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THE SOCIAL COST OF AIRCRAFT NOISE: THE CONTINGENT VALUATION METHOD APPLIED TO PARIS-ORLY AIRPORT

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ABSTRACT

This paper deals with an estimation of the social cost of sound annoyance from air traffic of Orly Airport by applying the contingent valuation method. The data were collected thanks to a sample survey realized between October 1998 and April 1999 near Orly Airport among 607 persons. The results are the following: (i) more than 50 % of the sample declare to be annoyed by air traffic noise, (ii) opinion and practices associated with housing have an impact on the declared annoyance, (iii) acoustic exposure and declared annoyance parameters have a significant influence on the willingness to pay (noted WTP), (iv) social cost of air traffic amounts to about twelve millions of French francs per year in the six districts of the survey.

1 - INTRODUCTION

Despite a strong social demand for an improvement of the sound quality of life spaces, French government expects some reliable information about the social cost of transport noise. Thanks to the financial support of the General Council of Val-de-Marne, we try to value the social cost of air traffic near Orly Airport. In this view, the contingent valuation seemed to be an interesting method in order to strengthen the data production. Indeed, this is the only methodological process that allows to appreciate the set of explicative factors and structuring dimensions of individual preferences expressed through the willingness to pay in order to suppress the sound annoyance, that is used as measurement of the social cost. This perspective has encouraged the crossing of different fields (Faburel, 1999). In addition to Economics, scientific corpus from which arises method that has been chosen, Psychology is used for the determination of sound perception, of acoustics that explains in part this perception. Besides, it guarantees the representativeness of the survey sample, as well as it helps for the public policies analysis in order to build the sketch of exchange from which the WTP is obtained. We have been notably incited by the knowledge used to analyze the influence of sound annoyance from air traffic noise on monetary judgments revealed through the WTP declared associated with a hypothetical suppression of sound annoyance. The empirical framework realized from November, 1998 to April 1999 expresses the used of different scientific fields. This survey realized door-to-door on a representative sample of 607 persons of 6 districts of Val-de-Marne near Orly Airport: Ablon, Boissy-St-Léger, Limeil-Brévannes, Orly, Valenton and Villeneuve-le-Roi.

First of all, we note that the sampling criteria –Zone of exposure (acoustic measurement campaign realized by the Beture Conseil in 1996, distributing the space of the survey in three area with an equal exposure (more than 80 dB(A) en Lmax for the zone one, from 75 to 80 dB(A) for the zone two and from 70 to 75 dB(A) for the zone three), social and professional group and sex– have been respected. The interviewed population turns out to be representative of the main population, that is 62 350 inhabitants distributed on the six districts (INSEE, RGP on 1990). Once the sample representativeness assured, we were able to begin statistical treatments according to two orientations: the first concern individual sensitiveness to traffic noise and the second concern the WTP.

The point of this double treatment is first to allow us to consider sound annoyance associated to air traffic in the perspective of an appreciation of individual sensitiveness to noise. This variable may potentially explain the WTP. During this stage, we have tried not only to explain this bother, but also valueate the other explaining factors of sound sensitiveness, as several methods of environmental psychology have already done. That is why some people which are not bothered by noise can nevertheless be sensitive to the quality of their sound environment (role of lived perceptive, degree of information, sociocultural level, status and way of using of the housing). This hypothesis seems all the more grounded as our territory is a very sensitive context. It is the core of a strong media influence and an associative mobilization that creates notably several legal rules (upper limit of the number of air movements, existence of a curfew, project to make the Orly-Rungis area dynamic again . . .). The consistency of results stemming from the first treatment (factorial analysis) has allowed to make sure of the robustness of the annoyance measurement through the behavioral annoyance indicator. Then we have been able to valueate the individual sound sensitiveness thanks to numerous collected information. In the second statistical stage, it has been possible to insert the annoyance and sensitiveness responses into the econometric treatments, in order to explain in a better way the WTP, that is the core of social cost valuation of the annoyance associated to air traffic noise. Both type of results will presented.

2 - BEHAVIOR REVEALED BY THE SURVEY

Factorial decomposition advances globally three types of explicative factors for the expressed annoyance. According to the indicator of maximum gap percentage, it is about, in a decreasing order) opinions, behaviors or practices first connected with the environmental impacts of planes. On the 96 persons declaring to be extremely bothered, 64 feel close to associations that fight against noise, and most of them emphasize in naming of them; and 62 express technical and human ways to contravene exposure situations, proof of often eloquent understanding.

As suggested by the exploratory step (20 interviewed realized before the survey in order to valueate the individual representation schemes associated with the objects studied: noise, planes, public policies about environment, housing, space of life and their value, willingness to pay . . .), opinions and behaviors associated with housing constitute the second type of main variables. For instance, 42 persons of this under population estimate that air traffic noise lower the value of the main residence. Concerning the valuation of property depreciations, we precise that the estimations made by these persons are very close to those collected within the framework of interviews made in Villeneuve-le-Roi in 1997 by the INRETS and realized on real-estate agents. Among these persons, after crossing, we find again the respondents that would like to leave this area for an other in spite of long time of residence, but that are likely stopped because of the financial loss. For what concern the practices, 51 persons spend more than 6 hours a day in their residence (older population cf. *infra*) and 39 persons go sometimes in a quiet place for the week-end.

Finally, it is not surprising in the light of the numerous surveys on sound annoyance, that several individual socioeconomic characteristics seem to have an influence on the expressed annoyance. The 96 persons of the population declaring to be very bothered has a specific profile. 47 persons of this population are residential owner, living in couple with a child and living in a house with a garden (43). These characteristics point up the superiority of the role of housing in sound annoyance.

So, acoustic energy, expressed by zone of exposure variable, can not itself explain the declared annoyance. Only 40 of 96 persons that declared to be extremely bothered, live in the districts that are the most intensively subjected to air traffic noises (Villeneuve-le-Roi and Ablon). At last, although it is a dominant explanation of environmental dissatisfaction, sound exposure seems to be little dissociable to other environmental transport effect; the first one is atmospheric pollution and risks of accident, that confirms the results of recent researches.

After having add the persons declaring to be strongly bothered, 48,5 % of actual total sample used for the survey, declare to be bothered at least a lot. Reporting in the main statistical population, 30 240 inhabitants of Val-de-Marne declare to be so strongly disturbed by air traffic noise near Orly. Nevertheless, this evaluation of the annoyance that comes from air traffic in Val-de-Marne seems minimal, the three main reasons are: hypothesis of minimization of the negative component which represents noise in order not too much depreciate the image of oneself; the inhabitants of the district of Villeneuve-Saint-Georges (26 952 inhabitants, 1990) that is totally exposed to air traffic noise was not interviewed because of too numerous multi exposures situations; finally only the strong or deep declarations of annoyance were used for the of bothered persons.

On the opposite, persons which declare to be not at all bothered are clearly distinguished from these which express a high level bother. These persons are not interested in the debates relative to air traffic

noise: they do not pay attention to reports and papers for 60 of them and do not know any way to reduce the noise of planes (50). Logically, annoyance, because it is limited or absent, does not influence the possible or real practices (notably in connection with the environment): these persons do not intend to move on (35), they spend not enough time at home in the week or in the week-end. Finally, this population is globally younger (23 of less than 30 years), male (54) and childless (43). Considering these characteristics, they seem to be more mobile (posterior year of moving on in 1994 for 40 persons) and they prefer to rent (70) an apartment (77).

Checking off the determinants of sound annoyance in a descriptive way ensures the robustness of the valuation of sound sensitiveness. Then, it is necessary to study thanks to econometric treatment (so quantitative treatments), according to which intensity this sound annoyance and explicative factors influence the WTP, and by this way the amount of social cost that will be deducted from.

3 - WILLINGNESS TO PAY AND COLLECTIVE COST

3.1 - Explicative variables of the WTP

Here, we aim explicitly to reconcile as well psycho sociological interpretations (i.e. individual sensitiveness to air traffic noise) and/or economic one (i.e. income) as territorial organization interpretations, when we link the WTP with the environmental characteristics (type of housing, sound insulation ...) and the characteristics of the district (space features, environmental attributes ...). At last, we define the modalities of calculation of an mean WTP, that is worth only thanks to his synthetic indicator feature. In a public decision view, it will be necessary to study accurately the relevant explicative variables and their role within the framework of a global valuation of territorial organization.

We only take into account here the individuals who were interviewed from the way of revelation of the WTP from two successive offers ("referendum with double interval"). So we have excluded from treatments experimental questionnaires of the pilot test that was necessary for calibrating the offers that were proposed during the following step. In the same way, the questionnaires of people which refused to answer to the question of a monetary valuation of the noise social cost were excluded from the statistical analysis. Finally, strategic behaviors were excluded from this econometric treatment, they were identified by crossing three variables (level of declared annoyance, importance of reductions noise actions and WTP equal to zero). After applying these three criteria of selection, 510 observations will be treated

VARIABLES	ESTIMATED PARAMETERS	SIGNIFICANCE
Constant	0.874634	***
Middle executive	0.549191	*
Low school diploma	-1.055988	***
Free housing occupancy (with parents or groups)	1.235591	**
House with garden	0.379885	**
Exposure area 2	-0.993754	***
Exposure area 3	-1.115562	***
Pay attention to noise information or not	-0.341929	***
Level of annoyance (the level of the annoyance was declared from two scales: a verbal one with four points, and a numeric one with ten points; both are increasing scales, i.e. the highest level of annoyance corresponds to the highest note)	0.120188	***

Table 1: Main explicative variables of the mean WTP (Logit); source: OEIL/GREQAM.

This table reports just the significant variables on the WTP. Furthermore, the importance of the role of each variable is represented by the last column thanks to a scale of three values (three is the best significance. Finally, the positive or negative sign of the estimated parameter indicates the sense of this influence.

Variables that express exposure area or the sensitiveness (declared annoyance and attention paid to reports and papers about noise), in other words variables that are directly linked with the air traffic

noise, have a major incidence. The hypothesis according to which it seems convenient to approach some factors is validated. The first factors are the relation between the individual and his sound environment, and the postulate according to which indicators used in this way are effective, so they can be integrated in the econometric treatments. The psychosociology can help, in a operating way, to analyze preferences that have been shown on the basis of a monetary standard.

3.2 - Collective cost

Considering the robustness of the results (robustness of econometric results on the basis of classic and derived models, matching with data stemming from factorial treatments, assured statistical representativeness), economic theory allows us to add the WTP obtained on the territory of the survey in order to estimate the cost for the collectivity. This cost, presented below, must be mentioned as "the collective cost of air traffic noise in the six districts of the study". The mean WTP is 45.87 F by households per month for two years, this cost is about more than 12 millions francs per year.

In operational purposes (arbitrage in the politics of territory organization, new interest for reflections about a third airport in Ile de France Area, debates on the compensation to be given for the districts for undergone damages), it seemed necessary to aggregate these results for each studied districts.

	Mean WTP (in FF per month for the household)	Main population	Collective cost (in constant FF per year)
Villeneuve-le-Roi	107.50	17 276	7 874 925
Ablon	81.33	4 691	1 617 748
Limeil Brévannes	31.52	14 463	1 933 033
Valenton	28.49	11 110	1 342 150
Boissy-St-Léger	13.37	8 316	471 455
Orly	9.67	6 494	266 276

Table 2: The mean WTP and collective cost of aircraft noise per districts; source: CEIL/GREQAM.

The more the considered space contains people which declared to be bother by air traffic noise, the higher is the collective cost. This relation has never been scientifically demonstrated by confirmed statistical treatments until now in France. As for the valuation of the annoyance, if the territories and contexts of exposure excluded from the survey (i.e. Villeneuve-Saint-Georges) had been taken into account, it would have likely increased the mean WTP, and by then increased the derived collective cost.

Finally, in order to determine values as reference for compensations, implementation of taxes and royalties in application of the polluter-payer principle, integration of noise in transport projects that is a strong demand of institutional territorial builders (CEMT, 1994), we have tried to settle datd on the annual cost of noise according the exposure area:

- Zone 1 (more than Lmax 80 dB (A)): 547 F per person and year;
- Zone 2 (from Lmax 75 to Lmax 80 dB (A)): 203 F per person and year;
- Zone 3 (from Lmax 70 to Lmax 75 dB (A)): 70 F per person and year.

According to the recommendations of the report of the Economic advisory committee (1994) updated by the instruction centers of October 3, 1995 and the circular n° 98-21 of February 11, 1998), France has established a tutelary value of 963 F/year per person bothered by the noise of a new infrastructure of transport. Costs per person bothered that we obtained here seem to be moderate in comparison with settled values. The modalities of the results production do not seem to be able to explain these observed gaps, as the obtained data are robust. The reasons that might explain partially these gap are multiple. They deal alternately with the nature of the estimation indicator of the collective cost (exclusion of the individual expense of health associated with air traffic noise paid off by the Social Security), with the object of analysis (principle polluter / payer), with particularities of the territory of the survey (strong local mobilization and media relay) and with the data and the calculus on which the tutelary values are based (utilization of foreign data applied to the bothered persons and estimated with data dating of 15 years).

Only the internal validation of this method, by reproduction of the hypothetico-deductive process then linked with the produced materials, and the external validations of this method, by mobilization of the other tools of valuation and comparison of obtained results, could lead us toward the interpretation of observed gaps. In this perspective as scientific as operational (comparison of social costs according

to the way of transport), it will be advisable to put together the set of these data with the results produced with two other contingent valuation and with the application of the price hedonic method (property depreciations attributable to the outside noise), both steps have been implemented to estimate the social cost of the road traffic noise and the railway noise in Val-de-Marne; results are foreseen for the last quarter of 2000 (these researches were realized in association with the INRETS, the GRACTICE (University of Paris XII) and the GREQAM (EHESS-CNRS) with the financial support of the Direction of the Research (DRAST), of the Equipment Ministry, the noise mission of the Environment Ministry within the framework of PREDIT).

But, it will be advisable also to compare results obtained here with a scientific building material stemming from a more qualitative procedures: deliberative processes. In the same spirit as scientific realizations carried out within the framework of the VALSE project engaged by the European Commission, two focus groups will be, during the summer term of 2000, constituted (financial support of the Direction of the Research (DRAST) of the Equipment Ministry, within the framework of the Valuation-Decision Commission of the PREDIT). A representative sample of the six studied districts within the present framework of the contingent valuation will be regrouped during a entire day. The aim is to make the judgments on the notion of the social cost of air traffic noise being expressed, on the obtained results and by induction on the used method. One of correlative purposes is the observation of mechanisms settled in the social building of the value granted to the conservation of the sound environment associated with planes (believes, representations . . .). The development of these deliberative processes will enlighten us then on the role of the local territorial context in the behavior that were observed during the present survey. It is necessary to estimate the role of this context, among others, to claim to control globalizations and spatial transpositions (cf. above). More globally the developed argumentation will help us to clarify what the obtained social costs exactly covered, and then to guarantee any following calculus.

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