Telecommunications Policy 35 (2011) 291–300

Contents lists available at ScienceDirect

Telecommunications Policy

URL: www.elsevierbusinessandmanagement.com/locate/telpol

Allocative vs. technical spectrum efficiency

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ARTICLE INFO

Available online 15 March 2011

Keywords:
Spectrum
Efficiency
Trading
Transaction cost
Uncertainty

ABSTRACT

Achieving allocative and technically efficient spectrum management is a key aspect of deregulatory reforms in several OECD countries. However, reform legislation offers few clues as to how these objectives should rank when they conflict with one another. An 'innocent' prior acquisition of service-neutral spectrum at an efficiently run auction may prove allocative efficient but fail to be technically efficient if the spectrum is left fallow in the short term. Accountability for the productive usage of a public resource and pressures from short-term political cycles may induce regulators to mandate some minimal level of activity. Two plausible regulatory responses are considered: use it or lose it clauses and spectrum trading incentives. The former favours technical efficiency whilst the latter promotes allocative efficiency. The argument is formalised in a simple economic model buttressing the roles of uncertainty and transaction costs to assert the primacy of allocative efficiency over technical efficiency.

1. Introduction

In the long run, the economic performance of sovereign nations rests on the efficient use of scarce strategic resources such as the radio spectrum. Achieving efficient spectrum management is of particular importance for the expansion of the information and communications industries, with flow-on benefits for the consumers and communities they serve. However, traditional command and control regulations such as currently applying to many legacy services worldwide present an obstacle to objectives of efficient usage.

Accordingly, achieving efficiency in spectrum allocation, use and access became the central tenet of legislative reforms introduced at varying degrees in several spectrum liberalising countries about a decade and a half ago.[1] As is well established in the spectrum regulation literature, there are various ways of thinking about efficiency in spectrum policy and concepts such as allocative-, productive-, technical-, dynamic- or functional efficiency are commonly put forward as building blocks in the overall quest for spectrum efficiency (Burns, 2002; Cave, 2002; Cave, Doyle, & Webb, 2007; FCC, 2002).

How these efficiency sub-objectives are to combine in the promotion of the public interest remains a vague proposition. In particular, is the systematic and simultaneous pursuit of allocative (highest value) and technical[2] (most intensive usage)

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[1] A comprehensive, comparative review of the licensing reforms in these countries can be found in Marcus et al. (2005), and more briefly in Annex A of Hazlett (2008).

[2] A referee stresses the importance of semantics in efficiency definitions, suggesting that it might be technically efficient, when irreversibly investing in new technologies, to leave spectrum unused for a short period while a new, more 'technically' efficient technology is developed. This definition refers to an optimal resource usage problem, at times described as 'dynamic efficiency' (Cave et al., 2007). This concept is simply 'allocative efficiency over time': the outcome of a long-run process optimally migrating resources to where they are needed most in social welfare terms (regardless of short-term periods of resource non-use). Risk aversion and time preferences fully shape this process. By contrast, technical efficiency is a throughput measure, referring to the continuous, intensive usage of the resource, often to satisfy short-term regulatory targets (such as set by the demands of political cycles).

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doi:10.1016/j.telpol.2011.02.002

spectrum efficiency feasible? If the answer is yes, achieving these objectives will unambiguously contribute to the maximisation of an overall efficiency measure. Otherwise, if these distinct efficiency concepts mutually exclude each other, pursuing one of them will come at the expense of the other. This situation may lead to wasted opportunities and welfare loss if the socially weaker objective replaces the stronger one.

As this article illustrates, regulators commonly encounter such intricate trade-offs between different efficiency objectives. With little objective criteria to guide their decisions, they have generally tried to steer a course between the requirements of legislated texts, and the interests of spectrum users and their consumers.

This is problematic in many ways. Spectrum management reforms have created leasehold property rights regimes, such as auctioned and used in New Zealand (management rights), Australia (spectrum licences) and the United Kingdom (spectrum usage rights). When competitively auctioned, spectrum property rights provide ideal pathways to achieving allocative efficiency but they are not necessarily technically efficient, in the sense that the spectrum may remain largely unused. Therefore, property rights and auctions may help channel the spectrum to where it is valued most, but they offer no guarantee of efficient use (or any use at all).

Conversely, administrative licensing arrangements that facilitate the productive use of a specific frequency band will usually not be allocative efficient because the deployed service or the adopted technology are typically prescribed with no regard for market forces.

Hence, efficiency objectives can diverge significantly from one another in practice and the type of licensing regime adopted can itself be a source of divergence through the transaction costs they impose and the incentives they generate. With competing efficiency objectives, the quest for efficient spectrum policy presents daunting public interest dilemmas to regulatory agencies, and as will be discussed, spectrum law offers little guidance to help clarify these choices.

This article aims to contribute to a clearer hierarchy of spectrum efficiency objectives. A first section stresses the lack of clear direction in legislated and regulatory texts in major spectrum liberalising countries (where the emphasis on spectrum efficiency objectives is highest). A second section illustrates the regulatory problems arising from this lack of direction through a practical example of conflicting efficiency objectives in Australia. A third section discusses two approaches used by regulators to resolve the conflict between allocative and technical efficiency: facilitating spectrum trading and inclusion of 'use it or lose it' clauses in the licensing contract. Finally, the paper presents an economic model, which sheds some light on the relative economic efficiency of these two approaches. The basic point is that, in general, 'use it or lose it' restrictions fall short of achieving efficient allocation of spectrum because they distort the dynamic investment decisions of market participants. This result highlights the crucial role of a well functioning secondary market for spectrum in achieving both allocative and technical efficiency in spectrum use.

2. Efficiency objectives in selected reform countries

Consider several efficiency objectives as articulated by several key jurisdictions in spectrum-liberalising countries. In the US, the Spectrum Policy Task Force (SPTF) of the Federal Communications Commission (FCC) has repeatedly stated that:

> 'One of the Commission's key spectrum management goals has been to promote efficient *access* to and *use* of the radio spectrum' (FCC, 2002, p. 4)

Does efficient access implicitly lead to efficient use, or do these two objectives contribute separately and independently to an overall efficiency goal? To clarify its intentions, the FCC distinguished between (FCC, 2002, pp. 5–9);

(i) Spectrum efficiency, which is a narrowly defined input–output ratio referring to the maximum information throughput that can be dispatched per unit of radio spectrum.
(ii) Technical efficiency, which combines spectrum efficiency with the cost of using other resources[3]: a highly spectrum efficient device may be technically inefficient if it is too costly in terms of other resource use, say specialised labour, new equipments or managerial time.
(iii) Economic efficiency, which is the ratio of output value over inputs cost and differs from throughput definitions by measuring value rather than quantity (output value varying from utility value for TV programs to the value of a life saved, say as measured by QALY methods).

Importantly, the SPTF stresses (correctly) that 'spectrum and technical efficiency feed into and become a component of economic efficiency' (FCC, 2002, p. 6). High rates of spectrum and technical efficiency may just be too costly to achieve compared to the benefits they create to society as a whole. This type of analysis seems to support the pursuit of allocative efficiency. Accordingly, the FCC supported the following reforms: (1) more exclusive usage rights (e.g. allowing subdivision, trading and service neutrality) when transaction costs associated with market negotiations and contracting

[3] Note that this definition of technical efficiency differs from the one used in this paper (which emphasises continuous and intensive usage) and is closer to what Cave et al. (2007) refer to as 'productive efficiency'.