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Infrastructure: the social value of shared resources, by Brett Frischmann, New York, Oxford University Press, 2012, 417 pp., US$85 (hardcover), ISBN 9780199895656

Frischmann's book has to be considered in the context of a recent stream of original contributions aimed at integrating research from different social science disciplines to address shortcomings in the traditional economics literature. Against this background, these contributions have focused on the structure, driving forces and dynamics (von Hippel, 2005; Tapscott and Williams, 2006) as well as the institutional environment affecting knowledge production in modern societies (Benkler, 2006). In this context, Frischmann's book addresses a major limitation of current economic theory – that there is 'no subfield within economics devoted to infrastructure' (p.xiv). In the 14 chapters of the book, Frischmann's objective is to fill this blind spot in an interdisciplinary manner by integrating new insights from law, economics and environmental analysis. The book is divided into six parts and puts Frischmann's earlier published (and highly cited) papers – for example, on the economic foundations of his theory (Frischmann, 2004) or spillovers (Frischmann and Lemley, 2007) – into a broader and more fundamental context.

Frischmann describes his novel approach towards infrastructure, combining 'a particular set of resources defined in terms of the manner in which they create value, with *commons*, a resource management principle by which a resource is shared within a community' (p.ix, original emphasis). In this way, the book is aimed at providing a more coherent framework for the analysis of a variety of infrastructures by focussing on the demand side. In contrast to Frischmann's approach, most studies have concentrated on technical treatments of infrastructure, one particular type of infrastructure (transport, energy or telecommunications) and economic analysis of infrastructure (from a public choice or regulatory economics point of view). The contribution of Frischmann's approach is to stimulate interdisciplinary research in the area of regulating shared infrastructure resources.

The key lesson from the book is: 'we should share infrastructure resources in an open, nondiscriminatory manner if it is feasible to do so' (p.xiii). This conclusion has theoretical and policy implications, which Frischmann develops for road and transportation infrastructure and for environmental and intellectual infrastructure, as well as for current discussions on, for example, network neutrality. Even if the reading of these chapters is refreshing and provides new insights (e.g., on telecommunications), more elaboration and conceptualization of Frischmann's concepts are needed. In particular, his chapter on intellectual infrastructure can provide new insights into the economics of innovation. Similarly, his discussion on market

failure can contribute to innovation policy and to the debate on open innovation (Metcalfe, 1995).

In the second part of the book, Frischmann develops his concepts of infrastructural resources and commons management. In introducing these concepts, he links to the discussion in economics on public goods and price discrimination. His concept of infrastructural resources is based on the definition of economic resources in terms of excludability and rivalrousness of consumption. Frischmann argues that a producer of a good incurs costs of exclusion as he intends to charge a consumer for using it. If markets do not work efficiently, the costs of exclusion are too high and there is a case for government intervention. With respect to rivalrousness, Frischmann focuses on the 'sharable' nature of resources (the extent to which these resources can be accessed and used by multiple users at the same time). As most resources have finite capacity, problems can emerge even from nonrivalrous consumption (leading to resource depletion), which can be overcome by management choices in favor of providing only a particular resource to users. As the market will allocate this resource to the consumers valuing it most, nonrivalry gives a wider range of choices to producers (e.g., sharing is feasible). Frischmann then focuses on forms of impure public goods which are based on partially (non)rival consumption such as a lake or a computer network (p.31). These resources can sometimes be nonrivalrously consumed and sometimes rivalrously consumed, 'depending on the number of users and available capacity at a particular time' (p.31). Therefore, Frischmann concludes that '(1) the degree of (non)rivalry of consumption is variable and often manageable, and (2) the means for managing congestion also vary' (p.32). To define infrastructure resources further, Frischmann adds to the issue of nonrivalrous consumption, social demand for the resource coming from downstream productive activity (requiring the resource as an input) and the extent to which the resource is used as an input into a wide range of goods and services (p.xiv).

In linking to the theoretical discussion on price discrimination, Frischmann introduces commons management as an alternative strategy for firms and policy makers in cases in which 'a resource is shared among members of a community on nondiscriminatory terms' (p.92). Nondiscriminatory terms means in this context 'terms that do not depend on the users' identity or intended use', but members of a community have 'equal opportunities to use the resource as they see fit, under conditions that are more or less uniform' (p.92). A central issue in commons management is the concept of openness (the degree to which access to and use of a resource is controlled and the relationship between potential resource owners and resource users is organized) (pp.91–2). Frischmann proposes that commons management can be used – depending on a number of preconditions – to generate value for private and public parties by involving users. For example, commons management can maximize the (future market or social) option value of infrastructure for private and public parties in the case of high uncertainty. For private parties, market uncertainty is related to sources of future market value (e.g., missing markets). For public parties, the degree of market uncertainty is linked to the extent to which spillovers are generated between different productive activities of users. In the case of high market uncertainty, it becomes important to evaluate whether private firms already deploy a commons strategy which would make government intervention unnecessary (p.113).

Frischmann elaborates on preconditions which have to be taken into account when evaluating the case for managing infrastructure as a commons related to

pricing issues, managing congestion and supply-side incentives. By using the building blocks of his theory and taking these complications into account, Frischmann examines the road and telecommunications infrastructure. For transport infrastructure, Frischmann shows that even if the case for commons management is quite strong, congestion and negative externalities generated from environmental pollution require new approaches related to capacity expansion, congestion pricing and rationing, as well as new ways of facilitating the shift towards more environmentally sound and energy-efficient technologies (p.130). For telecommunication infrastructure, he shows that the transformation of the sector attributable to innovation, regulatory change and shifting business strategies has led to more 'scope of possible user activities' and 'substantial market and social value uncertainty' (p.222). Frischmann's vision is that this transformation has 'increased the social option value of infrastructure, and correspondingly strengthened the case for commons management as a public strategy' (p.222). Even if this is a compelling theoretical argument, it remains important to observe how further conceptualizations will be made to examine practical issues in the telecommunications sector. For example, to what extent should public commons management be used to facilitate emerging general-purpose technologies? Is there a case for a private commons strategy facilitating the cooperation of telecommunication operators in broadband markets?

With respect to nontraditional infrastructure, Frischmann examines environmental infrastructure which has some tradition of using commons management as envrionmental resources are 'often associated with the tragedy of the commons' (p.228). He proposes that his concept of environmental infrastructure complements current research on '(1) multiple-use management (MUM) strateges for public lands and forests, and (2) ecosystem valuation and management' (p.249). Similar to these two approaches, his objective is to 'explore from a functional perspective how social value is generated in complex social-ecological systems' (p.252). In his chapter on intellectual infrastructure, Frischmann's focus is on basic research, intellectual property rights and general purpose technologies (GPTs), but also on languages. As a result, he uses a broad definition of intellectual infrastructure which includes the cultural environment (p.254). As the chapter links to some recent discussions (e.g., on the tradeoff in intellectual property economics between monopoly power and the diffusion of innovation; Scotchmer, 2006), other areas, such as research on GPTs, are just touched upon (Bresnahan and Trajtenberg, 1995) or, like open innovation (Chesbrough, 2006) and the concept of an appropriability regime (Teece, 1986), are not discussed at all. In the last two areas, Frischmann's research could could generate new hypotheses, say, in the area between a private commons strategy and the appropriability regime, or between access to open innovation and (Frischmann's concept of) congestion.

Frischmann's concepts (on congestion and supply side problems in particular) have provided the basis for his original contributions to the network neutrality debate and might also be useful in other discussions. Frischmann reframes the debate on network neutrality by considering the internet as a mixed infrastructure which is a 'partially nonrival resource … consumed both nonrivalrously and rivalrously, depending on the available capacity' (p.335). This allows him to focus on problems inherent in the use of the internet as an innovation commons leading to mass collaborations (Tapscott and Williams, 2006). As Elinor Ostrom and Suzanne Scotchmer note in their preview of the book, Frischmann's idea of infrastructure

commons will have broad implications for scholarship and public policy across a variety of fields. For academics, the book is a inspiring read. The interdisciplinary integration of these disciplines challenges the reader and demands familiarity with the discussions in these disciplines.

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Broadband networks, smart grids and climate change, edited by Eli Noam, Lorenzo Pupillo and Johann Kranz, New York, Springer, 2013, 255 pp., £92 (hardcover), ISBN 978-1-4614-5265-2

With a contemporary topic and a wide range of high-level contributors, chances seem high that this book will become a standard reading in the multi-disciplinary field of smart grids. In trying to merge different areas, such as broadband economics, law and regulation, the book attempts to provide snapshots of different aspects of smart grid development. The authors refer to the 2010 CITI (Columbia Institute for Tele-Information) conference at Columbia University on broadband networks and smart grids at the crossroad between information and communication technologies (ICT) and energy as the impetus for the book. There are four parts: interdisciplinary perspectives on smart grid developments, national energy and broadband plans, smart grid business strategies and, finally, policy and regulatory issues. My focus is on the original contributions to the conference.

In the introductory chapter, Matthias Kurth – former president of the German regulatory agency responsible for regulating power grids and telecommunications – provides definitions of smart metering, smart grids and smart market design. He also raises concerns about (1) the current lack of smart metering and control devices