Ten Years of Valuation of the Local Impact of Atmospheric Pollution: from Scientific Assessments to Political Decisions

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Ten years of valuation of the local impact of atmospheric pollution: from scientific assessments to political decisions

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Abstract

This paper focuses on the economic valuation of the impact of local air pollution. Two main issues are considered:

1/ The scientific issue: what is estimated, how and why? The main studies from the nineties are presented here. Two strong issues are stressed, with the diversity of valuation methods on the one hand, and the debates on how to take the long term into account and the discount technique on the other.

2/ The political issue: how the results from the economic field are analysed and used to establish official values for public policies? The methods used in three different European countries (France, Sweden and Switzerland) are studied here.

To conclude, we highlight the discrepancy between these two processes and, where possible, offer solutions to reach better synergy.

Key words: *local air pollution, external costs, economic valuation, official values, public decision, international comparison*

Introduction

First, the problem of air pollution in major cities seems to be declining. The efforts made in industry and in heating during the 70s and 80s, ad the technological progress made by transport in the last ten years have led to regular improvement in the quality of air in towns.

However, several factors contribute to keeping this issue on the political agenda. First, there are still uncertainties on the evolution of the background ozone and on finer particles. In addition, there are the growing expectations of urban populations faced with environmental and public health questions. Finally, epidemiological research has increasingly confirmed that air pollution has a significant long-term impact on human health. It was thought that deaths due to air pollution were limited (10,000 to 20,000 years of lost life per year in France – Academy of Sciences, 1999). However, research carried out in the name of the World Health Organisation (Künzli, 2000) estimates that deaths caused by average pollution such as that of 1996 could correspond to 316,000 years of lost life in France. The impact is similar to that of alcohol and tobacco (respectively 500,000 and 750,000 years of lost life in France). This radically changes the magnitude of what is at stake.

How can the economic approach, often used to justify the implementation of public policies, take into account this type of impact, in a context of uncertainty where there are strong discrepancies in the various perceptions of the problem. The aim of this research (Nicolas et *alii*, 2002) is to confront the cost assessment of atmospheric pollution from a scientific approach (what is measured, how, why?) to the evaluations taken into account for public policies (what are the institutional

mechanisms through which the values reached by the researchers -engineers, economists, epidemiologists, etc. – will help draw up official values providing a basis for the decisions taken in the management of public affairs?).

1. Method: bibliographical overview and comparison of European practices

Our research focuses on this two-sided question, on the scientific construction of the figures first, and on the institutional use made of these. The next step was to highlight the existing gaps between the two and to offer solutions where possible.

The exploration methodology was adapted to cater with the differences in academic research and public action.

From a research point of view in terms of valuation of the local impact of air pollution we opted for a bibliographical synthesis covering, as thoroughly as possible, topic related studies and reports published in the 90s. Two research axes were identified:

- Many works have dealt with the implementation of methods of immediate impact valuation: what are the differences between them, which are best adapted to the case of air pollution, are there any complementarities? A first study carried out within the "National Program of Research and Innovation in Land Transport" (Prédit 1996-2000) provided a first solid bibliographical base (Chanel and Vergnaud, 2001). Some twenty research studies illustrating the various methods and types of impact of air pollution were then selected to offer detailed reading lists. Table 1 presents the 21 studies selected.
- However, a monetary valuation approach, especially concerning environmental damage, is only meaningful if it is included in a dynamic vision of the long term situation (10-20 years, 30 years and plus). It was thus necessary to analyse the economic suggestions made to take into account the temporal dynamics of discussions around the theme of discount rate.

Regarding public policy and official monetary values accepting the impact of air pollution, we focused on European nations. In view of the gaps existing between countries, we selected three, France, Sweden and Switzerland, in order to better illustrate the links which exist between official used values, institutional traditions and national practices in terms of environment. This study was based on existing international syntheses and was also carried out, as far as the three-country study is concerned, through contact with national experts and the consultation of official web sites devoted to the issue.

2. The economic valuation of the cost of air pollution

What valuation methods for which results?

When initially studying the financial estimates of the impact on the environment and the quality of life, one is struck by the diversity of the measurement methods, with a dozen generic methods and a variability of results (which can range from 1 to 15 for air pollution – see for example Chanel and Vergnaud, 2001).

Thus, the extreme diversity of impact requires evaluations in very different domains, on goods that are in fact not at all of the same nature. For instance, the methods most approaching traditional economic logic will attempt to find a market of goods that are affected by air pollution. Either, within the framework of *contingent valuations,* this market is created and those surveyed are asked to position themselves on a scale of value in one or several imaginary situations. Or the manner in which economic agents behave on real markets concerned by the environmental impacts is studied - but here the *Hedonic Price Approach*, measuring the impact on the costs of the housing or job market, the *Travel Cost Method*, evaluating how much individuals are ready to spend getting to a given place, and the *Protection Expenditure Method* turned out to be ill-adapted to air pollution.

It is also frequent to try to identify and analyse the chain of impact with dose-response curbs estimation before working out costs: either by calculating the loss of subsequent wealth (*production*

92 *losses*, or *human capital methods* in terms of risk and sanitary impact), by estimating the *restoring*
93 *cost* of the damage*,* or by assessing the cost of prevention measures (*avoidance costs,* but this last
94 practice does not really attempt to measure the cost of damage and therefore was not considered as
95 relevant for our study).

96 The valuation methods developed do not therefore necessarily have the same approach nor provide
97 the same results. It is worth questioning the relevance of the different methods, their
98 complementarities and their zones of "competition".

99 Three distinctions appear essential to establish the relevance of a method in terms of a given
100 evaluation objective:

101 - *The type of damage* to be evaluated (public health, buildings and materials, fauna and flora,
102 etc…) as well as their position in the chain of causality (direct effects, such as illness, and
103 indirect effects such as absenteeism from work).

104 - *The individual or collective nature of costs:* certain methods only measure the costs borne by
105 individuals (such as hedonic price approach or contingent valuations); the costs borne by the
106 community, such as medical costs reimbursed by social security, will have to employ other
107 methods, and more especially the estimation of the cost of damages accorded.

108 - *The type of value to be measured,* use or existence of the good that has suffered deterioration [1].

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1 To carry out their evaluations, environmental economists have had to distinguish between the several natures of the same good. For example, Pearce and Turner (1990) suggest different values: the *actual use value* first, linked to the direct use of the good; the *option value*, linked to a potential use of the good, even if this use is still unknown; the *legacy value*, a good may have a use to be transmitted to one's descendants or to future generations, beyond its current use, and finally it may be possible to attribute an inherent value to a person, a rare species, an ecosystem, etc.

This last distinction underlines the interest of contingent valuations which may take into account non-use values, sometimes of importance in the case of environmental goods and often difficult to incorporate in the case of public health problems, such as pain, social isolation or deaths due to illness.

From this point of view, the methods are complementary rather than concurrent. The objectives of the valuation will determine which tool should be used. As with Rozan (2001), it is possible to estimate the morbidity cost of air pollution by adding the medical costs (damages), the losses due to absenteeism (production losses) and the sufferings linked to illness (contingent methods).

However, it is far from clear where are area of pertinence each and another begins. There are many overlaps and a meta-analysis carried out by Manière (1999) on 49 studies and 96 estimations, points out that each method provides different costs in terms of the impact of air pollution. Thus, in her sample, the method of protection expenditure gives costs that are 1.5 to 1.9 times higher than the contingent estimation that in turn is 3 times greater than the hedonic price method. The methods of production surplus (*i.e*. human capital, production losses) and of restoring costs could even provide lower estimates. Significant differences also appear within the same family of methods. With contingent evaluations for instance, the values obtained on the basis of a referendum are on average 3 times higher than those obtained using pre-established values. The open questions provide intermediary results. As for damage costs, the way in which

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independently of any current or future use. This leads to the notion of *existence value,* creating a bridge between ethics and economics. This existence value is close to the notion of *non-use value*, used by several authors in opposition to the above-mentioned use value. The *total economic value* of any good is the sum of all these values, which may be of greater or lesser importance depending on the nature of the good.

the damage is estimated (in-depth indexation *vs.* extrapolation based on a few cases) seems to further determine the result.

The discount rate and questions of intergenerational equity

The second key variable in socio-economic valuation is the way in which the different time frames are taken into account.

The discount rate, frequently used in economics to treat the expected advantages and drawbacks of a project, is often designed as an expression of current preferences: 100 € available immediately are preferred to 100 € available in one year. If a is a given discount rate it would take 100x(1+a) € in a year to convince us to give up the immediate 100 €. The present value S_0 of a sum S_n expected for the year n will therefore be $S_0 = S_n/(1+a)^n$. Thus, the higher the discount rate n, the faster the future values will be erased with the passing years.

This preference for the present is of course variable according to each individual and their current situation, but it can be added to on a collective level, via financial markets or by the value adopted by public authorities to evaluate their projects.

Although these reflections on the discount rate were introduced in the 30s, they have re-surfaced over the last few years due to the emergence of the problems linked to the green house effect.

First of all, the notion of discount rate has been enhanced compared to the he first accepted notion presented above. Three obvious justifications can be put forward for its use (Arrow et *alii*, 1996): the *"pure time preference"* represents the preference of economic agents for the present with an estimated rate at 1 or 2 % per year depending on authors (even 0% for intergenerational effects); "*the riches effect"* linked on the one hand to an average growth in income over time and on the other hand to a decrease on the marginal use of that income; around 2 to 3% per year in western countries; and a "*money opportunity cost"* for private economic agencies such as firms and companies. Real rates of long term debentures can be taken here as reference, currently around 4%,

even if in truth, a number of rates exist, depending on loan periods, client risk, and the economic and political situation.

As a rule, as far as a public authority representing community interest is concerned, only the first two elements are taken into consideration, outside profit made on money payments. However, and this is the dilemma with which nations are confronted with today, the implied rate of 4% results in accepting too many projects on account of public funding capacities.

For example, France currently prefers an official standard rate of 8%, which limits projects but masks long term advantages and drawbacks. To compensate for this drawback, a number of solutions have been envisaged:

- Different discount rates can be distinguished depending on the term considered, notably for weaker rates for the effects expected in 20 or 30 years, thus making it easier to take them into consideration in the analysis.
- Following the recommendations of Hotelling (1931), the cost of non-renewable resources such as oil will be reassessed annually to an equivalent rate to the discount rate. In a more punctual and a static way, the worth of certain non marchands goods taken into account by public authorities may be reassessed when it is considered that gap is too wide between official values and those which come from general developments in the society (an example is the value of a human life which has recently risen from 0,5 to 1,5 millions € in France).

However other countries have chosen to use a much lower discount rate. Thus Germany uses an official rate of 3% in the field of transport. To avoid any budget inconsistencies, projects that are judged to be cost effective are classed in function of their profit by invested euro. Public authorities give themselves a financial envelope for these investments and only those projects that are the most cost effective and fit the envelope are carried out. As in the French case of a high discount rate, the less cost effective projects are thus eliminated, but two advantages can be underlined. On the one

hand foreseeable long-term effects, positive or negative, are better taken into account. On the other hand, by fixing a global envelope of investment spending at the outset, the German method ensures a more transparent choice between investment and working costs. Instead of polarising debate on the question of the discount rate, which is very technical, we come to back to a policy choice on the distribution of public spending.

In conclusion of this part, the field of research in the domain of green accounting appears to be very open. This being the case, it is hardly probable that the methodological enhancement to come will lead to a convergence of results: there is no cost in itself, sole and objectivable, for the impact on the environment and our daily lives. In this perspective, we believe that besides scientific work permitting better assessment of impact, it is also necessary to look at procedures which lead to official values used to assess public projects. These will help public authorities in their investment choices. The following part deals with reflection, by comparing the different ways this is done in different countries and in proposing a few guidelines as a conclusion.

3. From environmental cost assessment to political decision

Within the political framework, the valuation of environmental impact (like external costs in general) leads to two distinct practical applications. First of all, economic assessment of public projects can be taken into account. Thus, at the end of the 90s, half of the European countries financially evaluated the effects of air pollution and global warming in their official method of transport project assessment. Financial assessment also leads to the setting up of the polluter/payer principle, through fiscal policies of environmental taxes and subventions. For example, all the OECD countries have installed taxes on road fuel, which adds up to two thirds of their green taxes.

However international synthesis also highlights wide divergence between countries, with very variable official values for external costs and environmental taxes, from under 1% to more than 4% of the gross domestic product depending on the OECD country. When it comes to analysing these

differences, general international comparison studies are insufficient. They scarcely ever show the objectives of each country, the assessment methods chosen or how arbitration works. It is thus necessary to look at a few countries, and we selected France, Sweden and Switzerland that each has clear practices.

In France, environmental costs are fixed by technical/administrative groups

In France, transport project socio economic assessment uses a normalised cost/benefit method of analysis. From the 60s studies already proposed taking external effects into account, leading to road insecurity costs in 1970. But 1994 was the real turning point, with the work carried out by M. Boiteux within the framework of Commissariat Général au Plan which systematised the integration of external costs (Commissariat Général au Plan, 1994). This study, carried out again in 2001, led to new official values for noise, local air pollution and the greenhouse effect, founded on acquired scientific knowledge and in consultation with private transport companies, public transport establishments and the ministries in charge of transports, environment, and finance (Commissariat Général au Plan, 2001).

Thus in France, there is a link between research on les external costs and socio-economic assessment methods for transport projects. But faced with the complexity of valuing methods and the variability in results put forward by researchers, it was a technical and administrative group, composed of experts and senior civil servants who discussed the choice of official values and politicians remained hardly involved. This relatively technocratic approach without doubt partially explains why socio-economic assessment is so little known in France, or even discredited by local deciders and the public, even though it is mandatory under the law. Non-specialists mostly consider that it produces results that are not understandable. In these conditions, socio-economic assessment is today seen more as a legal obligation than as a policy instrument or a subject of public debate.

In Sweden, green taxation is real matter of political debate…

In Sweden, a strong environmental concerns like a good economic culture are elements guiding public decision. The setting up of fiscal policy aimed at favouring environmental protection shows this. In the same way, a marginal social cost principle for infrastructure pricing, taking transport related environmental impact into account, is clearly stipulated in government legislation (« Transport Policy Act », 1979; « Transport Policy Proposal for Sustainable Development », 1998).

The existence of a green fiscal structure and ongoing public debate over some fifteen years is a considerable asset for Sweden: everything is in place for quick reaction to European demands or to international greenhouse effect agreements. Sweden also puts pressure on Europe with the aim to having environment protective measures adopted.

Socio-economic assessment of transport projects remains, as in France, a domain largely dominated by technical/administrative structure. The ASEK working group, composed of representatives in charge of the environment and different transport modes, meets with experts and scientists, then adopts, after discussion, cost/benefit reference values. In Sweden as in France, the use of socio-economic assessment of transport projects remains therefore reserved exclusively to specialists, and official values are the fruit of a compromise between theoretical knowledge and the convictions or interests, rarely explicit, of working group members. It should be noted however that the results and discussions within the groups are then taken up by parliamentary commissions before finishing in validated texts at parliamentary level. *In fine*, accepted money values for the greenhouse effect and local air pollution are respectively six and three times higher than in France.

In Switzerland, political will is combined with pragmatic research

One of the main objectives of Swiss transport policy is to protect the Alps, the veritable natural capital of the country, against the growing negative effects of growing road traffic. To do this, the

Swiss have chosen to favour rail transport, consenting substantial public subventions to this mode and limiting total authorised weights of heavy goods vehicles to 28 tonnes. Then, under European pressure, the Swiss authorities relaxed this statutory constraint to orient itself towards economic regulation: in 1998, popular vote resulted in a Heavy Vehicle Fee (HVF). From a technical point of view, the aim of this tax is to oblige heavy vehicles to take their total cost into account: the average fee of the HVF corresponds exactly to the sum of external costs and infrastructure costs not covered by previous taxes, related to heavy goods traffic in tonnes-km. Two thirds of the HVF product is destined to finance large rail projects, in perfect coherence with the political will to develop rail: in this way heavy goods vehicles are paying for their future transport by rail.

The existence of dynamic applied research being a part of the everyday social and economic life of the country has led to public authorities defining and financing thought on the external effects valuation. Great collective progress has thus been made since the 90s. Precise assessment of external costs taxable to road traffic has allowed the quantification of Swiss citizen expectancies regarding the environment. A very effective technical and political argument has thus been found in favour of the HVF. Furthermore, as national debate on the subject of the tax is far from over, it would not be surprising if Swiss research were to contribute yet more to the development of knowledge on externalities, as was the case in the 80s and 90s.

Conclusion

Air pollution impact costs may vary greatly from one study to another, depending on what is measured and how. Economics research does not aim to converge on a single value for an objectified cost. There seems to be no reason why this wide range of values should shrink in the coming years. For public authorities, wishing to rationalize their choices in regard to public projects or environmental tax policies, the exercise of determining official values of reference remains and should remain problematic if they expect definitive answers from scientific spheres. There is a

strong temptation to close off discussion on a technical level, which is reserved for experts while what is at stake concerns choices of the society at large. In the light of French, Swedish and Swiss experience, there seem to be two main ways to help in avoiding this pitfall resulting in more transparent and more operational choices:

- Working groups must be open to all those involved, notably with strong involvement of nationally elected parliamentary representatives in the genesis and validation of obtained values and with a great presence of local deciders and technicians during the elaboration of investment assessment methods.

- Further upstream, research (economics and sociology being most closely related to the theme here) must also be mobilized to take part in the public debate. There again, a close involvement of political deciders in the definition of applied research programs would lead to politically sound recommendations. Deciders and the public should be offered a large information on public funded research and its results. This would bring out main scientific conclusions and would also help in offering a coherent political message.

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365 Tables and Figures list:

366 Table 1: List and classification of the selected studies (Nicolas et *alii*, 2002)

367

	Valuation methods used in selected studies					
Included types of assessed damage	***Protection expenditures***	***Hedonic Price***	***Contingent Valuation***	***Restoring Costs***	***Human Capital Method***	***Production Losses***
Morbidity *Short term*			Alberini al., 1997			
			Johnson al., 1997			
			Navrud, 1998			
				Deloraine al., 1995		
				Scott Voorhees al., 2000		
					Hansen al., 2000	
Mortality-Morbidity *Short term*			Ostro al., 1998			
			Chanel al., 1996			
			Rozan, 2001			
Short and long term			Künzli al., 2000			
				Ecoplan, 1996		
Mortality		Lannoie al., 1995				
Buildings			Grosclaude al. 94	Jeanrenaud al., 1993		
				Apsimon al., 1996		
Fauna/Flora					Gregory al. 96	
Visibility			McClelland al. 93			
Many impacts		Figueroa 96				
			Saelensminde, 99			
			Halvorsen 1996			
	Manière, 1999 – *all methods*					

Table 1: List and classification of the selected studies (Nicolas et alii, 2002)