Lectures in Public Economics
Cours d'Economie Publique
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THE ECONOMICS OF MASS SERVICES
LE SERVICE DES MASSES

1971; 465 pages; Dunod (Paris)

This volume is the third of the 5 volumes of the Lectures in Public Economics published from 1968 to 1971. The set of results presented in these lectures constitute the basis of our understanding of the public economy. A number of them became standard procedures in the public, regulated of private management of large services, concerning optimum investment, pricing (including tolls and taxes), budgeting and subsidies, quality management, and regulation.

This volume belongs to a series of analyses investigating the nature of the goods that are neither purely private nor purely public, intermediate between both, and combining aspects of both, and the consequences of such structures for social optimality and optimum policies. The various possible types of these intermediate structures are presented. To begin with, for a standard (private) good, the quality of the good is in fact a collective concern (a pure public good) for its consumers and producers. Hence, an important class of these intermediate cases occurs when the quality depends on the total quantity consumed. More generally, this class consists of goods whose consumption entails external effects between the consumers. Since this is the case of phenomena of congestion, this class takes this name in an extended sense. Yet, it constitutes a very common economic structure which includes for instance, besides ordinary congestion, the environmental effects of human activities, the various negative and positive externalities of sharing an urban space, the quality of large services, the risk of failure of such a service, the depletion of resources (through effects on quality and price), and so on.

The crucial economic property of such a good is its structure of **qualitative returns to scale**. This is a property of the "congestion function" which gives the quality as a function of the quantity and of inputs which can improve the quality (often a dimension of infrastructure, or some environmental improvement, etc.). The *elasticity of qualitative compensation* is the elasticity of this input to the quantity, when the quality remains constant. One minus this elasticity is the *qualitative excess*. The fundamental theorem of congestion theory says that at an optimum where the users are taxed for their external effect on others (plus their individualized cost), *the overall financial outcome is the product of the qualitative excess by the cost of the input*.

There are *constant, decreasing or increasing qualitative returns to scale* according as to whether this qualitative excess is zero, positive or negative. With increasing qualitative returns to scale, the service should be in deficit (the congestion tax does not match the cost of the input at the optimum), and hence it cannot be provided in a purely private manner. Overall constant qualitative returns to scale means that the congestion function is homogeneous of degree zero in the quantity and in the input (its 3-dimensional representation is a helix). This compares and contrasts with the classical quantitative returns to scale.

This theory, previously developed in the volume *The General Economic Theory of Congestion* (1968), is extended to the cases of multidimensional congestion, and of the various situations of market structure and of quantitative returns to scale for the production of the input. The dynamics of the phenomena of congestion is presented. The most important properties of congestion functions and their various consequences are analyzed. All this is applied to a number of important problems: road, rail and air transportation; the depletion of natural resources; environmental quality; safety and accidents; stochastic congestion (or intertemporal use of an equipment) with a risk of failure, and various application (including in financial risks). In all cases, the optimum management and investment and the financial and institutional consequences are derived from the structure of the congestion function, with neat specific results (e.g. concerning the effect of correlation in stochastic congestion).

An important application is growth theory taking account of the quality of the environment, and the determination of the optimum policies in this respect including the optimum dynamics of investment control.

The more general results about optimum investment and its timing, under the various constraints and conditions, are presented.

Among the numerous articles applying the theory of qualitative returns to scale, one can in particular note the following:

Qualitative returns to scale and the optimum financing of environment policies, in *The Management of Water Quality and the Environment*, ed. by J Rothenberg and J. Heggie, Macmillan, 1974. Comments by John Hicks.

Le rendement qualitatif et le financement optimal des politiques d'environnement, *Econometrica*, December 1974.

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A very important and frequent structure of combination of private and public features for a good is provided by the dual structures of the collective consumptions of each piece of a privately shared good, and the private sharing of the various consumptions that collectively consume a good. They are, respectively, the joint uses of private shares and private sharings of joint uses, or goods that are between-group private and within-group public, and between-group public and within-group private. Examples are provided by sharing a good between groups each of which collectively consumes its piece, and the private sharing of a space which is successively occupied by various groups (the dimension of this space is a between-group public good and a within-group private good). A specific consumer can belong to several of these groups. One can consider that the various shares in the former case and collective uses in the second are various "varieties" of the good. In both cases, time can characterize the varieties. Location can characterize them in the former case, and the occurrences of uncertain events can characterize them in the latter case. The dual two-stage building of demand curves (with horizontal and vertical additions) and optimality conditions are shown. More complex cases associate further layers of private or collective consumptions. There can also be phenomena of congestion in addition.

These structures provide intermediate cases between pure private and public goods, in all degrees. With the joint consumption of shares, the good is purely private if each share has only one consumer, and purely public when all consumers benefit from the same shares. The correlation between the presence of consumers over the various shares is a degree of

publicness. With the sharing of each use of a joint use, the good is purely private if all consumers are present at each use, and purely public if there is only one consumer for each use. The correlation between the presence of consumers over the various uses is a degree of privateness. Precise definitions of these degrees are provided, along with the corresponding optimality conditions.

These general results are specified and applied to a number of important questions. In particular when the varieties refer to time and to uncertain events. The optimal management by pricing and the distributive effects are considered. In particular, the question of peak-load pricing is fully analyzed, including with a congestion effect on a quality of the service.

The service and pricing of a variable demand with common inputs and various structures of production and of possibilities of pricing has a major application when the various demands are the occurrences of an a priori uncertainty. This leads to the general theory of the public economics of uncertainty, and to results with important applications.

In particular, a chapter shows the remarkable results about the service and (ex ante) pricing of a random demand, concerning notably the optimum prices and the financial outcome (implying a role for the public sector if it is a deficit at the optimum), with a pricing of the moments and notably the mean and the variance or the standard deviation, and depending on the correlation or independence of the individual demands.

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Finally, Part III of this volume presents the normative economics of "mass services" with many consumers and a waiting externality (plus possibly others), by the joint application of the general theory of congestion and of the theory of equipments used privately at a time but collectively intertemporally. The various cases and problems are considered with certainty and in a stochastic world, with the results for optimum management, and consequences notably derived from the obtained congestion functions and their properties of qualitative returns to scale. Various important applications are shown.

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