] caused by mobile phone antennas in the Swiss cities showed that in general the radiations in urban areas are within the level prescribed by law. However, so far epidemiological studies have not made conclusive assessments about the potential negative health effects of electrosmog exposure.[2] In terms of an application of the precautionary principle, the Swiss federal state and the mobile phone companies agreed in 2006 to enforce the controls of the radiation levels of the antennas. Despite the lack of information on electrosmog and the uncertainty of its impacts on health, most people are concerned about the increasing intensity of radiated power in inhabited areas. For instance, studies performed by Siegrist et al. (2003 and 2005) show that people viewed risks associated with cell phones or base stations[3] as high.

In order to solve these environmental problems, policy makers are evaluating the possibility to introduce new environmental instruments to improve the quality of the environment in the Swiss cities. This paper aims at helping policy-makers to formulate effective environmental policies by providing them with the results of a valuation study. The focus of this paper is to estimate the individual willingness to pay associated with reduction of the levels of air pollution, noise and electrosmog to the levels stipulated in

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[1] Electromagnetic pollution caused mainly by mobile phone antennas, TV and radio transmitters and high voltage power lines. In this study we do not consider electrosmog emitted inside a dwelling or house, since this kind of pollution can not be considered as an externality for the household.

[2] For a review of these studies see Ahlbom et al. (2001) and Breckenkamp et al. (2003).

[3] Also known as “mobile phone antennas”, or “mobile-telephone transmitters”.

the Swiss norms. As a proxy for electrosmog we used the presence of a mobile phone antenna within 150 meters of a dwelling.

For the estimation of the economic benefits of a reduction of the levels of air pollution, noise and electrosmog we used a stated choice experiment (CE). The choice experiment has its background in Lancaster's attribute theory of consumer choice (Lancaster, 1966) and in the Random Utility Theory (RUT, Manski, 1977 and McFadden, 1974). Only in recent years it has been used for the valuation of environmental attributes.[4] In the context of environmental pollution, several CE studies have been conducted of noise valuations (Garrod et al., 2001; Galilea and Ortuzar, 2005) and air quality valuations (Ortuzar and Rodrıguez, 2002). There are only few empirical studies that have examined both noise and air quality valuations (Sælinsminde, 1999; Wardman and Bristow, 2004). Moreover, the empirical literature on the economic impacts of the sources of electromagnetic fields (e.g. mobile phones, base stations, high-voltage transmission lines) is poor. There are only few empirical studies for the US, Canada and Switzerland that have examined the impact of the presence of electromagnetic fields on the rents for dwellings using the market-based hedonic model.[5] Banfi et al. (2007) have estimated hedonic price functions using revealed data for the Swiss cities of Zurich and Lugano. The main findings show a significant negative impact of air pollution, noise and electrosmog on the rents for dwellings. For example, the presence of an antenna less than 200 meters from a residential building decreases rents by around 1.8%. We are not aware of any empirical studies on this issue that make use of a CE approach. Therefore, there are at least two novel aspects of this research. Firstly, in this paper we consider the valuation of the benefits of a reduction of electrosmog using a CE. Secondly, we have examined in the same study the WTP for noise, air quality and electrosmog. This allows us to compare the WTP for the improvements of different environmental characteristics.

The rest of the paper proceeds as follows: Section 2 presents the model specification used in this paper. The experiment design and the data are described in section 3 and 4. Section 5 presents the estimation results and discusses their implications. The main conclusions are summarized at the section 6.

[4] For a discussion of the application of choice experiments to value the environment see Hanley et al. (1998).

[5] For instance Hamilton and Schwan (1995) focus on the impact of high-voltage transmission lines on the sale values of houses in the Vancouver area. Des Rosiers (2002) investigated the impact of high-voltage transmission lines on surrounding property values in the City of Brossard.

2 MODEL SPECIFICATION

In this paper we employ the Random Utility Theory to model an individual's choice among a choice set of dwellings composed by the actual choice and several hypothetical alternative choices. The Random Utility Theory has already been used in the literature to value environmental attributes of housing.[6] In this framework, given a finite set of alternative dwellings characterized by distinct environmental attributes, the individual *n* chooses the dwelling *i* that yields the highest utility. According to the Random Utility Theory, the utility of goods or services, in our case dwellings, is the sum of a deterministic component, V_{in}, and a random component, ε_{in}. Therefore, the general model can be specified as a stochastic conditional (conditional on the choice made) indirect utility function of the form

$$U_{in} = V_{in}(y_n - P_i, Z_i, C_n; \beta) + \varepsilon_{in} \qquad i = 1, 2, 3, \ldots I \qquad n = 1, 2, 3, \ldots N \qquad [1]$$

where y_n is income of household *n*, P_i is the price paid for the dwelling choice option *i*, Z_i is a vector of observed dwelling attributes, C_n is a vector of observed individual characteristics and β is a parameter vector.

The probability $P_n(i)$ that individual *n* chooses dwelling *i* rather then dwelling *j* is

$$P_n(i) = P\left(V_{in}(y_n - P_i, Z_i, C_n; \beta) + \varepsilon_{in} \geq V_{jn}(y_n - P_j, Z_j, C_n; \beta) + \varepsilon_{jn}\right) \qquad [2]$$

Assuming that the random component follows an *i.i.d.* extreme value type I distribution, then the probability $P_n(i)$ that individual *n* chooses dwelling *i* can be written in a logit model of the following form:

$$P_n(i) = \frac{\exp(\mu V_{in})}{\sum_{j=1}^{I} \exp(\mu V_{jn})} \qquad [3]$$

where *I* is the number of dwelling choice options, and μ is a scale parameter, which is usually assumed to be equal to one. Expression [3] is the basic equation of a multinomial/conditional logit (cf. Greene, 2003).

In our stated choice experiment we used a conditional logit model; this means that we assume that the values of the choice characteristics vary across choices, while the parameters are common across the choices. In this case, the social and economic characteristics of the households are constant across choices for any given household; they can only enter the model as interaction terms with the dwelling attributes.

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[6] See for instance the studies by Chattopadhyay (2005) and Earnhart (2001).

The conditional indirect utility function ,V_{in}, considered in this study is assumed to be linear in parameters.

$$V_{in} = \beta_0 + \beta_y (y_n - P_i) + \beta_1 Z_1 + \beta_2 Z_2 + ... + \beta_h Z_h \qquad [4]$$

The conditional logit model is estimated using the maximum likelihood estimation method. Once the model parameters are estimated and assuming constant marginal utility of income, a welfare measure can be estimated. For instance, for a household *n* facing a choice set *I* the expected compensating variation (CV) can be computed using the following expression:

$$E(CV) = \frac{\ln \sum_i \exp(V_{i1}) - \ln \sum_i \exp(V_{i0})}{\gamma} \qquad [5]$$

where represents the constant marginal utility of incomes, and V_{i1} and V_{i0} represent indirect utility functions after and before the change considered in the choice experiment. Moreover, the estimated coefficients can be used to estimate the marginal price of each attribute which, assuming short-run equilibrium in the housing market, is equal the marginal willingness to pay for that attribute. The marginal WTP for a change in a single attribute can be represented as a ratio of coefficients:

$$MWTP = -1\left(\frac{\beta_{attribute}}{\beta_{monetary\,variable}}\right) . \qquad [6]$$

3 EXPERIMENT DESIGN

In order to examine the impact of these externalities on the rent for dwellings, we have conducted a choice experiment in the cities of Zurich and Lugano. The choice of these two cities is mainly motivated by the fact that these cities are highly affected by air pollution and noise. Moreover, Zurich is located in the German part of Switzerland, whereas Lugano is located in the Italian part. This allows the identification of potential differences in the evaluation of pollution improvements across different cultures.

The dataset used for this CE comprises a representative sample of 394 households for Zurich and 241 households for Lugano. In the choice experiment, each respondent faced six choice sets. In each choice set respondents were asked to choose between three alternatives. To reduce the hypothetical character of the choice experiment, the third alternative always indicated the current dwelling situation of the respondents. This third option of choosing none of hypothetical alternatives, commonly called status quo, stated that there would be no changes in the environmental attributes of the dwelling. Alternatives 1 and 2 were characterized by a change in the rent and in the environmental attributes of the dwelling with respect to the status quo alternative.

Based on a focus group and discussions with the representatives of the Swiss Federal Office for the Environment, a monetary attribute, the monthly rent, and four environmental attributes were chosen: view of a mobile phone antenna, presence of a mobile phone antenna within 150 meters from the dwelling, level of the air quality and level of the traffic noise exposure. The levels of these attributes were defined as follows:

- **Monthly rent:** the monthly rent was related to the current rent for the apartment. According to the change (improvement or deterioration) in the environmental attributes of the dwelling the rent was varied by +10%, +7%, +5%, +2% or -2%, -5%, -7% and -10%[7]. We used these percentages to calculate the attribute levels to be shown in the choice experiment.
- **View of mobile phone antenna:** two levels were defined; yes and no.
- **Mobile phone antenna in the surrounding (150m):** this attribute had 3 different levels: a) no antenna in the surrounding, b) antenna in the surrounding with a 10 times lower limit value than the one fixed in the safety guidelines of the government; and c) antenna in the surrounding that does not exceed the limit values of the safety guidelines.
- **Air quality:** the air quality represents an overall air quality and was defined with three levels; good, medium and bad. Good air quality was defined as the situation where values of air quality clearly fall below the limit values; medium as the situation where the limit values are just preserved and low as the situation when the limit values are clearly exceeded.
- **Traffic noise exposure:** for this attribute also three levels were defined. Low traffic noise exposure as in quiet small streets; medium as in streets with moderate traffic and high as on a highway or on a road with heavy truck traffic. This latter level implies that the limit of the noise imposed by the law is exceeded.

A typical choice screen presented to the respondents is illustrated in Table 1. Respondents were asked to imagine their current dwelling situation would change with

[7] The percentage changes have been selected after broad literature review.

regard to the above mentioned attributes, with all other dwelling characteristics such as number and size of rooms, interior, floor etc. remaining the same. Then they were asked to select out of the three alternatives the one most preferred. Respondents were provided with the description of the different attributes and their levels in the form of pop-up windows.[8]

Table 1: Example of a choice situation

SITUATION 1	Alternative 1	Alternative 2	Your current dwelling situation
Monthly rent	1'774	1'605	1'690
View of a mobile phone antenna	No	yes	no
Mobile phone antenna in the surrounding (150m)	yes – with lower limits	Yes – with present limits	none
Air quality	Medium	bad	good
Traffic noise exposure	Low	medium	medium
My choice is:	□	□	□

Given the five attributes and their associated levels, 432 (the full factorial design) treatment combinations[9] exist. In generating a fractional factorial design, we managed to reduce the number of treatment combinations to 27. Further, depending on the participant's current dwelling situation, 12 profiles have been randomly selected for CE by the computer program used to administer the CE. We utilized a web-based survey and we proceeded in two steps. In the first step, potential participants[10] were contacted by phone and asked if they were interested to participate in the survey. In the second step we sent an e-mail with an official invitation to participate in our survey and with a link and password to fill in the questionnaire.

4 DATA DESCRIPTION

The survey was conducted during the summer 2005 and consisted of three parts. The first part collected information about the dwellings' characteristics and surrounding environment quality such as the traffic noise exposure, air quality and presence of mobile phone antennas in the neighborhood. The choice experiment was the centre of the questionnaire, and the last part contained questions regarding the participant's socio-

[8] Further details of the choice experiment can be found in the book by Banfi et al. (2007).

[9] 3^3x2x8

[10] The sample consisted of inhabitants living in rented dwellings in Zurich and Lugano for at least 12 months.

economic status, such as age, education etc. and household income. The questionnaire and the attributes used in the choice experiment were developed after discussions with researchers specialized in electrosmog, noise and air quality and in-depth literature review.

The original data sets collected from the second step consist of 409 participants from Zurich and 258 from Lugano, corresponding to the response rate of 72% and 66% respectively. This sample is further reduced by omitting a number of observations because of missing data or inconsistent responses. After removing such observations, the final regression sample was reduced to 394 participants (2'364 choice situations) for Zurich and 241 (or 1'442 choice situations[11]) for Lugano. The descriptive summary of this sample is presented in Table 2. The upper part of the table lists the socio-economic characteristics of the respondents; the middle part states the attributes of their current dwellings and the lower part lists the attributes of the alternatives offered in the choice experiment.

There are several characteristics of the participants that we can see directly from Table 2. The gender distribution of our sample with 47% of males in Zurich and 49% in Lugano is similar to the cities' averages. [12] The ages ranged from 19-85 years in Zurich and 19-95 years in Lugano, with an average age of 40 in both cities. Among the participants, 42% in Zurich and 44% in Lugano had a graduate degree. The participants' average household income was between 5'000 and 6'000 Swiss Francs (CHF) for Zurich and for Lugano between 6'000-7'000 CHF, with a standard deviation between 2'000-3'000 CHF for both cities. The median income lay between 5'000-6'000 CHF. This, compared to the average values of the Swiss population in the year 2000, shows a considerable over-representation of educated individuals (see Banfi et al., 2007).

Regarding the environmental characteristics of the current dwellings the sample can be described as follows: around 40% of the participants in Zurich and 42% in Lugano perceive their air quality as bad; one fifth in Zurich and one fourth in Lugano think that the air quality of their current dwellings is good. Concerning the traffic noise exposure, the share of participants with high traffic noise exposure is 31% in Zurich and 25% in Lugano. Almost half of the participants from Lugano think their traffic noise exposure is low. This share is lower in Zurich with 36% of the participants. For 31% of

[11] Computed as, number of respondents times the number of choice cards. In the case of Lugano there were four missing choice situations.
[12] Statistics of the city of Zurich (2005); and Federal Office of Statistics, population statistics (2003).

the apartments in Zurich there is a mobile phone antenna with present limit values within 150m, in Lugano this share is slightly lower with 26% of the apartments.

The average monthly rent is 1'585 CHF in Zurich and slightly lower in Lugano, with 1'442 CHF. The median monthly rent is 1'485 CHF and 1'400 CHF respectively.

Each participant decided for one alternative in each of six choice situations. The share of participants who always preferred their current dwelling situations over other alternatives is 20% in Zurich and 22% in Lugano. These shares are not so large comparing to the shares from other studies.[13]

The lower part of Table 2 gives a descriptive summary of the characteristics of the hypothetical offers. These can be described as a balanced sample in that there is a comparable share of apartments with good, medium and bad air quality in the offered alternatives. This applies also to traffic noise exposure and presence of a mobile phone antenna. The monthly rent of alternatives varies from 450 to 7'056 CHF in Zurich and from 450 to 3'920 CHF in Lugano, with an average of 1'556 CHF and 1'410 respectively. In both samples the average monthly rent of the alternatives is about the same as the average monthly rent of the current dwelling situations.

[13] See Banfi et al. (2006)

Table 2: Descriptive statistics

Socio-economic characteristics of the participants		Zurich (N=394)	Lugano (N=241)
		Sample mean	Sample mean
Age		40.9	40
Participant is a female[a]		0.527	0.506
Household income in Swiss Francs (CHF)		5'845	6'014
University education		0.449	0.428
Household member(s) with allergy		0.528	0.492
Attributes of the current dwelling			
Monthly rent in CHF		1'585	1'442
View of a mobile phone antenna		0.579	0.531
Mobile phone antenna with present limit values in the surrounding (150 m):	yes	0.315	0.261
	no	0.685	0.739
Air quality:	good	0.223	0.257
	medium	0.383	0.320
	bad	0.394	0.423
Traffic noise exposure:	low	0.363	0.465
	medium	0.325	0.282
	High	0.312	0.253

Hypothetical alternatives	Zurich (N=4'728)	Lugano(N=2'884)
	Sample mean	Sample mean
Monthly rent in CHF	1'556	1'410
View of a mobile phone antenna*	0.287	0.286
Mobile phone antenna with stronger limit values in the surrounding (150 m)**	0.401	0.406
No mobile phone antenna in the surrounding (150 m)**	0.172	0.172
Good air quality***	0.335	0.342
Medium air quality***	0.334	0.333
Low traffic noise exposure****	0.327	0.326
Medium traffic noise exposure****	0.272	0.275

[a]Reference category male *Reference category is No view of mobile phone antenna; **Reference category is Mobile phone antenna with present limit values in the surrounding; ***Reference category is Bad air quality; ****Reference category is High traffic noise exposure

5 ESTIMATION RESULTS

The choice experiment data were analyzed using the conditional logit model. The explanatory variables included in the estimation are: the monthly rent for the dwelling; two dummy variables for air quality, traffic noise exposure and presence of a mobile-phone antenna with the worst level being chosen as the reference category (bad air quality, high traffic noise exposure and presence of a mobile phone antenna with present limit values). Further, we introduced a dummy variable for the view of an antenna and a dummy variable that takes value one for the status quo and zero for the two hypothetical alternatives that imply changes in the environmental attributes of the dwelling.

We estimated for each sample of the two cities two models: The basic model and the extended model. Both models include all the experimental design variables and the alternative-specific constant. In addition, the extended model includes a number of individual characteristics through interaction terms. The variables considered for interaction terms are: household income (interacted with the rent), family members with allergies (interacted with air quality) and education level (interacted with the presence of a mobile phone antenna).[14] Besides these classical socio-economic characteristics, we considered in the estimation of the extended models both a dummy variable that takes value one, if the rent of the alternative dwelling choices was lower than the rent for the status quo (otherwise zero), and an interaction variable between monthly rent and frequency of choosing the status quo.

The results of the estimations for both models are presented in Table 3 and Table 4.

The interpretation of the coefficient values is not straightforward, except for the significance and relative size. All experimental design attributes are significantly different from zero at 1% significance level and have the expected sign in both models and for both samples.

The coefficient of the dummy variable for the view of the antenna is negative. This implies that households tend to not choose a dwelling with this characteristic. As expected, the coefficient of the monthly rent is negative. All other experimental design attributes have a positive coefficient estimate. This means that improving the environmental characteristics of a dwelling will increase its probability to be chosen. Furthermore, from the magnitude of the coefficients one can see that participants are more likely to prefer the better attribute level to the worse attribute level. For example, starting from a high traffic noise exposure they prefer a reduction to a low exposure rather than a reduction to a medium exposure.

[14] Further interaction terms were tested but, since not significant and theoretically not necessary, they were excluded from the extended model.

Table 3: Estimation results of the conditional logit model for Zurich

Variables	Model1		Model2	
	Coeff.	Rob. t-stat.	Coeff.	Rob. t-stat.
Status quo (constant)	1.247***	*15,08*	1.196***	*9,96*
View of a mobile phone antenna	-0.201***	*-2.82*	-0.252***	*-3.29*
No mobile phone antenna in the surrounding (150m)	0.192***	*2,31*	0.322***	*3.00*
Mobile phone antenna with stronger limit values in the surrounding (150m)	0.330***	*3,98*	0.357***	*4,03*
Good air quality	1.943***	*21.97*	1.812***	*14.85*
Medium air quality	1.266***	*16,80*	1.171***	*10,49*
Low traffic noise exposure	2.113***	*22.31*	2.199***	*20.62*
Medium traffic noise exposure	1.534***	*17.59*	1.592***	*16.43*
Monthly rent (in CHF)	-0.003***	*-7.98*	-0.009***	*-6.26*
Monthly rent * low household income (between 0 and 4'000 CHF)			0.0000003	*0.57*
Monthly rent * high household income (5'000 CHF and more)			0.0000005***	*4,02*
Monthly rent * frequency of choosing status quo			0.0008***	*4,78*
Negative difference in the monthly rent			0.0002	*0.14*
Bad air quality * allergies			-0.384***	*-2.53*
No mobile phone antenna in the surrounding (150m) * University education			-0.291***	*-2.17*
No. of participants	394		344	
No. of observations	2634		2064	
Log likelihood	-1741		-1490	
PseudorR2	0,329		0,343	

The alternative-specific constant is positive and significant. This result indicates that participants are averse to choosing hypothetical alternative dwelling situations for reasons that are not considered in the model.

In the extended model only few coefficients of the interaction variables are significant and have the expected sign. For instance, the interaction term between bad air quality and allergies is significant in both extended models. This result tells us that households whose members suffer from allergies are less likely to choose apartments with bad air quality.

The significant coefficient of the interaction term between rent and high income level indicates that households with higher income (above 5'000 CHF per month) are more likely to choose more expensive dwellings in comparison to households with a medium income level (between 5'000 and 6'000 CHF per month). We could not observe a similar effect (with a negative sign) on the choices of low income households.

The interaction term between rent and the frequency of choosing the current dwelling situation is positive and significant. The environmental quality of more expensive flats is usually better; therefore, households with such conditions are less likely to choose an alternative. Finally, the variable indicating if the alternative is characterized by a lower rent than that for the current dwelling situation is not significant.

Table 4: Estimation results of the conditional logit model for Lugano

Variables	Model1		Model2	
	Coeff.	Rob. t-stat.	Coeff.	Rob. t-stat.
Status quo (constant)	0.890***	*8,57*	0.563***	*3,53*
View of a mobile phone antenna	-0.339***	*-3.61*	-0.370***	*-3.40*
No mobile phone antenna in the surrounding (150m)	0.458***	*4,40*	0.585***	*4,22*
Mobile phone antenna with stronger limit values in the surrounding (150m)	0.385***	*3,72*	0.425***	*3,59*
Good air quality	1.993***	*16.22*	1.721***	*10,17*
Medium air quality	1.235***	*11,72*	1.068***	*6,80*
Low traffic noise exposure	1.786***	*16.55*	1.909***	*15.39*
Medium traffic noise exposure	1.192***	*10,59*	1.248***	*9,45*
Monthly rent (in CHF)	-0.003***	*-5.48*	-0.011***	*-5.20*
Monthly rent * low household income (between 0 and 4'000 CHF)			0.000001	*1,67*
Monthly rent * high household income (5'000 CHF and more)			0.0000003	*1,66*
Monthly rent * frequency of choosing status quo			0.001	*3,51*
Negative difference in the monthly rent			0.007	*2,76*
Bad air quality * allergies			-0.539***	*-2.57*
No mobile phone antenna in the surrounding (150m) * University education			-0.081	*-0.47*
No. of participants	241		192	
No. of observations	1442		1149	
Log likelihood	-1125		-864	
PseudorR2	0,289		0,315	

In a second phase using equation (6) and the results obtained in the extended model we calculated the marginal WTP for a change in the attributes. We chose to use the results of Model 2 because this model has a higher explanatory power than Model 1. The WTP (or implicit prices) for both samples are presented in Table 5.

From Table 5 we gather that WTP is highest for a reduction of noise exposure from a level clearly above the limit to a level below the limit. Moreover, WTP for a reduction of the air pollution from a situation where the limit imposed by law is exceeded to a situation where this limit is clearly complied is also high. The slightly higher marginal WTP for the reduction of traffic noise could be explained by its direct and immediate impact on well-being in comparison to the lagged effect of air pollution on people’s health. The implicit prices for the avoidance of a mobile phone antenna in the neighborhood as well as for the presence of an antenna with stronger radiation limits are low. This is not surprising, since there is still no empirical evidence that electromagnetic radiation affects health. The WTP could be interpreted as a measure of precaution in order to avoid any risks coming from antennas. Further, some people can be considered as electromagnetic- sensitive (about 5% of population); it can be expected that these persons have a higher WTP for a decrease in radiation. Finally, the WTP for avoiding the view of an antenna is lower than the WTP for avoiding the presence of an antenna. At any rate, this WTP of nearly 30 CHF per month is not negligible.

Comparing the two cities, it is important to note that the WTP in Zurich is larger for reduction in noise and air pollution, whereas it is higher in Lugano for measures against electrosmog. Further analysis is needed in order to identify the reasons for such differences (cultural and educational reasons, information level of inhabitants, etc.).

Looking at the 95%-significance intervals it can be recognized that the average WTP have to be considered and treated with caution, since they are situated within a large interval.

Table 5: Marginal willingness to pay in CHF/month for Zurich and Lugano[15]

Attribute	Zurich			Lugano		
	WTP	Sign. 95 % - Interval		WTP	Sign. 95 % - Interval	
View of a mobile phone antenna	-28	-9	-47	-32	-10	-55
Mobile phone antenna with present limit values in the surrounding (150m):						
to no mobile phone antenna	35	11	60	51	22	81
to mobile phone antenna with stronger limit values	39	15	63	37	12	63
Air quality:						
From bad to good	198	133	263	151	88	214
From bad to medium	128	86	171	94	54	133
From medium to good	70	47	92	57	34	81
Traffic noise exposure:						
From high to low	241	166	315	168	104	231
From high to medium	174	121	228	109	66	153
From medium to low	67	45	87	59	38	78

These results are consistent with previous studies showing that households associate improved environmental quality with a reduced health risk and may choose to reduce the risk by moving from bad environmental conditions to dwellings with better environmental qualities.

[15] 1 CHF ≈ 0.62 EUR (25.1.2007)

6 CONCLUSIONS

This paper attempts to estimate the benefits of an increase in local environmental quality in two Swiss cities, Zurich and Lugano. Individuals' WTP is estimated through a web-based choice experiment, in which participants were asked to choose between their current and two different dwelling alternatives with varying environmental characteristics and monthly rent. The environmental characteristics considered are: air quality, traffic noise level, view of a mobile phone antenna and presence of such an antenna in the surroundings (until 150 meters).

This analysis contributes to the wide literature on environmental valuation studies by applying a stated preference approach to a new environmental field, that is the presence of mobile phone antennas in urban areas and in particular to the externalities due to radiation and impairment of view. The importance of this topic may increase in the next years with an increment of the number of mobile phone antennas. Further, the paper gives to policy-makers important information about the benefits of an improvement of air quality and a reduction of noise level to the limits set by law. In a second step, this information can be compared to the costs of policy measures suitable for reducing the pollution level under the allowed threshold value.

The estimation results show that not only the levels of traffic noise and air pollution are important when choosing a dwelling, but also the presence of mobile phone antennas and the view on them play a role in this choice. Second, people show a positive and significant WTP for an improvement of environmental quality in the two urban areas. Low traffic noise exposure and good air quality are the highest valued attributes, while the presence and view of a mobile phone antenna shows a smaller willingness to pay. Nonetheless, the magnitude of WTP for these last two effects is not negligible. In general, we can observe some differences in the magnitude of WTP between the two cities analyzed.

Finally, it is important to mention also some limitations of this study: The 95% significance level of the WTP is quite broad. The use of the average WTP for policy purposes therefore needs particular caution. Other limitations are related to the design of the choice experiment: the increase or decrease in the rent chosen affects the WTP. Further, well-educated and high-income households are overrepresented in the samples, and there is a considerable share of respondents always choosing the status quo. We cannot exclude that these factors lead to some bias in the estimation results.

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