



# Cost structure and complementarity in U.S. Telecommunications, 1989–1999

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## Abstract

A multi-product cost model is estimated on a panel of U.S. local exchange carriers from the period 1989–1999. The model allows specification of cost inefficiency to avoid potential bias in the estimates. Unlike earlier research, the paper experiments with several proxies of the carriers' access provision. The results show slight economies of scale and density with moderate cost increments due to allocative inefficiency. Between the network access provision and call services, there are anti-complementarities in costs. The latter finding, joined with confirmation from cost elasticity estimates that the bottleneck of the technology is network access, might question the efficiency of vertical integration.

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## 1. Introduction

From the outset of the debate on the Bell system, economic analysis of telecommunications received permanent attention. The econometric study by [Evans and Heckman \(1984\)](#) played a very important role in the final decision of AT&T's divestiture in 1984. Indeed, it provided evidence that the Bell system had not been a natural monopoly. Later, [Shin and](#)

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Ying (1992) confirmed this result using panel data on local exchange carriers (ILECs). However, several restrictions and limitations in the specification could affect those findings, thus justifying new research.

In this paper the economic structure of the industry is re-examined using new data and comparable methodology. A multi-product cost model is applied to a panel of U.S. incumbent local exchange carriers (ILECs) from the period 1989–1999. There are two more features that distinguish this study from earlier econometric research on the industry. First, using current standard results of the stochastic frontier methodology, the model allows firms to deviate from the minimum cost function due to allocative and technical errors. This is crucial as, for example, neglecting truly existing allocative inefficiency yields inconsistent parameter estimates. Second, two types of models are estimated, each differing in the way that they approximate the network access providing activity of firms. The more traditional approach is to use the total number of lines variable, e.g., Shin and Ying. An alternative is to use network infrastructure maintenance expenses as a proxy of access provision. This solution recognizes that giving access involves maintenance and improvement of the infrastructure as well. These latter activities are important from a policy perspective when liberalizing a network industry. The comparison of the two approaches makes conclusions more robust.

The results show slightly increasing returns to density (1.05–1.16, returns to scale when network size is fixed), and similar increasing returns to scale (1.07–1.16, for the variable network size case). Cost increments due to allocative inefficiency were medium (5.2–5.7% per annum), with a steady productivity growth rate (2.3–3% per annum) in the period studied, on average. Further investigations shed light on the cost–complementarity relationships of outputs. Between the access provision and the operational outputs (local and toll call services), there are anti-complementarities. That is, increasing the volume of one increases marginal costs associated with the other. Call services, on the other hand, display a less clear pattern of cost–complementarity. These findings, joined with cost elasticity estimates confirming that the bottleneck is indeed network access, highlight the possible inefficiency of vertical integration. However, a more serious analysis of economies of scope and efficiency of vertical integration is beyond the goal of the study, as it would require a more detailed structural model.

The paper is organized as follows. Section 2 provides a brief description of the industry. Section 3 presents the model to be estimated. Section 4 discusses data and Section 5 discusses the results from estimation. Section 6 concludes.

## 2. The industry

This section briefly reviews the main technological aspects and the regulatory environment in U.S. telecommunications.<sup>1</sup> All carriers in the data have their own network infrastructure with which they provide services to consumers. These services are the network access provision and the operational services (calls). Other operating companies can also provide call services on the same network by paying terminating and/or originating access charges (interconnection fees) to the owner firm. Building a network involves huge fixed costs and maintaining, expanding or improving its quality are also fairly costly activities.

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<sup>1</sup> For a more detailed economic description of the industry see the monograph by Laffont and Tirole (2000).

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