

based on age, sex, culture and class. The discussion of cost and technical difficulties introduces a note of healthy scepticism.

He concludes with two views, each a collage of the frequently expressed views of others, of information technology in education in the year 2000. One is extremely but not absurdly optimistic, the other quite pessimistic — or, rather, it is a set of alternative grounds for pessimism: declining funds for education, increased government control and centralisation, privatisation, and the domination of education by technology. Finally, he presents his own, cautiously optimistic and humane, view of the likely future, in which, despite the commercial and political pressures operating and inequality of access to technological resources, the new technology is used as a powerful tool to enrich education.

There are some surprising omissions or lacks of emphasis. A lot is said in the book about the use of television, but only half a page [p. 155] is devoted to the long term effects on children of watching television. Little is said about the images or stereotypes presented by video games or educational courseware presented in a games format; nothing is said about violence.

The book limits itself to the use of information technology in education. Consequently, hardly anything is said on the subject of teaching about technology, especially in the important sense of empowering students to understand and form critical judgements about the place of information technology in society. The use of technology for educational administration receives scant mention, nor is a great deal said about the role of technology in information and library management.

Hawkridge writes well and clearly. The continual citing from his large list of references, however, is overdone, intrusive and often inappropriate for what is essentially a textbook. There is no need to provide authority for simple factual statements. Many of the references, moreover, are unsuitable for student use or are relatively inaccessible (such as newspaper articles, the more obscure journal articles, and internal reports). While he cites one of Weizenbaum's more recent papers, he does not include his classic work of technological scepticism, *Computer Power and Human Reason* (Freeman, 1976), nor the even earlier book of Oettinger, *Run, Computer, Run* (Collier, 1969).

In summary, since there are so few books yet on new technology and its use in education written by people with knowledge and understanding of education, this will be a useful text for a few years. It would, however, have greatly benefited from trial as the basis of a course or from greater critical review by people with good knowledge of both information technology and of educational theory and practice.

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Economic Analysis of Telecommunications: Theory and Applications edited by L. Courville, A. de Fontenay, R. Dobell
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This book is a valuable addition to the relatively sparse literature on the economics of telecommunications. The editors have rendered a great service in

putting together selected papers on the subject presented at a conference held in Montreal, Canada in 1981. It is divided into three sections: the first deals with production, the second with demand, and the third with the welfare calculus and regulation.

In the first section, a paper by Fuss dealing with recent results in production analysis of telecommunications makes a significant contribution to recent advances in econometric literature. It surveys empirical results from the application of new techniques of economic analysis to telecommunications. The author rightly claims that considerable attention has been paid to the scale effects of telecommunications due to its close relationship with issues of natural monopoly. In the course of the paper, the author discards past assumptions of at least constant elasticities of substitution, homogenous growth of output and Hicks-neutral technical change as being irrelevant to telecommunications. He does so by using the cost function rather than the production function as the basis for a choice of the behavioural model and assumes cost minimisation behaviour on the part of the firm. The drawback to such an assumption is that most telecommunication firms are monopolistic so that competition as a cost-minimising factor is absent. The author suggests the use of an intertemporal cost-minimising model with increasing marginal costs of adjustment. A number of studies of telecommunication service production firms have been surveyed as the author finds that, for Canada, the unrestricted cost function is the most appropriate because it uses long-run constant marginal costs of adjustment. Technical change can be introduced into the model either as capital augmenting change or as all factors augmenting or as output augmenting. Generally in cost function models, the rate of technical change is measured by the proportionate downward shift of the cost function over time as shown by the author. He concludes that the separation of efficiency gains into those generated by scale economies and those generated by technical change are difficult to sort out in telecommunications.

The specific case of Bell Canada for economies of scale and scope are examined in a paper co-authored by Kiss, Karabadjian, and Lefebvre. Using the dual cost theory, the authors claim that cost functions are more suitable for estimating the characteristics of Bell Canada's production process than production functions. The authors use translog and generalised translog forms of cost functions to represent Bell Canada's production structure, construct a fairly complete model and deductively conclude that there is a specific pattern of economies of scale which emerges from a comparison of models with one, two or three outputs. The analysis of economies of scope indicated uniformity but not of a convincing nature from the economic point of view. It follows from this analysis that cost functions are relevant for regulated public utilities since their output levels are exogenously determined. The advantage with basing the analysis on cost functions is that multi-output production processes can be considered with ease. An important outcome of this study is that the assumption that Bell Canada reaps maximum monopoly profit when prices are endogenously set appears unrealistic, despite the efforts at cost minimisation. Demand for many categories of toll services are price-inelastic.

An examination of Bell Canada's productivity gains by Kiss discusses the problems of total factor productivity measurement followed by a descriptive analysis of Bell Canada's productivity performance during the period 1952 to 1980. Productivity gains of this telephone company were attributed to

improvements in production technology as well as to growth in demand with a ratio of 25 per cent gains from the former and 75 per cent from the latter. This is followed by a comparison of the efficiency of three Canadian telecommunication companies by Denny, Fontenay and Werner. The authors have used aggregate publicly available data and claim that results of their efficiency analysis will remain unchanged even if more disaggregated data were available. The paper identifies profits and efficiency levels without explaining any causal relationship between the differences in efficiency.

The application of economic analysis is covered by three papers focusing on total and global factor productivity as an input for management decisions and planning. It measures the output/sum-of-factors ratio as contrasted with partial productivity estimates which deal only with one factor of production and its value added. Factor substitution would minimise total product costs. Its effect on global factor productivity is also taken into account. A. Chaudry uses a productivity-based planning model used by AT&T in order to highlight the significance of total factor productivity in the firm's budgeting process. The usefulness of this concept of total factor productivity is explained logically in the paper by Denny, Fontenay and Werner. The problem with integrating this concept into the planning process is that the model does not allow for planned costs and actual costs to deviate from revenues. It is more a post-mortem methodology in contrast to the Productivity Analysis for Planning model which can be used to generate a plan for corporate budgets.

The section on demand analysis is comprehensive and includes eight papers, five of which deal with local measured telephone service. Modelling of telecommunication demand encounters some problems. Economic analysis of telephone demand includes both access and use for residential and business consumers. Taylor presents an exhaustive review of literature on externalities associated with access and call and option demand for rural exchanges. He believes that option demand may be "a factor in many subscribers' apparent preference for flat-rate pricing of local service over measured service." The author justifiably concludes that empirical analyses of telephone demand need to be co-ordinated with theoretical analyses. Price elasticities of demand are estimated in a general way and need to become more specific. The same uncertainty surrounds estimates of income elasticities of demand for telephones. Without reducing these uncertainties tariff policy may not always be efficient and equitable.

The paper on long-distance calls B.C./Alberta critically discusses the presence of network externality and the validity of the assumption of constant elasticity of demand. De Fontenay and Lee suggest a model which can cope with price elasticities in value terms increasing with distance. Their results indicate own price elasticity of demand decreases with price and increases with income. So also income elasticity increases with price and decreases with income.

Price elasticity is dealt with in great detail in the next paper on telephone demand and usage by Curien and Vilmin who propose a micro-economic integrated model based on classical assumptions of utility maximisation. Wilkinson examines specific exchanges and tariffs for usage repression under local measured service. He suggests intervention modelling as a useful tool for identifying the effects of price changes upon usage. T.F. Wong identifies shifts induced by tariff changes in the distribution of local telephone usage. He

analyses the impact of a shift from flat rate telephone charges to measured service. Drawing on Bridger Mitchell's *ex post* billing option, Dansky discusses its impact on profits and on consumer's surplus. In a convincing presentation, the author contends that a customer's benefit from *ex post* option is Pareto superior to a flat rate option. It will increase the consumer's surplus without reducing the profits of the firm. Bridger Mitchell in an enlightening paper proves that the design of appropriate rate structures for local telephone calls should be determined by the technology and cost characteristics of the local network. He suggests peak-load pricing to cover the costs of local telephone service and concludes that a uniform average cost price is less efficient than a flat-rate tariff. On the other hand, Brander and Spencer discuss Ramsey pricing for local telephone service on criteria of efficiency, i.e., markups over marginal cost should be higher as relevant elasticities are smaller. They conclude that Ramsey optimal pricing may not be desirable on the grounds that under it, downstream competitive firms will be subsidised or a "captive" group of consumers will subsidise the rest. Under regulated imperfect competition the problem of sustainability becomes difficult with cross subsidy.

This issue is scrutinised at length under Section 3 which deals with the welfare effects of regulation and subsidised pricing. In his paper on welfare optimality, Rhéaume elaborates on the criterion of allocative efficiency and distributional equity under regulated monopoly. He uses the Pareto criterion and Koopman's efficiency ranking to test allocative efficiency and demonstrates welfare differences between cross-subsidised Ramsey pricing and a subsidy-free rate structure. Cross-subsidy tests done by Autin and LeBlanc show that no such subsidy is detected by them for the Canadian Interregional Telecommunications Network. Investment decisions under regulation of the firm are dealt with in the final section of the book. The papers cover the existence of uncertainty in economic decision making and incorporate it into microeconomic analysis. While the theory of the firm has focused on regulation since the Averch-Johnson finding of input distortions induced by regulating the rate-of-return, Perrakis develops both forward-looking and backward-looking regulation models. When used in connection with value maximisation, the author invalidates the Averch-Johnson results and points to the existence of greater backward-looking regulation.

On the whole, this book is of value to the economist, academic or technocrat and perhaps to graduate students in economics. It is also of worth to telecommunication corporations for setting tariffs and planning income and efficiency levels within the industry. It is not for general or uninitiated readers nor, for that matter, for communication practitioners. It has a wealth of interesting theoretical applications which can be used for public utilities other than telephone companies.

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