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How difficult is it to go beyond Dupuit ?

Emile Quinet¹

PSE, école des ponts ParisTech, France

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ABSTRACT

This text develops a comparison between Dupuit era of *ingénieurs économistes* where the same person was both a decision maker and an economist, and the present era where there is a clear separation between the decision making world and the economic research world, the result being that economic research is less well linked to decision making. Applying this analysis to the case of transport, it shows how this separation leads to inefficiencies in the implementation of economic analysis for decisions. It appears that the level and nature of these inefficiencies, which varied along the history of the field, highly depends on the role of expertise and consultancies which ensure the links between the two worlds.

1. Introduction

Jules Dupuit is probably the most famous representative of this category of *ingénieurs économistes* who flourished during the 19th and 20th centuries, at least in France. They occupied high ranking positions in the decision making process, especially in the public sector, and had to decide on issues with both strong technical and economic content, such as for instance in the case of Dupuit the railway network or the road network. The strange fact is that they did not just use the existing knowledge on these matters, but that they made major break-throughs in technology (Dupuit worked also on technical issues, especially on hydraulics and some of his works in these fields are still in use) and in economics in the field related to the industry they ran. Should Dupuit have been an *Ingénieur des Mines*, he would perhaps have addressed the management of nonrenewable resources or the theory of discount rate, but probably would not have worked on surplus. In the present time, it is as if the chairman of DB² were at the same time acting as a renowned researcher in economics of regulation and competition, and making major break-throughs in the knowledge of wheel-rail contact.

It seems that this time is over. In France, the last *ingénieurs économistes* are probably P. Massé who was head of EDF (the French electric power provider) and had to solve problems of investment in power plants in a dynamic framework and was one of the developers of dynamic programming (the Bellman principle was in the past named the Bellman/Massé principle), Marcel Boiteux who was confronted to the problem of pricing the products of a public monopoly and designed the corresponding theory when heading the same public firm as P. Massé, Jacques

Lesourne, and Claude Abraham who developed various tools of traffic modeling and investment appraisal as responses to the problems he had to solve when he was first an executive at the road directorate and later the head of the directorate of air transport; but this was 40 years and more ago. On the contrary, our two Nobel prizes, Maurice Allais (recently deceased) and Jean Tirole held both several high degrees in engineering but never exercised in techniques nor had a position of managers; both spent the whole of their career as economists.

Why was such a situation possible in the past and seems to be impossible now, and what are the consequences of this change? The purpose of this text is to explore these questions and to suggest some directions for the future.

The first section will be devoted to some possible explanations of this evolution, based on the changes in the decision making and in the research processes which intervened since Dupuit era. We will show how these changes jeopardize the relation between research and decision and induce the appearance of a third part, the experts, at the junction of research and decision, which imperfectly fills the gap between them.

The second section illustrates these difficulties along three successive adaptations to the initial Dupuit surplus which took place along the time with more or less success: adaptation to congestion externalities through traffic models; adaptation to environmental concerns through monetarization of externalities; and now adaptation to economic geography effects.

The third section will focus on this last change and develop the issues and problems found in trying to include in project assessment the productivity effects due to geography.

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² Deutsche Bahn AG, German railway company.

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The conclusion will build on the previous sections to suggest evolution in the relation between decision making and research and to enhance the importance of the category of experts.

2. Long term changes in decision making and research processes

Without deepening the explanation, let us suggest, among other reasons, that two differences between the past time and nowadays probably explain why the time of *ingénieurs économistes* is over.

First, research has changed. One century ago, economics was in a pioneering phase, where all had to be built, where large progress could be done just through conceptual work, without field work. Now things have changed, research is less and less the issue of isolated persons, and more and more the outcome of large teams dealing often with large databases and huge softwares, allowed by the progress in statistics and in computing. Correlatively, the results are in general situation specific, and marked often by a higher degree of uncertainty and larger error margin. The situation is somewhat comparable to atom physics: before the war, huge progress has been done by a few people (Bohr, Curie, Einstein, Fermi, ...) working with very small means, while now research in atom physics needs a lot of funds and large teams (for example the CERN in Geneva). The result is that research is now a full time job, which cannot be exerted along with other activities. Research has developed in an independent way, where the works of scholars are often influenced by the ambition of reputation among their peers more by their interest for decision making. In the same vein, research, at least in the case of economics, seems to be in a phase of decreasing returns to scale; each scientific publication provides a smaller marginal gain to the scientific community.

The second point is the change in the condition of management of large firms: it is now much more stressing and more time consuming than in the past. It leaves less time available for possible research through the constant assault of news and communications made unavoidable through telephone, internet and the fast transport and communication means, leaving not much time for meditation and thinking. The tasks of managers have also greatly changed and are more and more diversified; human resource issues have gained in importance, as well as communication and public relations.

So, nowadays, both activities are split, and this situation has some negative consequences, in that the connection between the current issues at stake and economic research is not so efficient. Researchers have a less clear idea of what are the needs of decision makers and develop their own research field on other bases, and decision makers are less able to express these needs in terms of economic analysis. In a word, the bridge between theory and practice is less easy to build.

Unfortunately the need for more knowledge did not stop at the end of the 19th century. In terms of infrastructure investment appraisal, the basic surplus Dupuit, though it provides the bulk of the estimates and valuable magnitude of the appraisal, does not cover the present needs of the decision makers.

Let us first shortly express it in loose and modern words³: it states that the collective welfare change –in case for instance of a new infrastructure investment– is the sum of the changes in producers' surplus and consumers' surplus, which is the change in the area between the demand curve and the marginal cost curve. So the general welfare change can be calculated in a partial analysis framework, limited to the market in which the initial change takes place. This procedure was easy to implement, and implied only easy to get data: the costs and traffic before and after the investment.

This very efficient result presents two major drawbacks. First, to the eyes of the economist, the Dupuit surplus is valid under strict limitations: mainly the assumption that the distribution of income is optimal and that the rest of the economy is in a first best situation (no externalities, no

market power and firms are price-takers); we will not dwell on the first limitation and focus on the second one about the situation of the rest of the economy. It is well known that situations of first best are not realistic. Since Arrow/Debreu, the bulk of economic analysis has been devoted to the departures from first best situations, due to imperfect competition and externalities.

Second, to the eyes of the modern decision maker, the Dupuit surplus does not give any indication on who benefits and who loses from the new investment; it gives just the algebraic sum of the changes. It could be sufficient at the epoch where decision was taken by a few people, generally the high ranking public servants and politicians. But now decision is the result of very complex procedures and a lot of lobbies, bodies and public are in position to influence the final decision. And those varied decision makers are at a utmost degree eager to know the detailed effects of the investment, and not only the overall consequences: productivity of firms, wages, employment, distributional effects among social categories, location of economic activities, public finances, exports/imports, consequences on economic growth, all subjects which are eagerly asked for by the stakeholders of the debate on infrastructure investments. Modern decisions are shared between many stakeholders, who are interested in the consequences of the project for them, and not only on the change of surpluses. To go beyond Dupuit in these fields, it is necessary to develop our knowledge in positive economics, to be able to track the diffusion of the initial changes in the whole economy.

At the time of Dupuit, these drawbacks were not that important: there was no concern about road congestion, environment was not an issue; industry was in the infancy as well as services which are now acknowledged as being a main source of increasing return to scale, and cities were limited vis-à-vis rural areas. In the framework of a very simple decision making process, the discussion about the results of assessments was very limited and no break-down of the effects was important.

Unfortunately, it is not the case in the modern world. Since Dupuit period, a lot of new factors not included in the initial framework have gained in importance, and their inclusion in investment appraisal is becoming more and more difficult. Let us see how things work now and how appeared a third actor, the experts, at the junction of research and decision. We will illustrate it through the three main adaptations of Dupuit theory for infrastructure assessment.

3. The successive waves of enlargement of Dupuit surplus

Most parts of the works of Dupuit, was just updated and deepened after him, as [Bonnafous and Crozet \(2017\)](#) and [Rothengatter \(2017\)](#) show in their contributions to this issue. However, in the case of transport, several new fields had to be addressed, due first to the emergence of new techniques (car and trucks) or new concerns (environment). The historical changes happened along three phases.

3.1. Congestion externalities and traffic modeling

First, with the development of cars and road traffic, congestion externalities appeared and were dealt with through traffic modeling; this field was first developed by engineers which marked its initial features: traffic models were at the beginning quite operational, but lacking economic bases, which came during the 70's for instance with the discrete choice models. Perhaps Dupuit, being both an engineer and an economist, would have avoided this dichotomy, and would have contributed to design models both operational and coherent from an economic point of view. But it is sure that he alone could not have achieved the whole work. Traffic modeling involves huge models, implemented at the cost of high expenses and long delays with the usual black box syndrome and large uncertainties due to many reasons among which are poor data, cost and delays of studies. In fact a new profession of specialists in traffic appeared and developed. Their role, mainly held by consultancy groups, was to input the results of research in this field of traffic modeling in tools able to answer to the questions of decision makers.

³ and perhaps using an extensive interpretation of Dupuit's ideas on "relative utility" and its links to consumer's surplus.

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