Geography and the costs of local telephone networks

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Abstract This paper expands past research on the cost structure of local telephone networks by considering the cost effects of geographical factors, such as service territory size, land uses, street patterns, population density, soil types, slopes, and the spatial partitioning of a company into local exchanges. A translog cost function is estimated using data on 41 telephone companies operating within the New York State, together with GIS-derived geographical data. The results confirm the importance of geography as a determinant of local telephone costs, and suggest that earlier estimates of size thresholds between economies and diseconomies of scale may be too low. The trade-offs between geographical factors in shaping the frontier between economies and diseconomies of scale are assessed. The implication for public policy on competition at the local level is that natural monopoly may be more prevalent than previously assumed.

JEL Classification B23 · D24 · D42 · L96
1 Introduction

The US Congress enacted the Telecommunications Act of 1996 establishing nationwide policies for competition in local telephony. Overturning state rules that made it illegal to compete with an incumbent Local Exchange Company (LEC), the Act requires incumbent LECs to avail parts of their networks to potential competitors. The promise of competition, however, has remained largely unfulfilled. Less than 1% of residential customers had shifted to competitive local exchange carriers by 1999 (Sanders 1999). The local telephone industry is still largely composed of dominant incumbent LECs facing competition from other LECs at the fringe (Abel and Clements 2001). Sanders (1999) suggests that Congress may have overestimated the technological feasibility of local competition at the time it passed the legislation, and this may be the primary reason for the slow progress.

Little is known about the cost structure of local telephony. The question whether natural monopoly characterizes this industry has never been fully answered (Shin and Ying 1992). The goal of this research is to provide new insights into this issue by expanding earlier empirical research on the structure of local telephone costs while accounting for geographical factors.

The remainder of the paper is organized as follows. Section 2 consists of a literature review. Section 3 presents the cost function framework. Data sources are described in Sect. 4. The cost function specification and estimation results are presented in Sect. 5. The implications of the results for public policy are discussed in Sect. 6. Sect. 7 concludes the paper.

2 Literature review

Econometric studies of the telephone industry can be classified into two major groups: (1) production and cost function analyses of large organizations (Bell System, Bell Canada), and (2) cost function analyses of LECs. The focus of this review is on the second group. Bowers and Lovejoy (1965) regress total cost on access lines, and conclude that local telephone service, excluding small towns, operates under increasing average costs. Perl and Falk (1989) show that marginal costs are below average costs. Using translog cost functions, Guldmann (1990) and Shin and Ying (1992) show that the cost function for pre-divestiture companies is not subadditive. Dalton and Mann (1988) find that non-traffic-sensitive costs per loop increase with the share of underground cable and the service territory, but decrease with subscriber density. Armstrong and Fuhr (1993) include a service density variable in their function of non-traffic-sensitive costs per access line. In support of Dalton and Mann (1988) and Armstrong and Fuhr (1993), Gabel and Kennet (1994) point to higher fixed costs associated with lower subscriber densities. However, Armstrong and Fuhr (1993) indicate that not all rural companies have high costs. Shin and Ying (1992) consider density of service and Guldmann (1990) service territory area, as cost determinants. In contrast to investment costs, Shin and Ying find that operating costs increase with density of

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