IMPACT OF THE TELECOMMUNICATIONS ACT 1996 ON LOCAL TELEPHONE SERVICE

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ABSTRACT

Through the 1980s and the early 1990s, the U. S. telecommunications industry experienced rapid technological change, which failed to deliver expected cost reductions to users. In 1996, Congress passed the Telecommunications Act 1996, which substantially deregulated the telecommunications industry with the intent of increased competition and increasing benefits to consumers. This paper examines the impact of the Telecommunications Act 1996 on local telephone markets. Key findings are that the Telecommunications Act 1996 reduced local residential and business monthly telephone rates and connection charges, reduced the cross subsidization of residential telephone customers by business telephone customers, increased the number of fixed line telephone connections, improved labour productivity in the fixed line and wireless segments and led to modest increases in entry in local telephone markets.

KEY WORDS

Telecommunications, fixed line telephones, wireless telephones, economic regulation, regression models.

1. INTRODUCTION

Through the 1980s and the early 1990s, the telecommunications sector experienced rapid and substantial technological change due to: (1) reduced transmission costs because of fibre optic technology, (2) reduced switching costs because of integrated circuits, and (3) reduced information processing and system control costs because of computerization. Cost reductions normally lead to lower prices and increased benefits for consumers, but some observers argued that an outmoded and inappropriate regulatory framework restricted competition and increased consumer prices. In response to widespread public perceptions of problems with telecommunications regulation, Congress engaged in a four-year struggle to develop a new, pro-competition framework culminating in the passage of the Telecommunications Act 1996 (Act).

The purpose of this study is to examine the impact of the Act on local telephone markets, with a focus on prices, quantities, labour productivity and entry by market segment. An outline of the paper is as follows. Section 2 reviews previous research and the data and approach for the study. Section 3 summarizes relevant legislative, regulatory and technological background. Section 4 examines the level, structure and determinants of local telephone rates by market segment. Section 5 examines the number, distribution and determinants of local connections by market segment. Section 6 examines entry into local telephone markets. Section 7 examines changes in and determinants of relative labour productivity for the fixed line and wireless segments. Section 8 provides a summary and conclusions.

2. PREVIOUS RESEARCH AND STUDY APPROACH

A number of papers have examined various aspects and impacts of the Act. Economides (1998) supports the general thrust of the provisions pertaining to local telephone markets, but he argues that entry was slowed by numerous legal challenges to the Act by the Regional Bell Operating Companies (RBOCs). In an early paper, Hazlett (1999) argues that the reforms of the Act, although modest in scope, have been successful in increasing competition in local telephone markets. But in a later econometric study, Hazlett and Bazelon (2005) find that regulated unbundling of network elements combined with calculation of regulated wholesale prices using the total element long-run incremental cost method has resulted in lower, rather than as expected higher, levels of investment in telecommunications infrastructure. Wexler (2005) notes that the Regional Bell Operating Companies (RBOCs) reneged on the compromise that permitted local telephone companies to provide long distance service in exchange for opening their local markets to competition.

Crandall, Ingraham and Singer (2004) state that although the Federal Communications Commission (FCC) emphasized facilities-based competition for new entrants to local telephone markets, its unbundling decisions deferred new investment by both the competitive local exchange companies (CLECs) and the incumbent local exchange companies (ILECs). Crandall (2004) argues that under the Act's assumptions, there should have been reduced local rates, reduced local telephone revenues and little impact on long distance rates, whereas he find that local residential rates have not fallen, revenues per local access switched access line have risen, and long distance rates have fallen sharply. Bauer (2005) describes major legal challenges to the rules adopted by the FCC and notes that unbundling obligations of the ILECs have been reduced, while the ILECs gained considerable flexibility on pricing of unbundled network elements (UNEs). A summary of the main themes of the literature is included in Saraswat and Schiano (2006).

Based on a review of recent literature on local telephone rates, four issues were identified for this study: (1) examine the level, structure and determinants of local telephone rates by market segment; (2) examine the number, distribution and determinants of local connections by market segment; (3) examine changes in and determinants of labour productivity in the telecommunications sector; (4) examine the level, structure and determinants of revenues for incumbent firms and new entrants to local telephone markets.

The period covered by the study is 1989 to 2004, which was the longest period for which time series information for all the variables used was available. To facilitate the assessment of trends, these sixteen years are split into four four-year periods, with the first two periods covering the pre-1996 Act phase and last two periods covering the post-1996 Act phase. The data used in the statistical models comes from the Federal Communications Commission and the Bureau of Labour Statistics.

We consider a simple four equation model where the endogenous variables are labour productivity, L_{it}, product price, P_{it}, and number of connections, Cit, with an ancillary equation to model revenues R_{it} by type of service provider as a proxy for entry. There are three business segments, residential fixed wire service, commercial fixed wire service and wireless service, which are indexed by i, and sixteen time periods which are indexed by t.

Let Y_{it} be segment output and N_{it} segment employment, so that labour productivity $L_{it} = Y_{it} / N_{it}$. We assume that labour productivity can be modelled as a linear function of a constant α_1, of the capital/labour ratio K_{it} / N_{it}, of a dummy variable A representing the presence of the Act, and of an error term ε_1, as follows:

$$L_{it} = Y_{it} / N_{it} = \alpha_1 + \beta_1 (K_{it} / N_{it}) + \gamma_1 A_{it} + \varepsilon_1$$

Product price P_{it} is assumed to be a linear function of a constant α_2, of current period labour productivity L_{it}, of a dummy variable A_{it} representing the passage of the Act, and of an error term, ε_2, as follows:

$$P_{it} = \alpha_2 + \beta_2 L_{it} + \gamma_2 A_{it} + \varepsilon_2$$

Number of connections C_{it} is assumed to be a linear function of a constant α_3, of constant dollar Gross Domestic Product GDP_{it}, of a dummy variable A_{it} representing the passage of the Act, of price P_{it}, and of an error term, ε_3, as follows:

$$C_{it} = \alpha_3 + \beta_3 GDP_{it} + \gamma_3 A + \gamma_3 P_{it} + \varepsilon_3$$

Finally, revenues R_{it} are modelled as a linear function of a constant α_4, of constant dollar Gross Domestic Product GDP_{it}, of a dummy variable M_{it} representing the upholding of key elements of the FCC's regulations pertaining to entry (as well as AT&T's re-entry to local telephone markets) and of an error term, ε_4, as follows:

$$R_{it} = \alpha_4 + \beta_4 GDP_{it} + \gamma_4 M_{it} + \varepsilon_4$$

Note that this model is recursive since the capital labour ratio determines labour productivity, which in turn determines price, which in turn determines number of connections. Since the model is recursive, the equations can be estimated using ordinary least squares, and a simultaneous equation framework is not needed.

3. LEGAL, REGULATORY AND TECHNOLOGICAL BACKGROUND

Before examining the quantitative evidence, it is useful to briefly review the relevant legislative, regulatory and technology background. The telephone regulatory system was established by the Communications Act of 1934. The purpose of this Act was to regulate interstate and international communications, with a view to ensuring the universal provision of services (see Table 1). The Communications Act of 1934 established the Federal Communications Commission with broad regulatory powers over the telecommunications industry including telephone, telegraph and broadcasting, while explicitly leaving regulatory control over local exchange service and intrastate telephone services to the states [Hughes (1996)].

At the end of World War Two, the public switched telephone network (PSTN) consisted of five key elements. (1) Terminal. The telephone handset was the only available terminal. The role of the terminal was to capture user information and convert it to an analogue electronic signal. (2) Access Link. The access link or station line, which connected the user's terminal to the first switching node, was typically a copper two-wire circuit, where one wire transmitted the information and the other wire provided the return path for the circuit. (3) Switching Node. The first switching node, either a private exchange or the local exchange, provided connections between two customers' access lines (within the same exchange) so that they could communicate with each other. Subsequent switching nodes handled and directed calls between adjacent exchanges, between toll centres or between countries. (4) Trunk. A truck was a set of circuits that carried multiple signals between local exchanges, between toll centres or between countries. Trunks were made up of multiple sets of lines gathered together. Since at longer distances signals required reinforcement or amplification, trunks required four-wire copper circuits, one path in each direction plus a complementary return for each path. (5) Control. The control system determined the switching path between two parties that wished to communicate [Goleniewski (2001)].

Table 1. Selected Legal and Regulatory Events

	Event	Description
1934	Communications Act of 1934	Act establishes the FCC with broad powers for the regulation of interstate communications
1949	United States v AT&T	DOJ launches suit against AT&T, alleging violations of sections 1, 2, 3 of the Sherman Act
1956	United States v AT&T (consent decree)	AT&T agrees not to provide enhanced information services but retains Western Electric
1968	Carterfone Decision	Decision allows consumers to connect approved, non-Bell equipment to their telephone lines
1974	United States v AT&T	DOJ and MCI launch antitrust against AT&T alleging violations of the Sherman Act
1982	Modification of Final Judgment (consent decree)	AT&T signs consent decree with DOJ for divestiture to take place in 1984
1984	Bell System Dismantled	Some 22 local Bell operating companies divested and consolidated into seven RBOCs
1996	Telecommunications Act of 1996	Act seeks to open local telephone markets to competition, increase long distance telephone competition, promote cable competition
1996	FCC Local Competition Order	FCC Order sets out details of seven specified UNEs and the total element long-run incremental cost pricing methodology (TELRIC)
1997	Iowa Utilities Board v FCC	Eighth Circuit Court consolidated various cases affirming some rules but overturning other rules
1999	AT&T v. Iowa Utilities Board	U.S. Supreme Court upheld authority of the FCC to promulgate rules implementing section 251 of the Act and upheld TELRIC standard
2002	Verizon et al v FCC	U. S. Supreme Court decision upheld FCC on (1) pricing rules for UNEs, (2) appropriateness of exclusion of historical costs in pricing, (3) appropriateness of rules for combining UNEs
2004	U.S. Telecom Ass'n v FCC	U.S. Court of Appeals for D.C. Circuit Court vacated FCC's unbundling rules as being unduly expansive

Source. Adapted from Saraswat and Schiano (2006) and FCC dockets (various).

Within five years, four technical developments took place, which were eventually to transform the telecommunications landscape almost beyond recognition (see Table 2). First, on June 17, 1946, AT&T and its subsidiary Southwestern Bell began offering mobile telephone (MTS) service in St. Louis, Missouri. MTS used a centrally located transmitter transmitting to the car based mobile sets, the mobiles transmitting to several receivers spread throughout St. Louis, and connections between the transmitter, the receivers and an operator at the central telephone office. The radio phones were built by Motorola and initially occupied six channels in the 150 MHz band. The severe capacity constraints of mobile phone systems, due to limited allocated bandwidth, were eventually overcome with cellular systems leading to a revolution in the end use terminal as well as the final mile technologies with the development of the cell phone.

Table 2. Selected Technological Events

	Event	Description
1946	Mobile Service	AT&T begins offering mobile telephone service in St. Louis
1948	Invention of Transistor	Bell Labs scientists John Bardeen, Walter Brattain, William Shockley invent the transistor
1948	Information Theory	Bell Labs Claude Shannon publishes seminal paper on information theory
1948	Microwave Transmission	AT&T launches microwave relay system
1951	Customer Dial Long Distance	First customer-dial of long distance calls by initiated by AT&T in New Jersey
1956	Trans-Atlantic Phone Cable	AT&T opens first trans Atlantic telephone cable
1958	Integrated Circuit	Jack Kilby of Texas Instruments invents the integrated circuit
1963	Touchtone Telephone	AT&T introduces first phone replacing traditional dial with touchtone keypad
1965	Electronic Switch	AT&T introduces first electronic telephone switch in a local exchange in New Jersey
1969	Cellular System	AT&T introduces first cellular system
1971	Unix Operating System	Bell Telephone Labs creates the Unix operating system, eventual underpinning of the Internet
1975	Digital Switch	AT&T introduces first digital electronic switch, the 4ESS
1977	Network Operations	AT&T opens Network Operations Centre to manage its entire long distance system
1977	Fibre Optic Cable	AT&T installs first fibre optic cable in a commercial communications system in Chicago
1983	Cellular Network	AT&T opens first cellular telephone system, Advanced Mobile Phone Service, in Chicago
1988	Fibre Optic Atlantic Cable	AT&T lays TAT-8, first Atlantic fibre optic cable
2004	VOIP	AT&T introduces Voice Over Internet Protocol

Source. Adapted from Bell System Memorial (no date), Hughes (1996) and Farley (2005).

Second, on July 1, 1948, Bell announced the transistor which had been invented by Bell Labs scientists William Shockley, John Bardeen and Walter Brattain in 1948. This work, begun in the1930s but interrupted by the War effort, was initially motivated by Bell Labs' director Mervin J. Kelly's vision of an electronic telephone exchange. Such an exchange would need an amplifier that uses less power and generates less heat as part of the strategy to develop an electronic telephone exchange. Transistors would eventually replace fragile, bulky and expensive vacuum tubes in most applications in the radio and telephone industry. The transistor, combined with the integrated circuit invented by Jack Kilby of Texas Instruments in 1958, led to a wide range of key technologies including digital switches, required for effective use of fibre optic transmission technology.

Third, in 1948, Claude Shannon of Bell Labs published A Mathematical Theory of Communication in the Bell System Technical Journal. This paper was the basis of modern information theory and led to the technology of using wires to transmit messages coded as streams of 0s and 1s rather than as electromagnetic waves. This led to the development of digital switching and signal carriers systems, with dramatic impacts on system capacity and costs.

Fourth, in 1949, AT&T launched the first commercial microwave relay system between Boston and New York, the first of several alternatives to copper wire carriers for telephone signals, including the first telecommunications satellite, Telstar I, in 1962. This had two crucial and related impacts: a dramatic reduction in the costs of transporting telephone signals over long distances and the opening of the possibility of long distance competition, since potential competitors could compete in long distance transportation without duplicating AT&T's expensive wire and switching system [Farley (2005), Bell System Memorial (no date)]

On the regulatory front, the first important post-War development was an antitrust suit brought against AT&T by the Department of Justice in 1949, alleging violations of sections 1, 2 and 3 of the Sherman Antitrust Act. The Department of Justice alleged that AT&T had monopolized the market for telecommunications equipment, and it sought the divestiture of Western Electric [Friedrich (1995).]. After seven years of legal proceedings, the consent decree of 1956 brought further legal actions to a halt, and resulted in the restriction of AT&T's activities to running the national telephone system and undertaking defence-related special projects for the U.S. government. In particular, AT&T was not permitted to offer computer or information services, and it was forced to divest its 40% share in Northern Electric of Canada. But AT&T was allowed to retain ownership and control of Western Electric, and there was no substantive impact on AT&T's domestic local telephone service monopoly position or dominance in the supply of telephone equipment.

The consent decree represents one of the most dramatic episodes of regulatory capture in American history, and an assessment by M. W. Hughes (1996) merits quoting at length:

> "In 1959, the House of Representatives Committee on the Judiciary appointed the Antitrust Subcommittee to investigate the negotiation process that led to the 1956 Consent Decree…The Subcommittee reported that the willingness of the Attorney General to forego the original goals of the antitrust action demonstrated 'partiality towards the defendants incompatible with the duties of his public office"…The Antitrust Subcommittee was also dismayed by the unwillingness of the Justice Department to disclose information necessary of the investigation. The subcommittee reported that the Justice Department's defiance was the result of its 'desire to cover up those facts which the Department considers to be embarrassing'."

The Carterfone decision of 1968 allowed interconnection of equipment from non-Bell sources. Until that time telephones were leased by Bell as part of a total service package. The decision further required that telephone manufactures equip that their telephones with standard plugs which would fit into the jacks provided by telephone companies.

A number of major technological developments in the telephone industry began in the 1950s, 1960s and 1970s, and these continued to drive structural change through the present. These changes include the following. (1) AT&T opened the first trans-Atlantic telephone cable in 1956. This led to major improvements in cross-ocean communications and helped to integrate national product, stock and financial markets. (2) AT&T introduced the touchtone telephone in 1963. By replacing the traditional rotary dial with a touchtone key pad, immense flexibility was provided with respect to eventual access to rich menus of caller telephone options, including call waiting, call forwarding and voice mail. (3) AT&T introduced the first electronic switch at a local telephone exchange in New Jersey in 1965. This both reduced costs and increased capacity but led to the eventual development of packet switching, a key element of the internet and of Voice over Internet Protocol telephony, which was introduced in 2004. (4) AT&T introduced the first digital electronic telephone switch, the 4ESS, at a local exchange in New Jersey in 1965. This generated even greater cost reductions in telephone switching, made possible the use of fibre optic cable for transmission and helped lead to a massive increase in data transmission over the telephone system. (5) Bell Labs introduced the UNIX operating system in 1971. This became the eventual underpinning of the Internet. (6) AT&T introduced the first fibre optic cable in a commercial communication system in Chicago in 1977. The first fibre optic cable to span the Atlantic Ocean followed in 1988. (7) AT&T opened its Network Operations Centre to manage its entire long distance network with a computerized control system in 1977. Calls could now be routed to maximize the capacity of the transmission system. (8) AT&T introduced the first cellular telephone system in Chicago in 1983. Although the key components had been available for a number of years, delays within the FCC had slowed roll-out by a number of years, and FCC approval for commercial use of the system was not approved until 1981.

The next major development was a major antitrust suit, United States v. AT&T, initiated in 1974 by the Department of Justice (DOJ). The DOJ argued that AT&T: (1) had an illegal relationship with its Western Electric subsidiary by practicing illegal exclusion by buying equipment only from Western Electric, and (2) monopolized long distance telephone service. The case was settled in the Modified Final Judgment (MFJ) of 1982, which separated the local telephone companies from AT&T and formed them into seven Regional Bell Operating Companies (RBOCs), each with an exclusive franchise within its service territory. More comprehensively, the results of the MFJ were as follows: (1) AT&T divested itself of the Bell Operating Companies (BOCs); (2) the twenty-two BOCs were regrouped as the seven Regional Bell Operating Companies (RBOCs); (3) AT&T kept its manufacturing facilities; (4) AT&T kept its long-distance network; (5) RBOCs were not allowed to manufacture equipment nor were they allowed to offer long-distance business within their territories; (6) AT&T was not allowed to get in the local-exchange business nor to acquire the stock or assets of any RBOC [Glassman (1998)].

The impact of the MFJ is generally viewed as positive for consumers and for the economy as a whole. By 1996, AT&T's market share had fallen to just over fifty percent, average revenue per minute for AT&T's switched services had fallen by some 62 percent from 1984 levels, and there were five major facilities-based, long distance competitors: ATT&T, MCI, Sprint, LDDS-WorldCom and Frontier [Economides (1998)].

Despite these substantial successes, there were demands for further deregulation of long distance markets. First, the RBOCs argued that they should be allowed to enter the long distance market, because they believed that there were profitable opportunities to offer bundled local and long distance service to their customers. Second, stakeholders argued that originating access and terminating access charges earned by local telephone service providers were perhaps an order of magnitude greater than their marginal costs, and the reform of access charges became a key demand [Litan and Noll (1998)].

The Telecommunications Act of 1996 (Act) was passed by Congress on February 1, 1996 and signed by President Clinton on February 8, 1996 [United States Congress (1995, 1996a, 1996b]. The Act amended the Communications Act of 1934 and was the first success in a lengthy set of attempts to rewrite the Communications Act of 1934 [7, 8]. At the time of signing, President Clinton argued that this legislation would "stimulate investment, promote competition, [and] provide open access for all citizens to the Information Superhighway [Andrews (1996a, 1996b)]." Some key features of the Act as they pertain to long distance telephone markets can be summarized as follows. First, the Act allowed the Regional Bell Operating Companies to offer long distance telephone service for the first time since the break up of AT&T, thus reversing barriers originally erected under the Modified Final Judgment. Second, RBOCs were given permission to immediately offer long distance service to those outside their Local Access and Transport Area (LATA), where long distance is defined as service not offered between points within the same LATA. Third, RBOCs were given permission to offer long distance service to customers within their local market upon fulfilling a 14-point competitive checklist. This checklist either ensures or permits competition for local service within the local market [Hazlett (1999), Wexler (2005), Crandall, Ingraham and Singer (2004)].

The key issue for competition in local telephone market is entry by new competitors and provision of appropriate interconnection access. The three key mechanisms of the Act as they pertain to entry and access in local telephone markets can be summarized as follows.

(1) Entry thru Installation of Own Facilities. Competitor entry by competitive local exchange carriers (CLECs) is more difficult than long distance entry, because of high capital requirements and the need for significant cooperation on the part of the incumbent local exchange carriers (ILECs). The Act imposed mandatory unbundling, interconnection and telephone number portability to overcome these constraints and encourage entrants to install their own facilities. In particular, Section 251 of the Act required ILECs to "interconnect directly or indirectly with the facilities and equipment of other telecommunications carriers" at rates, terms and conditions that are "just, reasonable and non-discriminatory" [Beker (2001)].

(2) Entry thru Resale. ILECs were required to sell to entrants, at wholesale prices, any retail service they currently offered. This allowed new entrants access to retail markets without having to install their own facilities. Under this "stepping stone" theory, as new competitors gained experience and market share, they would be encouraged to build their own local facilities. One major issue was the determination of wholesale costs defined as the difference between retail costs and avoided costs. The FCC argued that this difference should be all the costs the ILEC incurs to maintain a retail rather than a wholesale business. The ILECs argued that only costs saved by giving up the relevant portion of a service were germane and that these amounted to about 3% of retail costs. The CLECs argued that the cost savings involved if the ILECs gave up retailing entirely would amount to 40%-50% of retail costs. In many cases, state utility commissions settled on discounts of around 20% based on estimated embedded costs [Beker (2001)].

(3) Entry thru Leasing of Unbundled Network Elements. ILECs were required to unbundle their networks and lease to entrants, on a non-discriminatory basis, the network components (unbundled network elements or UNEs) at cost plus reasonable profit. The promotion of effective competition requires that unbundled network elements, transportation and access termination were to be based on appropriate long-run economic costs. Under the Act, CLECs should have access to UNEs if lack of such access would impair competitive entry. CLECs could in fact purchase the whole set of UNEs or the unbundled network element platform (UNE-P) and provide telephone service using the ILECs equipment. The pricing of UNEs was, if anything, more controversial than the wholesale pricing of retail services because UNE prices are calculated using forward looking total element long-run incremental cost (TELRIC), which according to some observers does not compensate for actual costs. One study argued that UNE-P prices are provided at discounts of 40% to 60% of retail prices [Hazlett and Bazelon (2005)].

The impairment standard was central to the determination of which elements required unbundling as well as to future legal challenges and thus merits a brief explanation. The Act stated that "in determining what network elements should be made available for purposes of subsection (c)(3) of this section, the Commission shall consider in, at a minimum, whether (A) access to such network elements as are proprietary in nature is necessary; and (B) the failure to provide such access to such network elements would impair the ability of the telecommunications carrier seeking access to provide the services it seeks to offer." Section 252(d) required that UNEs be available at cost-based rates "… however determined without reference to a rate-of-return or other rate-based proceeding," with this often interpreted to mean the use of price caps to set rates for UNEs [Bauer (2005)].

The FCC released the Local Competition Order in August 1996 which set out details of the specified UNEs and the pricing methodology. The Order specified seven unbundled network elements: local loops; network interface devices; local and tandem switching; interoffice transmission facilities; signalling networks and call related databases; operations support systems; and operator services and directory assistance. Pricing was to be based on total element long-run incremental cost [FCC (1966)].

Cost based pricing also merits some further comment. As Roston and Noll [18] note, most cost based pricing methods essentially use the following formula

$$C = V + K(d + i + r)$$

where C is the cost of service, V is the variable cost, K is the capital investment, d is the depreciation rate, i is the competitive return on a risk free investment and r is the risk premium. Traditional utility regulation uses some combination of historical costs and forecast future costs to determine C, while TELRIC uses best practice forward looking costs. Some observers have noted that the Act rejects the use of historically based costs and replaces historically based costs with forward looking costs which may or may not appropriately compensate ILECs for reasonable sunk costs.

Industry groups and state regulators challenged a number of provisions of the Local Competition Order including the authority of the FCC to promulgate rules which applied nation-wide, the FCC standard used to assess and determine impairment and the FCC guidelines for the pricing of UNEs. The Eighth Circuit Court consolidated various cases as Iowa Utilities Board v. FCC. The Eighth Circuit Court's 1997 decision affirmed some rules, but it also overturned some other rules [Eighth Circuit Court (1997)].

Various aspects of this decision were appealed to the U.S. Supreme Court by the FCC, MCI, AT&T and other CLECs. In the AT&T v. Iowa Utilities Board decision of 1999, the U.S. Supreme Court upheld the authority of the FCC to promulgate rules implementing section 251 of the Act and upheld the TELRIC standard. While directing the FCC to reconsider the impairment standard, the Court did not limit the ability of the FCC to require any specific network element to be unbundled at cost-based rates [U. S. Supreme Court (1999)].

The FCC issued the UNE Remand Order in November 1999, which attempted to deal with the impairment standard issue by removing operator service and directory assistance from the list of UNEs. Some stakeholders viewed this as an inadequate response, and the UNE Remand Order was challenged by the ILECs in the D. C. Circuit Court of Appeals, which granted a petition for review of the Order [FCC (1999)].

In May 2002, the U. S. Supreme Court issued a decision in Verizon et al v. FCC which focussed on three main issues: first, the FCC pricing rules for UNEs; second, whether the exclusion of historical costs in pricing represents a government taking; and, third, the appropriateness of various rules for combining UNEs. In all three areas, the Supreme Court ruled in favour of the FCC at the expense of Verizon and the ILECs. This was generally viewed as victory for the CLECs at the expense of the ILECs. However, there was also considerable disagreement on whether or not the decisions represented a victory for consumers, because of the likelihood that it would reinforce entry through resale and especially through leasing of UNEs, with little construction of new facilities thus undermining the stepping stone theory [U. S. Supreme Court (2002)].

In March 2004, the U.S. Court of Appeals for the D.C. Circuit Court vacated the FCC's unbundling rules because they made the rules for network sharing unduly expansive, and, in doing so, promoted entry through resale competition rather than entry through facilities based entry. The decision by the FCC on June 9, 2004 not to appeal that decision substantially killed the UNE rules as of June 15, 2004 [D. C. Circuit Court (2004)]. In response, AT&T and certain CLECs indicated that they would cease marketing of local fixed line telephone services to residential customers.

4. LOCAL TELEPHONE RATES

This section begins by examining changes in the level and structure of local telephone rates over time. Table 3 summarises the evolution of average local telephone rates over the period 1989 to 2004. All rates are expressed in constant 1982-1984 real dollars, with standard deviations shown in parentheses below the relevant rate. The sixteen years covered by the table are divided into two pre-Act periods and two post-Act periods.

Residential monthly rates (for a single line) fell from $14.66 per month in Period 1, to $13.26 per month in Period 2, and to $12.14 per month in Period 3, before rising to $13.10 in Period 4. Business monthly rates (for a single line) fell monotonically from $34.93 in Period 1, to $29.38 in Period 2, to $26.51 in Period 3, and to $23.16 in Period 4. The relative impact of these changes was to reduce the ratio of business to residential monthly rates from 2.38 in Period 1 to 1.77 in Period 4, so that cross-subsidisation was substantially reduced.

Table 3. Average local telephone rates by period (1982-1984 prices = 100)

	Period 1 1989-1992	Period 2 1993-1996	Period 3 1997-2000	Period 4 2001-2004
Residential monthly charge (dollars per month)	14.66 (0.54)	13.26 (0.46)	12.14 (0.18)	13.10 (0.37)
Business monthly charge (dollars per month)	34.93 (2.69)	29.38 (1.44)	26.51 (0.69)	23.16 (0.78)
Residential connection charge (dollars)	31.47 (1.33)	27.91 (1.19)	25.07 (0.73)	23.28 (0.50)
Business connection charge (dollars)	58.56 (2.69)	49.40 (3.07)	43.55 (1.55)	40.04 (0.70)
Wireless rate (cents per minute)	55.25 (3.10)	51.50 (5.00)	32.00 (10.61)	11.00 (2.58)
Wireless rate (dollars per 250 minutes)	138.13 (7.75)	128.75 (12.50)	80.00 (26.52)	27.50 (6.45)

Source: FCC, Trends in Telephone Service, various.

Residential connection charges fell from $31.47 per connection in Period 1, to $27.91 per connection in Period 2, to $25.07 per connection in Period 3, and to $23.28 per connection in Period 4. Business connection charges fell from $58.56 per connection in Period 1, to $49.40 per connection in Period 2, to $43.55 per connection in Period 3, and to $40.04 per connection in Period 4. The relative impact of these changes was to reduce the ratio of business to residential connection charges rates from 1.86 in Period 1 to 1.72 in Period 4, so that again cross-subsidisation was reduced.

Wireless rates have exhibited the most dramatic changes over the period examined here. Wireless rates fell from 55.25 cents per minute in Period 1, to 51.50 cents per minute in Period 2, to 32.0 cents per minute in period 3, and to 11.00 cents per minute in Period 4. Comparing wireless to fixed line rates is difficult because wireless usage has increase dramatically as per minute rates have fallen. If, somewhat arbitrarily, we assume that wireless usage is 250 minutes per month, then the ratio of wireless monthly cost to residential monthly cost has fallen from 9.42 in period 1 to 2.10 in Period 4.

Next we examine the statistical determinants of local telephone rates. Table 4 summarises the results of ordinary least squares regressions for the period 1989 to 2004, with each regression represented by a column in the table.

The five outcome variables are residential monthly rates, business monthly rates, residential connection charge, business connection charge and wireless rates per minute. The standard error of each regression coefficient is shown below the coefficient in parenthesis, while the relevant level of statistical significance is represented by one asterisk for the ten percent level, two asterisks for the five percent level and three asterisks for the one percent level. The significance of the F-test is shown below the F-test value in parentheses. Finally, the estimated auto-correlation is shown below the Durbin-Watson statistic.

Table 4. Determinants of average local telephone rates, 1989-2004 (constant 1982-1984 dollars)

	Residential monthly	Business monthly	Residential connection	Business connection	Wireless minutes
Constant	14.1*** (0.91)	36.9*** (1.18)	43.5*** (2.07)	69.5*** (3.26)	81.6*** (3.41)
Labour productivity	0.00024 (0.011)	-0.090*** (0.015)	-.014*** (0.026)	-.019*** (0.042)	-0.31*** (0.035)
Act	-1.52*** (0.063)	-1.60* (0.81)	-1.16 (1.42)	-4.12* (2.24)	-9.97*** (3.15)
Adjusted R^2	0.53	0.93	0.89	0.89	0.95
F(2,13)	9.6 (0.00)	98.3 (0.00)	62.1 (0.00)	64.1 (0.00)	137.9 (0.00)
Durbin-Watson	13.3 (1.0)	0.69 (0.66)	0.57 (0.71)	0.70 (0.65)	1.17 (0.41)

The explanatory power of the regressions, as measured by either the R-squared values adjusted for degrees of freedom or by the F-test, is adequate, and the only statistical problem is the low values of the Durbin-Watson statistics, suggesting presence of auto-correlation. Fitting a first-order auto-regression model, the usual approach in the presence of auto-correlation, did not improve the regressions.

Our main interest is on the sign and statistical significance of the labour productivity variable and the Act dummy variable. In four of the five regressions, the sign of the labour productivity variable is negative as hypothesized, and it is significant at the one percent level. In other words, an increase in labour productivity significantly reduces local telephone rates. In all five regressions, the sign on Act is negative as hypothesized, and the coefficient is significant at the five percent level in all but the regression explaining the residential connection charge. In other words, the Act reduced residential monthly rates by $1.52, reduced business monthly rates by $1.60, reduced residential connection charges by $1.16, reduced business connection charges by $4.12 and reduced wireless rates by $0.10 per minute.

5. LOCAL TELEPHONE CONNECTIONS

This section begins with an examination of changes in the level and structure of telephone connections over time. Table 5 summarises the evolution of the number of loops and wireless connections over the period 1989 to 2004.

Table 5. Average telephone loops and wireless connections (million)

	Period 1 1989-1992	Period 2 1993-1996	Period 3 1997-2000	Period 4 2001-2004
Residential loops	94.4 (4.1)	106.5 (4.0)	120.2 (5.3)	120.5 (4.9)
Business loops	42.3 (1.1)	49.3 (4.0)	62.5 (3.2)	61.6 (2.6)
Wireless connections	5.6 (2.7)	24.7 (10.9)	70.7 (20.9)	142.7 (13.3)

Source: FCC, Trends in Telephone Service, various.

The number of residential loops rose from 94 million in Period 1, to 107 million in Period 2, and to 120 million in Period 3, before remaining essentially flat in Period 4. The number of business loops rose from 42 million in Period 1, to 49 million in Period 2, and to 63 million in Period 3, before falling off to 62 million in Period 4. The number of wireless connections exhibited near exponential growth increasing from 6 million in Period 1, to 25 million in Period 2, to 71 million in Period 3, and to 143 million in Period 4. The impact of these changes was to increase the ratio of business to residential loops from 0.448 in Period 1 to 0.511 in Period 4, and to increase the ratio of wireless connections to residential loops from 0.059 in Period 1 to 1.184 in Period 4.

Next the statistical determinants of the average number of telephone loops are examined. Table 6 summarises the results of ordinary least squares regressions for the period 1989 to 2004, with each regression represented by a column in the table. The three outcome variables are the number of residential loops, the number of business loops and the number of wireless connections. The explanatory power of the regressions is good, although the low Durbin-Watson statistics suggest the presence of auto-correlation. Again, using a first order autoregressive model did not help.

Table 6. Determinants of number of loops, 1989-2004 (millions)

	Residential	Business	Wireless
Constant	149.7*** (36.1)	81.4*** (26.5)	-148 (114)
GDP	0.000019 (0.0030)	-0.00006 (0.0022)	0.031*** (0.012)
Act	8.56** (3.74)	8.39*** (2.72)	-26.1*** (9.22)
Rate	-1.55*** (0.45)	-0.66*** (0.19)	-1.83** (0.80)
Adjusted R^2	0.85	0.92	0.96
F(3,12)	30.3 (0.00)	55.5 (0.00)	116.8 (0.00)
Durbin-Watson	0.75 (0.62)	1.10 (0.45)	0.65 (0.68)

The regression coefficients on the variable GDP have the expected signs for residential and wireless, but it is insignificant for business, so that overall an increase in GDP significantly increases the number of telephone connections. The variable Act increases the number of residential fixed lines and business fixed lines by about 17 million, but it significantly reduces the number of wireless connections by about 26 million. Rates increases have the expected negative effect on the number of new lines, and this effect is significant at the one percent level for residential fixed lines, the ten percent level for business fixed lines, and the twenty percent levels for wireless connections.

6. LABOR PRODUCTIVITY

This section begins by examining changes in the level and structure of labour productivity over time. Table 7 summarises the change in labour productivity for the fixed line, wireless and general manufacturing segments over the period 1989 to 2004. General manufacturing productivity is used as proxy for general productivity improvements in the economy as a whole, since there is not detailed information on a broader aggregate sector that includes the telecommunications sector.

Table 7. Average labour productivity (1997 = 100)

	Period 1 1989-1992	Period 2 1993-1996	Period 3 1997-2000	Period 4 2001-2004
Fixed line	67.8 (5.0)	88.2 (7.6)	109.5 (8.7)	136.7 (13.3)
Wireless	78.8 (5.1)	98.3 (3.5)	121.9 (18.1)	194.7 (16.8)
Manufacturing	78.5 (2.8)	90.4 (4.9)	110.4 (8.9)	139.1 (13.0)

Source: BLS, Industry Productivity and Costs, various.

Average labour productivity for fixed lines rose from 67.8 in Period 1, to 88.2 million in Period 2, to 109.5 in Period 3, and to 136.7 in Period 4, where the average productivity in 1997 is set at 100. Average labour productivity for wireless lines rose from 78.8 in Period 1, to 98.3 in Period 2, to 121.9 in Period 3, and to 194.7 in Period 4. As a comparison, average labour productivity for total manufacturing rose from 78.5 in Period 1, to 90.4 in Period 2, to 110.4 in Period 3, and to 139.1 in Period 4.

Labour productivity for fixed lines rose faster than for manufacturing productivity during Period 1 and Period 2 and then tracked manufacturing productivity closely for Period 3 and Period 4. The pattern for labour productivity for wireless lines was essentially the reverse, as labour productivity for fixed lines tracked that for manufacturing for Period 1 and Period 2 and then increased much more rapidly than for manufacturing for Period 3 and Period 4. Comparing average sector labour productivity over time, productivity for fixed lines rose by 102% from Phase 1 to Phase 4, productivity for wireless lines rose by 147% from Phase 1 to Phase 4, and productivity in manufacturing rose by 77% from Phase 1 to Phase 4.

Next the statistical determinants of labour productivity are considered. Table 8 summarises the results of ordinary least squares regressions for the period 1989 to 2004, with each regression represented by a column in the table. The two outcome variables are labour productivity for fixed lines and labour productivity for wireless lines.

Table 8. Determinants of labour productivity, 1989-2004 (1997 = 100)

	Fixed line	Wireless
Constant	-40.0** (15.7)	-137.0*** (44.2)
Capital/labour	1.27*** (0.17)	2.46*** (0.48)
Act	22.8*** (4.7)	22.4* (13.1)
Adjusted R^2	0.94	0.82
F(2,13)	106.8 (0.00)	34.3 (0.00)
Durbin-Watson	1.00 (0.50)	0.54 (0.73)

The explanatory power of the regressions is good although the Durbin-Watson-statistics suggests the presence of auto-correlation. Once again a first-order autoregressive model failed to improve the regressions. For both fixed lines and wireless, the capital/labour ratio has a strong, positive impact on labour productivity. Our main interest is on the impact of the dummy variable for the Act on labour productivity. For fixed lines, the Act improves labour productivity by 23 points, and the impact is statistically significant at the one percent level. For wireless lines, the Act improves labour productivity by 22 points, and the effect is statistically significant at the ten percent level.

6. ENTRY AND COMPETITION

In the introduction, we noted that increased local competition was a major thrust of the Act. It was envisioned that CLECs could gain local access thru some combination of three routes: first, reselling the services of ILECs; second, making use of leased unbundled network elements; third, building their own facilities.

Table 9 provides information on the extent of local telephone competition. The CLEC share of end-user switched lines increased from 4.3 percent in December 1999 to 17.8 percent in June 2004.

Table 9. Distribution of fixed telephone lines

	ILEC		CLEC		Total	
	Lines (millions)	Share (%)	Lines (millions)	Share (%)	Lines (millions)	Share (%)
Dec 1999	181.4	95.6	8.2	4.4	189.5	100.0
Jun 2000	179.8	94.0	11.6	6.0	191.3	100.0
Dec 2000	177.6	92.3	14.9	7.7	192.5	100.0
Jun 2001	174.9	91.0	17.3	9.0	192.1	100.0
Dec 2001	172.0	89.7	20.0	10.3	191.7	100.0
Jun 2002	167.5	88.6	21.6	11.4	189.1	100.0
Dec 2002	164.5	86.9	24.9	13.1	189.4	100.0
Jun2003	158.4	85.4	27.0	14.6	185.4	100.0
Dec 2003	153.2	83.7	29.8	16.3	183.0	100.0
Jun 2004	148.1	82.2	32.0	17.8	180.1	100.0

Source: FCC, Trends in Telephone Service, various.

Given the entrenched positions of the established carriers, this could be viewed as good progress in establishing local telephone market competition. However, the “stepping stone” theory argued that CLECs would initially lease lines or unbundled network elements to gain market share and then build their own access lines. Table 10 shows that this has largely not happened as the CLEC-owned lines share of CLEC total lines fell from 33.2% in December 1999 to 23.4% in June 2004.

Table 10. End-user switched access lines

	Resold by ILECs		UNEs		CLEC owned		Total CLEC	
	Lines (millions)	Share (%)	Millions (%)	Share (%)	Lines (millions)	Share (%)	Lines (millions)	Share (%)
Dec 99	3.5	42.7	2.0	24.4	2.7	32.9	8.2	100.0
Jun 00	4.3	37.1	3.2	27.6	4.0	34.5	11.6	100.0
Dec 00	4.1	27.5	5.5	36.9	5.2	34.9	14.9	100.0
Jun 01	3.9	22.5	7.6	43.9	5.8	33.5	17.3	100.0
Dec 01	4.3	21.5	9.3	46.5	6.1	30.5	20.0	100.0
Jun 02	4.5	20.8	10.9	50.5	6.2	28.7	21.6	100.0
Dec 02	4.7	16.2	13.7	47.2	6.5	22.4	24.9	100.0
Jun 03	4.9	18.1	15.7	58.1	6.4	23.7	27.0	100.0
Dec 03	4.8	16.1	17.9	60.1	7.0	23.5	29.8	100.0
Jun 03	5.1	15.9	19.4	60.6	7.5	23.4	32.0	100.0

Source: FCC, Trends in Telephone Service, various.

Finally, we consider trends in revenues and shares of revenues. Table 11 show the amount of nationwide local service revenues for RBOCs, other LECs, CLECs and the total. Total local services rose from $80.0 million in 1993 to $122.0 million in 2003. During this period, the CLEC share rose from 0.3% in 1993 to 15.0% in 2003.

Table 11. Local telephone service revenues (millions of current dollars)

	Period 1 1989-1992	Period 2 1993-1996	Period 3 1997-2000	Period 4 2001-2004
ILECs	74,707 (1,773)	87,142 (6,742)	100,190 (6,717)	106,390 (4,086)
CLECs	206 (4.9)	545 (361)	5,633 (3,680)	16,534 (1,990)
Total	74,913 (1,778)	87,687 (7,097)	115,820 (10,371)	122,930 (2,320)

Source: For 1993 to 2003, FCC, Trends in Telephone Service, various. For 1988 to 1992 and for 2004, total revenue is based on trend in revenue using FCC, Statistics of Communications Common Carriers, various. Shares for 1988 to 1992 are based on shares for 1993 and shares for 2004 are based on shares for 2003.

Next the statistical determinants of local service revenues are considered. Table 12 summarises the results of ordinary least squares regressions for ILECs, CLECs and total local service revenues for the period 1989 to 2004, with each regression represented by a column in the table. Unlike earlier regressions where the dummy variable represent the presence of the Act, here the dummy variable represent the key decision, which appeared at the time to strengthen the legal position of the FCC rules implementing Section 251 of the Act. The key outcome is that the Act increased CLEC revenues by $6.8 billion per year and total revenues by $7.1 billion per year, but had an insignificant effect on ILEC revenues of less than 0.4 billion per year.

Table 12. Determinants of local telephone service revenues (millions current dollars)

	ILEC	CLEC	Total
Constant	7268 (12,960)	-20,661** (6,465)	-13,393 (10,060)
GDP	9.8*** (1.7)	2.8*** (0.82)	12.6*** (1.3)
Dummy	354 (3,382)	6,759*** (2,679)	7,112** (3,146)
Adjusted R^2	0.87	0.88	0.96
F(2,13)	52.8 (0.00)	58.1 (0.00)	170.6 (0.00)
Durbin-Watson	0.62 (0.69)	0.84 (0.58)	1.11 (0.44)

Note. Dummy variable is 0 for 1988 to 1998 and is 1 for 1999 to 2004.

7. CONCLUSIONS

Through the 1980s and the early 1990s, the U. S. telecommunications industry experienced rapid technological change, which failed to deliver expected cost reductions to users. In 1996, Congress passed the Telecommunications Act 1996, which substantially deregulated the telecommunications industry with the intent of increased competition. This paper examines the impact of the Act on four dimensions of performance of local telephone markets. Key conclusions of this study include the following.

First, the Act has reduced residential monthly rates by an estimated $1.52, reduced business monthly rates by $1.60, reduced residential connection charges by $1.16, reduced business connection charges by $4.12 and reduced wireless charges by $0.10 per minute. These are substantial consumer benefits, but they need to be weighed against the large investments made by telecommunications companies after 1996. Cross subsidization of residential monthly rates by business monthly rates was reduced by about 25%, presumably increasing economic efficiency. These results appear to contradict studies which argue that customers have seen little or no benefit on local monthly telephone rates and connection charges as a result of the Act.

Second, the Act has had a positive effect on the number of residential loops and business loops, increasing them in total by about 17 million, and a negative effect on the number of wireless connections, reducing them by about 26 million. But given the sizes of the standard errors around these estimates, the Act may have not had a significant impact on the total number of local loops.

Third, the Act has had a statistically significant positive effect on labour productivity in the fixed line segment and on the wireless segment, in each case boosting the labour productivity index by over 22 points. Labour productivity in telecommunications has increased more rapidly than manufacturing over this period. Key contributors to this improvement in telecommunications labour productivity have been high levels of investment in fibre optic technology, integrated circuits, and computerization.

Fourth, the CLEC share of end-user switched lines increased from 4.3 percent in December 1999 to 17.8 percent in June 2004, a substantial increase given the entrenched positions of the ILECs. However, the "stepping stone" theory which argued that CLECs would initially lease lines or unbundled network elements to gain market share and then build their own access lines, has largely not happened as the CLEC-owned lines share of CLEC total lines fell from 33.2% in December 1999 to 23.4% in June 2004. A key financial outcome is that the Act increased CLEC revenues by $6.8 billion per year and total local service revenues by $7.1 billion per year, but had a small effect on ILEC revenues of less than $0.4 billion per year.

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