Why Do the Poor and the Less-Educated Pay More for Long-Distance Calls?

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The benefits of competition among the long-distance interexchange carriers (IXCs) are not realized equally by all their customers. Despite the declines in rates under the discount plans, we document that basic message toll service (MTS) rates have been rising for several years. We show that poorer and less educated customers pay more than better educated and more affluent customers. We suspect that the reason for this correlation is that they are more apt to pay the MTS rates or other high rates, and we present some preliminary evidence that this tendency explains the correlation that we find. We also present evidence that the payment differences exist even after controlling for usage. These findings are significant because it seems likely to us that these two patterns (rising MTS rates and higher payments by the poor and the less educated) will each be ameliorated by the entry of the regional Bell operating companies (RBOCs) into long-distance markets—a state-by-state regulatory process that was nearly complete as of the beginning of 2004.

I. INTRODUCTION

Since the passage of the landmark Telecommunications Act of 1996,[1] the three largest interexchange carriers (IXCs)—AT&T, MCI WorldCom (now called simply MCI), and Sprint—have significantly increased the basic (nondiscounted) price of the standard long-distance service purchased by residential customers, a service known in regulatory circles as message toll service (MTS). The business press, however, has reported the competitiveness of long-distance service in light of the prevalence of the IXCs' discount calling plans and of long-distance resellers, which generally offer even lower prices.[2] More significantly as a public policy matter, the Federal Communications Commission (FCC) and Congress

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1. Pub. L. No. 104-104, 110 Stat. 56 (1996).

2. *See generally* Jane Bryant Quinn, *Use "Phone Rage" to Comparison-Shop*, WASH. POST, Aug. 5, 2001, at H2 (comparing basic and discount plans for MTS, and comparing both with long-distance resellers); Deborah Solomon, *How Do I Pick a Long-Distance Provider?*, WALL ST. J., Sept. 10, 2001, at R8 (reporting that AT&T, MCIWorldCom, Qwest, and Excel each offer a 7-cents-per-minute plan with a monthly service fee that ranges between $3.95 (AT&T, MCIWorldCom) and $4.95 (Qwest and Excel)).

have described the interexchange market as "substantially" or "highly" competitive.[3] Some academic economists have endorsed that view.[4]

However great may be the benefits of competition among the IXCs, those benefits are not realized equally by all their customers. Despite the declines in rates under the discount calling plans, we document that basic MTS rates have been rising for several years. By February 2002, AT&T's basic rate for MTS was higher in real terms than it was in 1996 (19.2 cents per minute in January 1996 versus 25.8 cents per minute in February 2002 an increase of 34 percent).[5] MCI WorldCom and Sprint similarly raised their basic rates for MTS. These higher prices are exceptional because the access fees that the IXCs pay to the local exchange carriers have decreased significantly since 1996, as have the costs of fiber optics and most other telecommunications equipment used to provide long-distance service. Further, these higher prices are paid by a significant proportion of customers—for example, for AT&T approximately 42 percent of customers paid these higher MTS prices in 2000. In January 2004, AT&T

3. Policy and Rules Concerning the Interstate, Interexchange Marketplace; Implementation of Section 254(g) of the Communications Act of 1934, as amended; 1998 Biennial Regulatory Review—Review of Customer Premises Equipment and Enhanced Services Unbundling Rules in the Interexchange, Exchange Access And Local Exchange Markets, Report and Order, CC Dkt. No. 96-61, 16 F.C.C. Rcd. 7418 ¶ 20 (2001) [hereinafter *Interstate, Interexchange Marketplace Report and Order*]. The FCC has consistently regarded the interexchange market as "substantially competitive" since at least 1991. *See* Competition in the Interexchange Marketplace, Report and Order, CC Dkt. No. 90-132, 6 F.C.C. Rcd. 5880, 5887 ¶ 36, 5889 ¶ 50 n.90, 5892 ¶ 66 (1991); Motion of AT&T Corp. to be Reclassified as a Non-Dominant Carrier, Order, 11 F.C.C. Rcd. 3271, 3288 ¶ 26, 3308 ¶ 72, 3318 ¶ 88, 3319 ¶ 89 n.241 (1995); Report in Response to Senate Bill 1768 and Conference Report on H.R. 3579, Report to Congress, 13 F.C.C. Rcd. 11,810, 11,827 ¶ 28 (1998). Chairman Michael K. Powell has endorsed this view. *See* Low-Volume Long-Distance Users, Notice of Inquiry, CC Dkt. No. 99-249, 15 F.C.C. Rcd. 6298, 6322 (1999) (separate statement of then-Commissioner Michael K. Powell, concurring) ("The long-distance industry is highly competitive and has created greater choice and value for all consumers. Further, overall long-distance rates have continued to decline . . . ."); *see also id.* at 6309 (separate statement of Commissioner Susan Ness, concurring) ("Today, most consumers are reaping the benefits of thriving competition in the long-distance market—choice is abundant, innovation is rampant, and per-minute rates are the lowest they have ever been."). In 2001, the House Commerce Committee also reaffirmed this view of the competitiveness of the interexchange market. *See* INTERNET FREEDOM AND BROADBAND DEPLOYMENT ACT OF 2001, HOUSE REP. NO. 107-83, pt. 2, 107th Cong., 1st Sess. (2001) (to accompany H.R. 1542) ("The impetus for the Telecommunications Act of 1996 arose from the application and effect of the [Modification of Final Judgment (MFJ)]. In the years following the MFJ, the long-distance industry became highly competitive with the entrance of numerous companies offering consumers greater choice and lower prices.").

4. For example, Glenn Hubbard and William Lehr testified before the FCC in 1998 on behalf of AT&T that long-distance markets are "effectively competitive today," such that additional entry would not benefit consumers. Affidavit of R. Glenn Hubbard and William H. Lehr on behalf of AT&T Corp., at 7 (undated), in Second Application by BellSouth Corp. *et al.* for Provision of In-region, InterLATA Services in Louisiana, CC Dkt. No. 98-121. *See also* Competitive Implications of Bell Operating Company Entry into Long-Distance Telecommunications Services, Affidavit of Marius Schwartz, at 13 ¶ 35 & n.7 (May 14, 1997) (prepared for U.S. Dept. of Justice) (describing long-distance markets as having "considerable competition" and citing approvingly the FCC's assessment of "substantial competition").

5. The sources of these data are explained in the text accompanying note 12 *infra*.

added a new $3.95 fee to the bills of roughly ten million customers on the basic rate plan.[6]

Long-distance carriers have numerous calling plans with complex rate structures. We show that poorer and less educated customers pay more than better educated and more affluent customers. There are two possible explanations for this observed correlation. Possibility 1 is that, given the tariff structure, those who purchase in quantity can buy at lower per-minute prices, and poorer and lower income customers pay higher prices only because they call for fewer minutes. Rappoport and Taylor find that these groups do call less than others.[7]

Possibility 2 is that poorer and less educated customers pay higher prices even controlling for level of usage. That is, poor and less educated customers could pay less for the calls they make if they were billed under the rate structure under which richer and better educated customers are billed. This second possibility can be further subdivided into several questions. Do the poor or less educated choose plans under which they pay more than they need to, or are they offered more expensive plans and denied or steered away from cheaper plans? (Possibility 2A) Are cheaper plans more actively marketed to affluent individuals? (Possibility 2B) Are the poor or less educated reluctant to ask their carrier for a lower rate or to switch to carriers with lower rates? (Possibility 2C)

We endeavor to distinguish Possibility 1 from Possibility 2, but the available data do not permit us to distinguish Possibilities 2A, 2B, and 2C. We present evidence that the payment differences exist even after controlling for usage, such that Possibility 1 can be rejected. These findings are significant because it seems likely to us that these two patterns (rising MTS rates and higher payments by the poor and less educated) will each be ameliorated by the entry of the RBOCs into long-distance markets—a state-by-state regulatory process that was nearly complete by the beginning of 2004.[8]

II. THE DIVERGENCE BETWEEN BASIC AND DISCOUNT PRICES FOR MTS

In this section, we document the increase in the tariffed price of MTS offered by the big three IXCs. The data show that the basic tariffed price of MTS (or the basic, nondiscounted price of MTS, following the FCC's decision to refuse to accept tariffs for long-distance service after July 31, 2001[9]) has risen steadily since the early 1990s. The difference between the

6. *See* Shawn Young, *The Surprise in Your Phone Bill*, WALL ST. J., Dec. 11, 2003, at D1.

7. Paul N. Rappoport & Lester D. Taylor, *Toll Price Elasticities Estimated from a Sample of U.S. Residential Telephone Bills*, 9 INFO. & ECON. POL'Y 51 (1997).

8. As of January 1, 2004, BOCs had received authorizations to provide interLATA service in 48 states and the District of Columbia. *See* http://www.fcc.gov/Bureaus/Common_Carrier/ in-region_applications.

9. *Interstate, Interexchange Marketplace Report and Order*, *supra* note 3, 16 F.C.C. Rcd. at ¶ 22 n.60.

basic rate for MTS and the discount rate has grown. Moreover, access charges, which are the fees that an IXC pays to a local exchange carrier to originate or terminate long-distance calls over its exchange network,[10] have fallen steadily. Access charges are the largest single component of the marginal cost of MTS calls. Thus, when expressed as a markup over the access charge, the basic rate for MTS has risen by several multiples since Congress passed the Telecommunications Act of 1996.

Long-distance carriers generally do not report the complete schedule of long-distance prices to the customer. Long-distance prices and promotional plans are largely agreed upon during telephone solicitations. Consequently, customers with similar usage characteristics purchasing identical long-distance services may pay different prices.

Several studies have examined the pricing of long-distance service, but none has investigated the connection between customers' demographic characteristics and price.[11] To undertake such a study, we collected the posted basic rate and the discount rate for MTS for each of the big three IXCs from HTL Telemanagement from January 1996 through July 2001. For the period from August 2001 to February 1, 2002, we collected these rates from the web sites of the big three IXCs, as HTL Telemanagement ceased to collect these data. In early January 2002, the *Washington Post* and *Wall Street Journal* reported the announcement of rate increases for all three companies, and we used the information from those reports and company websites to extend our data.[12] Figures 1 through 3 show the monthly difference between the basic rate for MTS and the discounted rate from January 1, 1996 through February 1, 2002. The figures also show the

10. *See* www.fcc.gov/Bureaus/Common_Carrier/News_Releases/2000/ncc0029b.html.

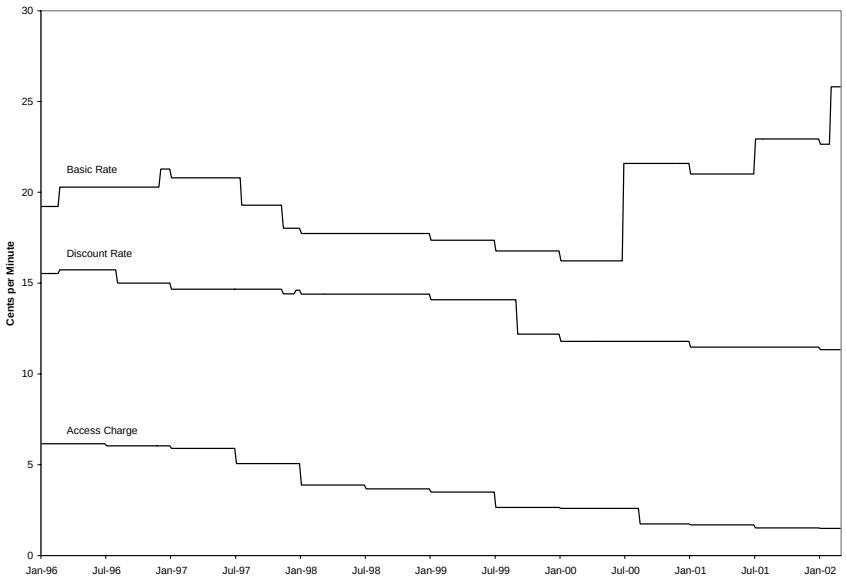
11. Using a sample of U.S. residential telephone bills, Paul Rappoport and Lester Taylor examined the connection between the volume of interLATA and intraLATA toll calling and socio-demographic characteristics. Paul N. Rappoport & Lester D. Taylor, *Toll Price Elasticities Estimated from a Sample of U.S. Residential Telephone Bills*, 9 INFO. & ECON. POL'Y 51 (1997). They found that toll calling is positively related to education and that Hispanic households have lower toll usage than other ethnic groups. *Id*. at 57. Their results also indicate that households with a high call concentration index (the percentage of calls that goes to three or fewer telephone numbers) have lower toll usage than households with a lower index. *Id*. at 58.

Other empirical studies have examined the state of competition in the long-distance market, a topic that differs from the focus of this paper. *See* Paul W. MacAvoy, *Testing for Competitiveness of Markets for Long-distance Telephone Services: Competition Finally?*, 13 REV. INDUS. ORG. 295 (1998); William E. Taylor & J. Douglas Zona, *An Analysis of the State of Competition in Long-Distance Telephone Markets*, 11 J. REG. ECON. 227 (1997); Paul W. MacAvoy, *Tacit Collusion under Regulation in the Pricing of Interstate Long-Distance Telephone Services*, 4 J. ECON. & MGMT. STRATEGY 145 (1995); s*ee also* PAUL W. MACAVOY, THE FAILURE OF ANTITRUST AND REGULATION TO ESTABLISH COMPETITION IN LONG-DISTANCE TELEPHONE SERVICES 105-71 (MIT Press 1996).

12. *See* Caroline E. Mayer & Christopher Stern, *AT&T, Sprint, MCI Hike Rates; Long-Distance Fees Aren't All Clear*, WASH. POST, Jan. 1, 2002, at E2; Deborah H. Solomon, *Phone Companies Are Raising Rates For Some Service*, WALL ST. J., Jan. 2, 2002, at A8. AT&T's rates were downloaded at http://serviceguide.att.com/ACS/ext/Documents.cfm?DID=1558. MCIWorldCom's rates were downloaded at www.mci.com/service_agreement/index.jsp. Sprint's rates are from GOLDMAN, SACHS & CO. INVESTMENT RESEARCH, LONG DISTANCE REPORT (Jan. 2, 2002). In addition to increasing the basic rate, the IXCs increased the universal service fee. *See* Mayer & Stern, *supra*.

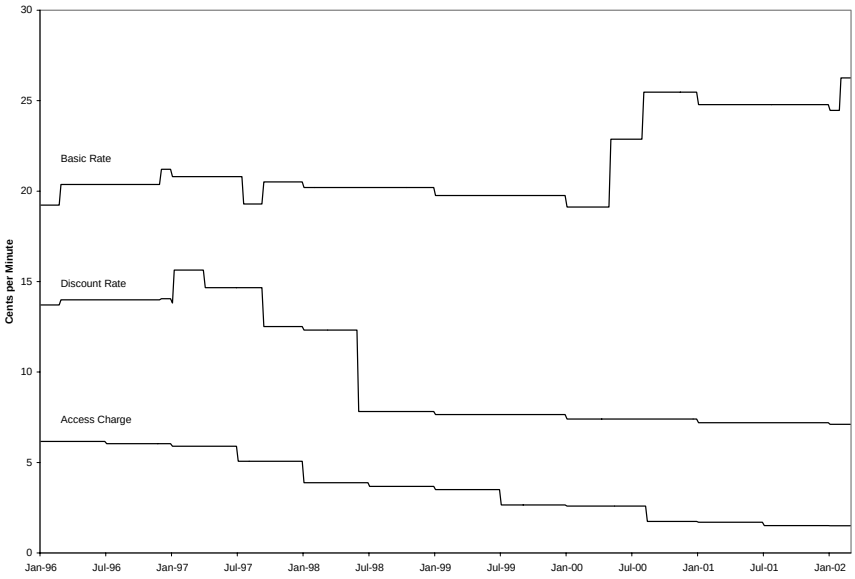
relationship between those rates and access charges, the IXCs' largest single component of marginal cost in the provision of MTS.

FIGURE 1: AT&T PRICES FOR BASIC AND DISCOUNT MTS CALLING PLANS, JANUARY 1996-FEBRUARY 2002



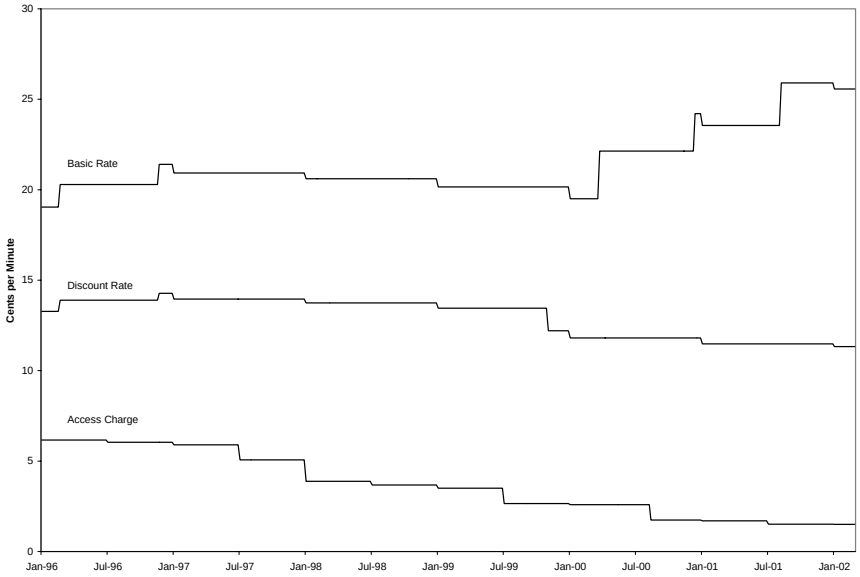
Source: HTL Telemanagement, Ltd. (data through August 2001); AT&T website; Goldman Sachs.
Note: Tariff rates expressed in real terms (1996 dollars).

FIGURE 2: MCI WORLDCOM PRICES FOR BASIC AND DISCOUNT MTS CALLING PLANS, JANUARY 1996-FEBRUARY 2002



Source: HTL Telemanagement, Ltd. (data through August 2001); MCI WorldCom website; Goldman Sachs.
Note: Tariff rates expressed in real terms (1996 dollars).

FIGURE 3: SPRINT PRICES FOR BASIC AND DISCOUNT MTS CALLING PLANS, JANUARY 1996-FEBRUARY 2002

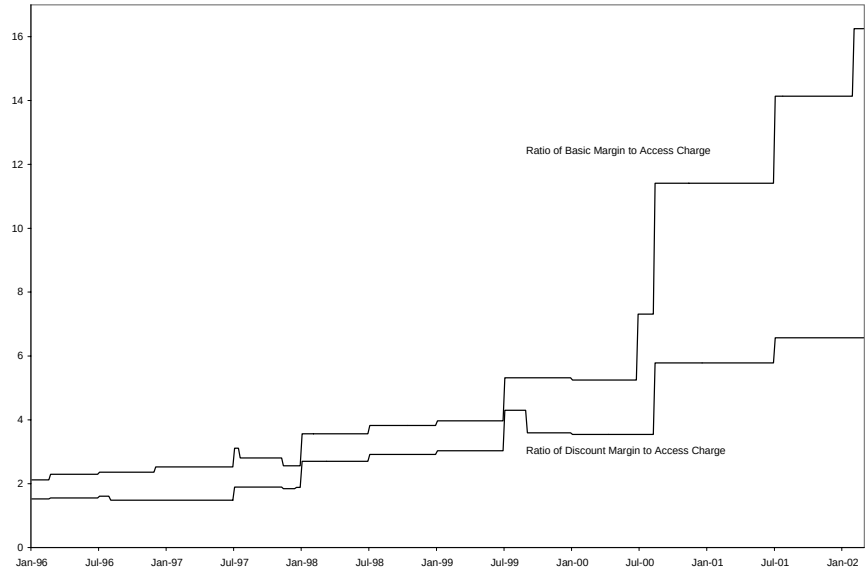


Source: HTL Telemanagement, Ltd. (data through August 2001); Sprint website.
Note: Tariff rates expressed in real terms (1996 dollars).

Figures 1 through 3 show that the difference between the basic rate and the discount rate for MTS increased after the passage of the Telecommunications Act of 1996. For example, the ratio of AT&T's basic rate to discount rate for MTS increased from December 1996 (1.42) through February 2002 (2.28). The ratio of MCI WorldCom's basic rate to discount rate for MTS increased from December 1996 (1.51) through February 2002 (3.69). The ratio of Sprint's basic rate to discount rate for MTS rose from December 1996 (1.50) through February 2002 (2.26).

Interestingly, the "basic margin" for AT&T, which we define as the difference between AT&T's basic rate for MTS and the access charge, increased over the same period from 13.0 cents to 24.6 cents per minute. AT&T's "discount margin", which we define as the difference between AT&T's discount rate for MTS and the access charge, increased over the same period from 9 cents to 10 cents per minute. Figure 4 shows the ratios of AT&T's basic margin and discount margin to the access charge from January 1, 1996 through February 1, 2002.

FIGURE 4: RATIO OF AT&T'S BASIC MARGIN AND DISCOUNT MARGIN TO THE ACCESS CHARGE, JANUARY 1996-FEBRUARY 2002



Source: HTL Telemanagement, Ltd. (data through August 2001); AT&T website; Goldman Sachs.
Note: Tariff rates expressed in real terms (1996 dollars).

As Figure 4 shows, the ratio of the AT&T's basic margin to the access charge increased from 2.1 in January 1996 to 16.3 in February 2002. That ratio can be considered an approximation of AT&T's marginal profitability—for every cent of access charge incurred in February 2002, AT&T grossed sixteen times that charge on customers who pay the basic rate. Because the access charge is the most significant component of marginal cost, the steady increase in both ratios suggests that AT&T has achieved steadily increasing markups above marginal cost. That phenomenon is inconsistent with either the notion that the market for MTS is currently "substantially" or "highly" competitive or the notion that the market is growing more competitive.[13]

III. DEMOGRAPHIC CHARACTERISTICS OF RESIDENTIAL CONSUMERS WHO PAY THE BASIC RATE FOR MTS

A significant share of the sample population pays the basic MTS rate. As of the second quarter of 2000, approximately 42 percent of AT&T's customers were not enrolled in a discount plan; the comparable shares for Sprint and MCI WorldCom customers were 60 and 45 percent, respectively. In this section, we use demographic data to analyze

13. It is also likely that other key elements of the IXCs' marginal costs were decreasing over this period, given the downward trend in the prices of fiber optics and telecommunications equipment. *See, e.g.*, Ken Branson, *Equipment Prices Dropping, But Not Plummeting*, BROADBAND WK., June 4, 2001, at 1.

econometrically the characteristics of consumers of MTS. Using three different econometric approaches, we consistently find that the consumers most likely to pay higher rates for direct-dial interLATA calls are the poor and the less-educated.

A. *Data Used to Perform the Analysis*

Each quarter, TNS Telecoms surveys approximately 30,000 consumers as to their telecommunications expenditures. Of all the customers polled in its general survey, approximately 3,000 customers provide TNS Telecoms with their actual long-distance bills. For this study, we used data on the long-distance bills of respondents from the third quarter of 1999 to the fourth quarter of 2000.[14] Our data set encompassed customers in the territories of the four largest providers of local exchange services.

We derived the per-minute price of MTS service through a two-step calculation. The total amount of the long-distance bill reported by TNS Telecoms was a sum of five components: (1) the subtotal of long-distance charges, (2) the sum of company service charges, (3) the sum of charges for non-itemized calls, (4) the sum of other charges, and (5) taxes. To focus on the charges that IXCs control, we included the first two components.[15] Next, we divided that charge by the total number of minutes that the respondent used during that period, leaving us with the per-minute price of long-distance service. We also calculated the per-minute price of interLATA and intraLATA service, but we had to exclude the service charge from this calculation.

In addition to harvesting the specific components of the customer's long-distance charges, TNS Telecoms collects detailed information about the customer specifically and the customer's household in general. For example, TNS Telecoms obtains the following variables: annual income, the number of people in the household, the region in which the household is located, the population density of the household's zip code, the head of household's age, the head of household's race, and the head of household's education. Hence, it is possible to determine the socio-demographic characteristics of the customers are paying the higher prices for MTS.

Before proceeding to the econometric analysis, we calculated the share of the sample population that is paying the basic rate for MTS. As an indicator for that share, we estimated the percentage of long-distance customers who are *not* enrolled in a discount plan. As of the second quarter

14. The TNS data are proprietary. Consequently, we cannot give the data to a third party who might wish to replicate our results. However, the data may be readily purchased from TNS Telecoms. *See* http://www.tnstelecoms.com/quarterlytrackingdata.html.

15. International long-distance calls were included in the subtotal of the customer's bill. TNS Telecoms includes a separate variable for international long-distance charges and international long-distance minutes. We subtracted these components from subtotal charges and total long-distance minutes, respectively, to obtain a variable that represented domestic long-distance calling only. In generating this variable, we found that, for two observations in our sample, the international long-distance bill exceeded the total long-distance bill. We excluded these observations from our sample.

of 2000, approximately 42 percent of AT&T's customers were not enrolled in a discount plan; the comparable shares for Sprint and MCI WorldCom customers were 60 and 45 percent, respectively.

Who are these callers? Table 1 shows the percentage of customers enrolled in discount plans by race, education, and income levels. We also computed the average price per minute of direct-dial interLATA calls for each customer class.

TABLE 1: PERCENTAGE OF LONG-DISTANCE CUSTOMERS ENROLLED IN DISCOUNT PLANS BY RACE, LEVEL OF EDUCATION, AND INCOME LEVEL (DIRECT-DIAL INTERLATA CALLS)

Group	Percentage Enrolled in Plan	Average Price (Cents per Minute)	Percentage Not Enrolled in Plan	Average Price (Cents per Minute)
Asian	58.0	11.7	42.0	15.8
White	51.1	11.3	48.9	15.8
Hispanic	49.4	12.1	50.6	18.0
African-American	47.2	11.9	52.8	18.0
Income less than $35,000	48.1	11.5	51.9	16.1
Income greater than $35,000	54.5	11.2	45.5	15.9
Education less than high school	47.5	12.0	52.5	17.2
Education equal to high school	49.4	11.7	50.6	15.9
Education more than high school	55.9	10.6	44.1	15.7

Source: TNS Telecoms.
Note: Third quarter of 1999 through fourth quarter of 2000.
*Average price equals direct-dial interLATA charges divided by direct-dial interLATA minutes.

As Table 1 shows, approximately the same percentage of customers from each racial category enrolls in discount plans (50 percent), although Asians were somewhat higher. Moreover, neither income nor race appears to have a strong influence in the decision to enroll in a discount plan. Hence, we conclude that a significant share of long-distance customers pays the basic rate.

Interestingly, Hispanics who are *not* enrolled in discount plans pay more per minute for direct dial interLATA calls than do whites (18.0 cents per minute versus 15.8 cents per minute). Higher income and higher education levels appear to lower the average price for customers regardless of whether they are enrolled in a discount plan.

B. *Econometric Analysis*

We perform econometric analysis to determine the influence of each socio-demographic variable when controlling for other factors that might affect a customer's price for long-distance service. In particular, we use the average price for direct-dial interLATA calls as our dependent variable in the regressions. Our econometric analysis consists of three separate methodologies: (1) ordinary least squares regression, (2) two-stage least

squares regression, and (3) instrumental variable analysis of quantile regressions.

1. *Ordinary Least Squares Regression Model*

After constructing the average price per minute of interLATA direct-dial calls for each customer in the dataset, we regressed that variable on a number of demographic characteristics. We included several household-level variables, such as annual income, the number of people in the household, the region in which the household is located, and the population density of the household's zip code. We also included more specific demographic variables associated with the head of household, including age, race, and level of education. Finally, we controlled for any potential trend in long-distance prices by including an indicator variable for the quarter during which the bill was received, and we also included indicator variables for the major IXCs: AT&T, MCI WorldCom, and Sprint. This regression specification should be interpreted as a "population regression" that describes the determinants of the average price per minute and determines their importance. In particular, we are interested in demographic variables to examine the hypothesis that the poor and less-educated pay a higher average price for long-distance service.

Because the TNS Telecoms data set reports all variables in categorical form, we converted the variables into continuous variables, with the exception of race and region, which are expressed as indicator variables. The approach that we used differed somewhat between variables. For age and income, we assigned the median value in each category to any household belonging to that category. Finally, we assigned a number representing the highest level of education completed, in years, to each educational category.

We used an ordinary least squares (OLS) regression technique on the regression sample of 12,289 observations and calculated robust Huber-White robust standard errors.[16] We report summary statistics for our regression sample in Table 2 below.

16. *See, e.g.*, WILLIAM H. GREENE, ECONOMETRIC ANALYSIS 546 (Prentice Hall 3d ed. 1997) (explaining calculation of Huber-White robust standard errors). We also performed a Hausman specification test on the model using sample weights. *See* Jerry A. Hausman, *Specification Tests in Econometrics*, 46 ECONOMETRICA 1251 (1978). This test indicated that there was no systematic difference between the coefficients of the weighted OLS model and the OLS model.

TABLE 2: PER-MINUTE LONG-DISTANCE PRICE REGRESSION VARIABLE SUMMARY STATISTICS, ALL RESPONDENTS, THIRD QUARTER 1999 THROUGH FOURTH QUARTER 2000 (DIRECT-DIAL INTERLATA CALLS)

Variable	Mean	Standard Deviation
Price Per Minute	.1363758	.1705326
Age	51.99561	13.2938
Age Squared	2880.254	1285.422
Income	39408.82	26920.88
Years of Education	12.77289	2.983995
Household Size	2.130442	1.155402
Population Density	276.5327	775.4238
Quarter of Bill	3.584425	1.676824
Asian/Pacific Islander	.007405	.0857366
African-American	.0458133	.2090886
Hispanic & Other	.0150541	.1217731
East North Central	.228497	.4198815
East South Central	.0828383	.2756489
Middle Atlantic	.1679551	.3738416
Mountain	.0109041	.1038559
Pacific	.0624949	.2420621
South Atlantic	.2637318	.4406735
West North Central	.0313288	.174212
West South Central	.1196192	.3245289
MCI	.2058752	.4043561
AT&T	.4529254	.4977993
Sprint	.0675401	.2509652
Teenagers	.085605	.2797913

We report our regression results in Table 3. Several demographic variables have statistically significant coefficients, and an F-test for zero slopes indicates that the model as a whole is statistically significant.[17]

17. Although the regression has an R^2 of 1.4 percent, this outcome is to be expected given the cross-sectional nature of the sample. Further, a low R^2 says only that the model will most likely not be able to predict the long-distance rate for a single individual with a high degree of accuracy. Given the extremely large t-statistics on our coefficients, we are able to estimate the effects across the population quite accurately, which is the goal of our econometric analysis.

TABLE 3: PER-MINUTE LONG-DISTANCE PRICE REGRESSION COEFFICIENTS, ALL RESPONDENTS, THIRD QUARTER 1999 THROUGH FOURTH QUARTER 2000

Variable	Coefficient	Robust Std. Error	t-Statistic	P>|t|
Age*	.0021432	.0012573	1.70	0.088
Age Squared**	-.0000258	.0000131	-1.98	0.048
Income**	-1.56e-07	7.13e-08	-2.18	0.029
Years of Education**	-.001865	.0005619	-3.32	0.001
Household Size	.0007517	.0020372	0.37	0.712
Population Density	1.43e-07	1.86e-06	0.08	0.939
Quarter of Bill**	-.0041045	.0008338	-4.92	0.000
Asian/Pacific Islander	.0039473	.0230938	0.17	0.864
African-American	.0099602	.0084241	1.18	0.237
Hispanic & Other	.0271081	.0379011	0.72	0.474
East North Central*	.012613	.0074025	1.70	0.088
East South Central	.0000578	.0078394	0.01	0.994
Middle Atlantic	.003852	.0077259	0.50	0.618
Mountain	-.0035053	.0135369	-0.26	0.796
Pacific	-.008721	.0105792	-0.82	0.410
South Atlantic	.0047296	.0076421	0.62	0.536
West North Central	.0095839	.0131815	0.73	0.467
West South Central	.008317	.0088372	0.94	0.347
MCI**	.0217729	.0048364	4.50	0.000
AT&T**	.0314953	.0033866	9.30	0.000
Sprint	.005307	.0038006	1.40	0.163
Teenagers*	.0161197	.0095658	1.69	0.092
Constant**	.1155016	.0276569	4.18	0.000
Regression Statistics				
R^2	0.0137			
N	12,289			
F	12.10			

Note: * Significant at 10 percent level. ** Significant at 5 percent level.

The omitted indicator variables were white for race, New England for region, and a company other than AT&T, MCI WorldCom, or Sprint for long-distance provider. Hence, each of the estimated parameters for the indicator variables should be interpreted relative to the omitted categories. We interpret the coefficient for each variable below. Several variables have significant explanatory power:

- Income—Income has a negative effect on long-distance rates, and the effect is statistically significant at the 5 percent level of confidence. The coefficient indicates that a consumer's price per

minute falls by 0.156 cents for every additional $10,000 of household income.

- Education—The effect of the level of education on the per-minute price of long-distance service is both statistically and economically quite large. The coefficient, which is significant at the 1 percent level, indicates that an additional year of education reduces the per-minute price of long-distance service by 0.186 cents. Thus, a college-educated individual would pay 0.744 cents less per minute than a high-school educated individual, all other factors being held constant.

- Long-Distance Provider—The coefficients on AT&T and MCI WorldCom are positive, large, and statistically significant at the 1 percent level. Households using AT&T or MCI WorldCom pay 3.1 or 2.2 cents per minute more for direct-dial interLATA calls than households using smaller carriers. This amounts to a higher payment, at the mean interLATA rate, of 15.7 percent for MCI and 23.1 percent for AT&T.

- Quarter of Bill—The statistical significance at the 1 percent level and the negativity of the coefficient capture the observed downward trend in long-distance rates from the third quarter of 1999 to the fourth quarter of 2000. This downward trend is likely due to the FCC-mandated decreases in access charges.

- Teenagers—The effect of at least one teenager in the household is to increase long-distance rates by 1.6 cents per minute, or almost 11.8 percent at the mean. This result, which is significant only at the 10 percent level, is likely due to the fact that teenagers have a higher probability of making calls during daytime hours than working adults, because teenagers tend to return home from school at earlier times than parents return home from their jobs.

The following variables are statistically insignificant or have ambiguous coefficients:

- Age—Age has a significant effect on the per-minute price of direct-dial interLATA calls in numerical terms. The coefficient on *Age* is significant at the 10 percent level, and the parameter on *Age Squared*, is significant at the 5 percent level. Jointly, these parameters are significant at the 1 percent level. Because of the squared term, the effect of age on long-distance rate will change with age. To be specific, the incremental contribution is .0021 -

.000052*Age*.[18] Thus, for ages below 40, the effect of an increase in age on the long-distance rate is positive, but for ages 41 and over, the effect of age on the long-distance rate is negative.

- Household Size—The coefficient on this variable is neither statistically nor economically significant, indicating that it has little or no effect on the per-minute price of long-distance service.

- Zip Code Population Density—The coefficient on this variable is neither statistically nor economically significant, indicating that it has little or no effect on the per-minute price of long-distance service.

- Race—The coefficients suggest that African-Americans and Hispanics pay slightly more for direct-dial interLATA calls (1 cent per minute and 2.9 cents per minute, respectively), but the t-statistics are not significant.[19]

- Region—The region in which a household is located has little effect on its own on the per-minute price of long-distance service at any level of statistical significance. However, regional variables taken together have a statistically significant effect at the 10 percent level. Only the East North Central region has a coefficient significant at the 10 percent level, and it indicates that households in this region pay 1.3 cents per minute more for long-distance service.

In summary, we find that poor households pay more per minute for direct-dial interLATA calls than do wealthy households. Households headed by someone with only a high-school education pay more per minute than do households headed by someone with a college education. Table 4 compares the predicted MTS rates for a number of hypothetical customers to illustrate the price differences that our model implies.

18. This result is calculated as the partial derivative of long-distance rate with respect to *Age*.

19. In a separate regression that we performed on the average of price of *all* interLATA calls (direct-dial, calling-card, and operator-assisted calls), the coefficient on African-American was positive (8.7 cents per minute), and the t-statistic was significant at the 1 percent level (3.97).

TABLE 4: PREDICTED PRICES CHARGED BY AT&T IN FOURTH QUARTER 2000, BY INCOME, LEVEL OF EDUCATION, AND STATE

State	Income ($ Annual)	Level of Education	Predicted Rate (Cents per Minute)
Florida	25,000	High school	10.8
	25,000	College	10.1
	75,000	High school	10.0
	75,000	College	9.3
New Jersey	25,000	High school	10.7
	25,000	College	10.0
	75,000	High school	9.9
	75,000	College	9.2
California	25,000	High school	9.5
	25,000	College	8.7
	75,000	High school	8.7
	75,000	College	7.9

Note: Assumes age, age squared, population density, household size, and population density are equal to the mean within the regression sample. Assumes the head of household is a white male. Assumes no teenagers.

As Table 4 shows, the predicted prices vary across customer profiles. A customer with a high school education earning $25,000 per year in New Jersey pays 10.7 cents per minute, while a New Jersey customer with a college education earning $75,000 per year pays 9.2 cents per minute. Similar disparities in predicted prices arise in other states, such as Florida and California.

2. *Two-Stage Least Squares Regression Model*

A potential problem with the preceding econometric results is the use of two-part (non-linear) tariffs by IXCs. The typical two-part tariff has a monthly payment (often around $5 per month) and offers lower per minute prices than the usual non-discount MTS plan. Our results may be affected by problem that a fixed cost exists for serving a customer each month (for example, sending out a bill), so that for a two-part tariff this cost is captured by the monthly charge and the per minute charge is more closely related to the variable (marginal) cost of providing long-distance service. However, many low-use customers choose the single price MTS plans so that they are charged closer to an "average cost" per minute that includes the fixed monthly cost. Thus, our results may arise because the poor and less educated make few long-distance calls and end up paying a higher per minute price because of the existence of non-linear price schedules.

To investigate this potential problem, we specify a price-per-minute equation that now has an additional right-hand side variable: the logarithm of minutes of use per month. This variable will take account of the non-linear price schedule and control for differing amounts of usage. However, because the number of minutes of use is likely to be jointly endogenous with the price, we perform a two-stage least squares analysis using income

as an instrument along with the other right-hand side variables.[20] Indeed, on the basis of a Hausman specification test, we find that minutes are jointly endogenous as expected.[21] Note that we do not include income as a separate right-hand side variable because the choice of plan should be determined by expected long-distance usage, not by income.[22] We test for this exclusion of income in the econometrics specification, and we do not reject the hypothesis that the specification is correct. The results of the two-stage least squares estimation appear in Table 5.

TABLE 5: INSTRUMENTAL VARIABLES
(TWO-STAGE LEAST SQUARES) REGRESSION

lrate	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lmins	-.0874359	.0289644	-3.02	0.003	-.1442096	-.0306622
agec	.0070278	.003013	2.33	0.020	.0011219	.0129337
agecsq	-.0000729	.0000317	-2.30	0.022	-.0001352	-.0000107
edhhc	-.0072466	.0022845	-3.17	0.002	-.0117244	-.0027687
hhsizec	.0093919	.0054569	1.72	0.085	-.0013043	.020088
popdens	-6.94e-07	6.21e-06	-0.11	0.911	-.0000129	.0000115
quarterc	-.0442418	.0024501	-18.06	0.000	-.0490443	-.0394392
Asian	-.0380053	.047488	-0.80	0.424	-.1310875	.0550768
Black	.0296967	.0218838	1.36	0.175	-.0131981	.0725915
Other	.0441669	.0336113	1.31	0.189	-.0217153	.1100491
East N Cent	.1039268	.0270291	3.84	0.000	.0509466	.1569069
East S Cent	.0336304	.02984	1.13	0.260	-.0248596	.0921203
Mid Atl	.0415383	.0277833	1.50	0.135	-.0129202	.0959969
Mountain	.0116463	.0295437	0.39	0.693	-.0462629	.0695556
Pacific	-.0178281	.0287084	-0.62	0.535	-.0741	.0384438
South Atl	.0448313	.0273603	1.64	0.101	-.0087981	.0984607
West N Cent	.0959531	.0281485	3.41	0.001	.0407786	.1511276
West S Cent	.0400915	.0284918	1.41	0.159	-.0157559	.0959389
MCI	.049864	.0155324	3.21	0.001	.0194186	.0803093
AT&T	.261322	.0144545	18.08	0.000	.2329893	.2896546
Sprint	.0913614	.0200264	4.56	0.000	.0521073	.1306154
Teenagers	.0087611	.0177743	0.49	0.622	-.0260787	.0436008
_cons	-1.955142	.1136005	-17.21	0.000	-2.177812	-1.732471

Number of observations	15330
F(22, 15307)	62.20
Prob > F	0.0000
Root MSE	.50473

20. Income gives a plausible instrument because it should be exogenous with respect to long-distance usage and income has been found to be a significant determinant of long-distance demand in previous empirical research. Note, however, that we are not estimating a demand function for long-distance minutes. Rather, we are estimating the determinants of a price schedule chosen by a consumer. We also estimated a model that used interactions of income and socio-demographic characteristics as additional instruments. The use of these additional instruments led to results that did not differ statistically from the results in Table 5. The model specification also did not reject the test of over identifying restrictions. *See, e.g.*, Jerry A. Hausman, *Specification and Estimation of Simultaneous Equation Models*, in 1HANDBOOK OF ECONOMETRICS 433 (Zvi Griliches & Michael Intriligator eds., North Holland 1983).

21. *See* Hausman, *supra* note 16. The value of the Hausman test is significant at about the 8 percent level.

22. Actual usage may differ from expected usage, but since we use 2SLS to estimate the model, errors in variables will not create a problem. *See* Jerry A. Hausman, *Simultaneous Equations with Errors in Variables*, 5 JOURNAL OF ECONOMETRICS (1977).

We estimate similar results to our previous findings, with larger effects of age and education than before. As expected, log-of-minutes has a negative coefficient on average price paid by consumers. However, older consumers and less-educated consumers pay more, even after controlling for minutes of use. Now AT&T customers pay significantly more, 26 percent, while MCI and Sprint customers also pay more, after controlling for minutes of use. Thus, we find stronger effects of price differentials after we control for minutes of use.[23]

3. *Instrumental Variable Analysis of Quantile Regressions*

We now perform a more general econometric investigation of the relationship between the price paid for direct-dial interLATA calls and consumer characteristics. The previous econometric specification assumed identical coefficients across consumers. However, the coefficients may differ depending on how much time consumers spend deciding on their long-distance plans, as well as consumer preferences for different brand names, such as AT&T. Also, some consumers may be better at choosing lower-cost long-distance plans.

To allow for differing coefficients, we specify and estimate an instrumental variables (IV) model of quantile regressions.[24] We again use the log of income to provide the instrument to do the IV estimation. In Table 6, we present results for five different quantiles: 10^{th} percentile, 25^{th} percentile, 50^{th} percentile, 75^{th} percentile, and 90^{th} percentile.

23. We also estimated a model that included, in the first-stage regression, interaction terms between the log of income and other covariates from the rate equation. Including these additional instruments had no significant impact on the regression results.

24. Quantile regressions have long been used in econometrics. The IV approach we use is by Victor Chernozhukov and Christian Hansen, *An IV Model of Quantile Treatment Effects* (MIT mimeo, Aug. 2002). Earlier research on IV median regression is Takeshi Amemiya, *Two Stage Least Absolute Deviation Estimators*, 45 ECONOMETRICA 689 (1982).

TABLE 6: INSTRUMENTAL VARIABLES QUANTILE ESTIMATION

	10th	Std Error	**25th**	Std Error	**50th**	Std Error	**75th**	Std Error	**90th**	Std Error
Log of Minutes	0.045675	0.044214	-0.05254	0.02953	-0.11900	0.02843	-0.10235	0.04232	-0.10468	0.048588
Age	0.007674	0.003533	0.00380	0.00350	0.00824	0.00356	0.01000	0.00411	0.011133	0.004521
Age Squared	-8.4E-05	3.71E-05	-0.00004	0.00004	-0.00008	0.00004	-0.00010	0.00004	-0.00012	4.69E-05
Household Head Edu.	-0.00936	0.002575	-0.00586	0.00238	-0.00616	0.00252	-0.00751	0.00314	-0.00484	0.002806
Household Size	0.006173	0.006266	0.00414	0.00583	0.00237	0.00604	0.01185	0.00766	0.017569	0.007856
Population Density	1.43E-06	8.67E-06	0.00000	0.00001	0.00000	0.00001	0.00000	0.00001	5.89E-07	9.78E-06
Quarterly Trend	-0.06449	0.003688	-0.07531	0.00314	-0.04408	0.00327	-0.02626	0.00329	-0.01006	0.004385
Asian	0.020301	0.058278	0.02610	0.04456	-0.06003	0.04106	-0.13757	0.06088	-0.20338	0.070539
Black	0.005613	0.028122	0.00426	0.02771	0.00239	0.02671	0.04606	0.03425	0.079026	0.031307
Other	-0.02836	0.041299	-0.01799	0.04655	0.04331	0.04070	0.07581	0.05435	0.161777	0.040216
East North Central	0.064267	0.028691	0.14128	0.03246	0.09566	0.03798	0.04557	0.04250	0.064284	0.034032
East South Central	0.000136	0.032274	0.04286	0.03603	0.03489	0.04221	-0.02121	0.04470	0.022086	0.040432
Middle Atlantic	0.049039	0.031343	0.08251	0.03322	0.02461	0.03964	-0.04346	0.04306	0.025632	0.037867
Mountain	-0.03502	0.031375	-0.01947	0.03650	0.00138	0.04183	-0.04446	0.04503	0.058001	0.038288
Pacific	-0.02696	0.030349	-0.00958	0.03484	-0.03918	0.03965	-0.08863	0.04387	-0.04062	0.037704
South Atlantic	0.001446	0.033656	0.05949	0.03323	0.03405	0.03894	-0.01713	0.04161	0.030394	0.033391
West North Central	0.073754	0.030139	0.13051	0.03388	0.10262	0.03901	0.03617	0.04270	0.04796	0.034023
West South Central	0.005395	0.030993	0.04645	0.03603	0.04376	0.03935	-0.00296	0.04391	0.023888	0.035882
MCI	-0.03424	0.016944	-0.09798	0.02385	-0.00153	0.02303	0.14850	0.01742	0.224672	0.026797
AT&T	0.193852	0.038056	0.17013	0.02451	0.24125	0.01495	0.33111	0.01270	0.356867	0.016328
Sprint	0.109975	0.045689	0.14981	0.02087	0.11573	0.02431	0.10279	0.03296	0.245469	0.051092
Teenagers	0.023234	0.019855	0.01961	0.02021	0.01504	0.01914	-0.01859	0.02451	-0.00929	0.029554
Constant	-2.9609	0.187954	-2.23969	0.12401	-1.85631	0.13167	-1.72837	0.17368	-1.63941	0.180526

We first test for constant effects across quantiles. We reject the hypothesis of constant effects at the 1 percent level. We also perform a Hausman specification test and again reject the use of non-IV quantile regression at approximately the .06 level.[25] For the IV quantile results we find that the log of long-distance minutes does not affect the price paid for the lowest quantile, but it does have the expected negative effects for all other quantiles. As before, the variable age and age-squared have a significant effect across all quantiles, while higher education leads to lower prices across all quantiles, with the effect significant at each quantile. Thus our previous findings continue to hold in this more refined approach.

Consumers who subscribe to AT&T pay a premium of between 17 and 36 percent, which is statistically significant. Sprint customers also pay a premium of about 10 percent. Although MCI customers in the lower quantiles receive a lower price, those at the medium do not, and MCI customers in the upper quantiles pay a premium approximately equal to that paid by Sprint customers.

4. *Summary*

Using three alternative econometric methods, we have controlled for the number of long-distance minutes of use. All three approaches find that older and less-educated consumers pay higher prices for direct-dial interLATA service.

IV. POSSIBLE EXPLANATIONS FOR THE HIGHER USAGE-ADJUSTED PRICES PAID BY THE POOR AND LESS EDUCATED

As we noted earlier, there are several possible explanations why, after controlling for long-distance usage, inverse correlations exist between per-minute prices and levels of income and education. Some of these possibilities concern consumer behavior, while others concern the marketing behavior of the long-distance carriers.

Consider first the possibilities based on consumer behavior. It is possible that poorer and less educated consumers invest less in search than do more affluent and better educated consumers. Lack of information among a subset of customers could increase the switching costs associated with changing MTS calling plans with a single IXC or changing plans across IXCs. [26] The theoretical economic literature shows that switching costs tend to create imperfectly competitive markets, resulting in higher prices and less

25. The test uses "non-standard" distributions based on Kolmogorov-Smirnov statistics. For details, see Chernozhukov & Hansen, *supra* note 24.

26. *See generally* Nickolay Moshkin & Ron Shachar, *Switching Costs or Search Costs*, Working Paper, Jan. 13, 2000 (attributing brand loyalty to the fact that individuals face asymmetric information about their alternatives and search costs). For an examination of switching costs in the context of long-distance service, see Douglas A. Galbi, *Regulating Prices for Shifting Between Service Providers*, Working Paper, Mar. 15, 2000 (showing that the price of changing long-distance service providers has a much larger effect on the distribution of surplus between consumers and service providers than it does on total welfare).

product differentiation.[27] High search costs can also contribute to a divergence in customers' willingness to pay.[28] Perhaps poorer and less educated consumers call their own carrier less to seek better prices. When they do call the carrier, perhaps these consumers are less assertive or less able to negotiate a low rate. Or perhaps these consumers have a greater level of brand loyalty than do more affluent and more educated consumers. Our data do not enable us to test these various hypotheses.

An alternative set of possibilities concerns the behavior of the long-distance carriers. Congress provided in the Telecommunications Act of 1996 that any communication by wire or radio shall be offered "without discrimination on the basis of race, color, religion, national origin, or sex."[29] Differential pricing based on income or level of education does not appear to violate the letter of U.S. telecommunications law, and we do not suggest that any particular IXC consciously uses income or level of education as a discriminating factor in setting prices. AT&T, for example, expressly states that it rejects the use of at least one of these two factors in pricing its services.[30] Still, it could be the case that the compensation structure that the IXCs offer their sales representatives creates an incentive for them not to offer poorer and less educated consumers a lower price. If so, the result could resemble third-degree price discrimination.

As defined by Stigler, price discrimination occurs when consumer *A* pays a firm a different price for a particular good than consumer *B*, even though the marginal cost of producing the good is the same for both consumers.[31] There are three necessary conditions for price

27. *See* Paul Klemperer, *Competition When Consumers Have Switching Costs: An Overview with Applications to Industrial Organization, Macroeconomics, and International Trade*, 62 REV. ECON. STUD. 515 (1995); A. Jorge Padilla, *Revisiting Dynamic Duopoly with Consumer Switching Costs*, 67 J. ECON. THEORY 520 (1996); Steven A. Sharpe, *The Effect of Consumer Switching Costs on Prices: A Theory and Its Application to the Bank Deposit Market*, 12 REV. INDUS. ORG. 79 (1997); Yongmin Chen, *Paying Consumers to Switch*, J. ECON. & MGMT. STRATEGY 877 (1997).

28. *See* Moshkin & Shachar, *supra* note 26.

29. 47 U.S.C. § 151. In addition, the Telecommunications Act of 1996 in effect requires uniform national pricing. Section 254(g) of the Communications Act, enacted in 1996, instructs the FCC to "adopt rules to require that the rates charged by providers of interexchange telecommunications services to subscribers in rural and high cost areas shall be no higher than the rates charged by each such provider to its subscribers in urban areas. Such rules shall also require that a provider of interstate interexchange telecommunications services shall provide such services to its subscribers in each State at rates no higher than the rates charged to its subscribers in any other State." *Id.* § 254(g). The FCC issued such rules in 1996. *See* Policy and Rules Concerning the Interstate, Interexchange Marketplace, Implementation of Section 254(g) of the Communications Act of 1934, as Amended, Report and Order, CC Dkt. No. 96-61, 11 F.C.C.R. 9564 (1996).

30. AT&T states on its website: "In areas in which it offers service, the Company provides service without discriminating based on race, nationality, color, religion, gender, marital status, income level, source of income, and without unreasonably discriminating on the basis of geographic location." *See* http://www.att.com/local_service/tx/html/>. AT&T does not mention a customer's level of education. This statement appears on an AT&T web page describing the company's local service offerings, but on its face the statement would seem to encompass MTS as well.

31. *See, e.g.*, GEORGE J. STIGLER, THE THEORY OF PRICE 210-11 (Macmillan 4th ed. 1987).

discrimination.[32] First, the firm must face a downward-sloping demand curve. Second, the firm must know or be able to infer consumers' willingness to pay for each unit, and this willingness to pay must vary across consumers or units. For example, strong brand loyalty among older (as opposed to newer) customers might lead to a greater willingness to pay. Third, arbitrage (that is, resale) cannot profitably occur.

If a firm has sufficient information to charge a different price to each consumer, it can achieve first-degree price discrimination, or perfect price discrimination.[33] But first-degree price discrimination is actually impossible to achieve. It is improbable that all consumers have the same reservation price, and it may be costly or impossible for the firm to gather sufficient information to ascertain the different reservation prices of its many customers. In practice, therefore, it is more likely that firms in imperfectly competitive markets resort to third-degree discrimination, in which consumers cannot be segregated by their reservation prices into infinitesimally small groups but rather must be segregated into larger and less refined groups.

If firms can identify consumers with high switching costs or limited information, third-degree price discrimination may be feasible and profit-maximizing even in oligopolistic markets that are considered quite competitive.[34] Branded and generic pharmaceuticals illustrate this possibility.[35] A number of potential pharmaceuticals may exist to treat a given condition, such as hypertension. When the patent for one particular pharmaceutical expires, or when its owner licenses the patent to rival manufacturers, it is possible for a pharmacist to supply a consumer with a generic (bio-equivalent and chemically identical) substitute for the branded drug. Although the generic drug is cheaper than the branded drug and is biologically equivalent according to Food and Drug Administration regulations, some consumers or their doctors may resist efforts by pharmacists or health management organizations to substitute the generic for the branded drug. In that case, it will be profitable for the owner of the branded drug to continue to charge a relatively high price so as to extract consumer welfare from the subset of customers having a low propensity to switch to the unbranded substitute. The price of the branded drug may even *increase* after the patent expires.

The three necessary conditions for price discrimination by IXCs are satisfied for direct-dial interLATA MTS. First, three major carriers—AT&T, MCI WorldCom, and Sprint—dominate the provision of long-distance services. As of the end of 1999, the big three IXCs controlled

32. *See, e.g.*, DENNIS W. CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 277 (3d ed. 2000).

33. *See* A.C. PIGOU, THE ECONOMICS OF WELFARE 240-46 (1st ed. 1920); JOAN ROBINSON, THE ECONOMICS OF IMPERFECT COMPETITION 186-87 & n.1 (1933).

34. *See* Severin Borenstein, *Price Discrimination in Free Entry Markets*, 16 RAND J. ECON. 380 (1985) (analyzing price discrimination in oligopolistic market that are competitive).

35. *See* Henry Grabowsi & John Vernon, *Brand Loyalty, Entry, and Price Competition in Pharmaceuticals After the 1984 Drug Act*, 35 J.L. & ECON. 331 (1992).

approximately 84 percent of long-distance revenues in the United States.[36] With respect to the second condition, the fact that IXCs offer switching vouchers to their competitors' customers indicates that the costs of switching carriers are significant.[37] Many long-distance customers display strong brand loyalty,[38] which contributes to a divergence in willingness to pay.

Overall discounted MTS service is technologically identical to basic MTS service. The same IXC supplies the basic and discount calling plans for MTS using the same network infrastructure, customer care and billing operations, and other assets. It is doubtful that the IXC has higher marginal costs creating the price differential on the basis of a higher risk of nonpayment or a higher cost of account servicing—and certainly not on the basis of higher marketing and advertising, because basic MTS will entail *lower* costs in this regard.

With respect to the third, no-arbitrage condition for third-degree price discrimination, resale among customers is impractical. The good in question is a service (literally the transmission of a unique conversation or dial-up data exchange) that cannot be traded across consumers. The price plan is connected to a particular "presubscribing" telephone number from which the customer originates calls. Consequently, the discount price cannot be arbitraged.

For these reasons, we cannot rule out the possibility that third-degree price discrimination is the reason that poorer and less educated consumers pay more for direct-dial interLATA MTS. Our data do not permit us to determine whether such price discrimination is intentional or merely the byproduct of other marketing strategies, including the compensation structure for sales representatives.

If price discrimination is occurring, we would expect BOC entry into interLATA markets to result in lower, less-discriminatory prices for direct-dial interLATA MTS across subsets of customers.[39] This outcome will be more pronounced if, as the 2,176 useable observations from New York and Texas allow us to examine, the characteristics of customers who choose the

36. Industry Analysis Division, Common Carrier Bureau, FCC, Statistics of the Long-Distance Industry, Jan. 24, 2001, at tbl. 32.

37. *See* Moshkin & Shachar, *supra* note 26, at 2.

38. *See, e.g.*, Debra B. McMahon, *Brand Battles*, TELEPHONY, July 13, 1998, at *1; Bill Menezes, *Survey Finds Customers Value Brand Names, Reliability*, WIRELESS WK., Nov. 11, 1996, at 45; Aldo Morri, *Carriers lament consumer confusion: Brand management and marketing new keys to telecom success*, TELEPHONY, July 21, 1997, at *1. The decision of the Department of Justice to challenge the proposed merger between WorldCom and Sprint was based on brand loyalty concerns. *See* Complaint, United States v. WorldCom and Sprint Corp. ¶ 64 (D.D.C. Jun. 27, 2000) ("Over the years, the Defendants and AT&T have collectively invested billions of dollars to market their long distance services and to establish, maintain, and enhance their brand images with mass market consumers. Brand recognition is often a deciding factor in mass market consumers' choices when they face complex price decisions such as those often presented by competing long distance plans.").

39. *See* Jerry A. Hausman, Gregory K. Leonard & J. Gregory Sidak, *Does Bell Company Entry into Long-Distance Telecommunications Benefit Consumers?*, 70 ANTITRUST L.J 463 (2002) (finding statistically significant evidence that the average consumer received a savings of 8 to 11 percent on the monthly interLATA bill in the states where BOC entry occurred as compared to control states where BOC entry had not occurred).

BOC for MTS service are similar to the characteristics of customers who pay the basic rates offered by the big three IXCs.

We calculated the savings to consumers from switching to BOC provision of MTS in three ways. First, we performed a test of the difference of means conditional on the customer's long-distance service provider for New York and Texas, the two states where BOCs had received section 271 authorizations to provide interLATA service during our sample period.[40] We found that BOC customers paid an average of 9.5 cents per minute for direct-dial interLATA calls compared with 13.7 cents per minute for non-BOC customers. This 4.2-cent-per-minute difference, or 30.7 percent, is statistically significant at the 1 percent level, for a two-tailed test.

A comparison of means, however, does not control for demographic characteristics that could influence the per-minute price of long-distance service. Therefore, we conducted a second stage of analysis in which we reran the OLS regression model described in Part III for residents of New York and Texas, this time including an indicator variable for whether or not direct-dial interLATA MTS was provided by a BOC and eliminating the indicator variables for AT&T, MCI WorldCom, and Sprint. This analysis indicated that, given a set of demographic characteristics, BOC customers on average paid 3.2 cents, or 24.2 percent, *less* per minute than customers of all other long-distance providers. This difference is again significant at the 1 percent level.[41]

The foregoing empirical analysis may misstate the consumer savings from switching to BOC provision of direct-dial interLATA MTS because it ignores interactive effects. We therefore conducted a third stage of analysis. The previous analysis examined only the consumer savings from switching to BOC provision of MTS given a set of demographic characteristics, thereby ignoring potential differences in the way in which these demographic characteristics affect the per-minute price of MTS provided by a BOC. First, we ran an OLS regression incorporating interactions between the BOC indicator variable and the demographic variables and performed a Chow test on these interactive effects to determine whether or not we should include them in our analysis.[42] This regression incorporated our 2,176 observations—that is the 2,026 observations for IXC customers and 150 for BOC customers. The Chow test yielded a F-statistic of 15.5, making all of the interactive effects taken together significantly different from zero at the 1 percent level. This test shows that the way in which demographic characteristics influence the per-

40. *See* note 10 *supra*.

41. We used standard econometric procedures to test for possible selection bias. We found no indication that it had any effect on our results.

42. The Chow test yields an F-statistic that identifies statistically significant structural differences in the coefficients of regression models between groups of observations. For example, if one were running a regression of earnings on education and experience, one might perform a Chow test to see whether the coefficients on education and experience were statistically different for men and women. *See* GREENE, *supra* note 16, at 349 (discussing Chow test).

minute price of direct-dial interLATA MTS differs significantly between BOCs and the IXCs.

Finally, we included these interactive effects in our consumer savings calculation by using the previous regression model to predict the average per-minute savings of BOC customers of direct-dial interLATA MTS. We first inserted BOC customers' demographic characteristics into the model to predict the price that they would have paid had they used an IXC. This regression was also based on 2,176 observations. We used the 150 survey respondents in the regression sample who were BOC customers in New York and Texas and predicted their rates using their demographic characteristics. We compared this non-BOC predicted rate to the actual rate for every BOC customer and then took the average over all of these customers. We found that BOC customers of direct-dial interLATA MTS in New York and Texas paid 1.8 cents per minute less than other customers.

Table 7 summarizes our empirical estimates of the consumer savings from BOC entry into direct-dial interLATA MTS. These results show that accounting for interaction effects yields findings that are consistent with our previous findings.

TABLE 7: CALCULATED SAVINGS OF BOC CUSTOMERS IN NEW YORK AND TEXAS ON DIRECT-DIAL INTERLATA MTS, THIRD QUARTER 1999 THROUGH FOURTH QUARTER 2000 (CENTS PER MINUTE)

Analysis	Non-RBOC Predicted Rate	RBOC Actual Rate	Predicted Savings	Percentage Change
Regression with indicator variable	N/A	N/A	3.2	24.2%
Regression with interactions	11.3	9.5	1.8	14.0%

In summary, several different econometric analyses indicate that a representative customer in New York or Texas who switches to a BOC for direct-dial interLATA MTS pays between 14 percent and 30 percent less in per-minute rates than she paid for the same service from one of the IXCs.

Some might argue that the consumer benefits from RBOC entry into the in-region interLATA market will not eventuate unless the RBOC itself refrains from differential pricing across customer groups. That proposition, however, is incorrect on both empirical and theoretical grounds. A comparison of long-distance pricing demonstrates that RBOCs do not price discriminate to the same extent that the big three IXCs do. First, the RBOCs' long-distance pricing plans are less complicated than the IXCs', and those plans are therefore easier for the typical consumer to understand. Table 8 compares the long-distance pricing plans of Verizon with those AT&T in Pennsylvania.

TABLE 8: RATE COMPARISONS OF VERIZON AND AT&T DISCOUNT PLANS IN PENNSYLVANIA, JANUARY 2002

Plan	Verizon	AT&T
1	e-values: state-to-state and in-state calls on weekends 5 cents per minute; state-to-state calls on weekdays 9 cents per minute; in-state calls weekdays 11 cents per minute; no monthly fee	e-weekends: state-to-state calls on weekends 5 cents per minute; state-to-state calls on weekdays 9 cents per minute; in-state calls weekdays 10 cents per minute; $5.00 minimum monthly usage fee
2	Smart touch: state-to-state calls 8 cents per minute; in-state calls 12 cents per minute; no monthly fee	One Rate: state-to-state calls 7 cents per minute; in-state calls 10 cents per minute; $3.95 monthly fee
3	Best times: state-to-state off-peak calls 5 cents per minute; state-to-state peak calls 7 cents per minute; in-state off-peak calls 8 cents per minute; in-state peak calls 10 cents per minute; $4.75 monthly fee	Nights: state-to-state off-peak calls 5 cents per minute; state-to-state peak calls 10 cents per minute; in-state calls 10 cents per minute; $5.00 minimum monthly usage fee
4	State saver: state-to-state calls 9 cents per minute; in-state calls 8 cents per minute; $4.75 monthly fee	One rate weekends: state-to-state calls on weekends 5 cents per minute; state-to-state calls on weekdays 7 cents per minute; in-state calls 10 cents per minute; $4.95 monthly fee
5		One Rate 12 cents
6		One Rate 7 cents Special Offer
7		One Rate Off-Peak II
8		One Rate Plan
9		One Rate Plus
10		AT&T True Reach

Source: Verizon plans downloaded from http://www.verizonld.com/home/index.htm. AT&T plans downloaded from http://www.att.com/home/index_js.html#0 and http://serviceguide.att.com/ACS/ext/osg.cfm.

As Table 8 shows, Verizon offered fewer pricing plans as of January 2002 than did AT&T. Verizon emphasized the simplicity of its plans on its website: "Simple, straightforward pricing with no monthly minimums to meet."[43] Even within AT&T's comparable offerings (plans one through four), AT&T did not offer a single plan that did not include a monthly minimum fee or usage fee. Such fees complicate the welfare-maximization calculation that long-distance customers must perform.

Second, the per-minute prices paid by non-RBOC customers in New York in 2000 had a greater dispersion around the mean than did the comparable rates of Verizon customers. Table 9 summarizes the minimum values, maximum values, and standard deviations of the average price per minute by carrier.

43. Downloaded from http://www.verizonld.com/home/index.htm.

TABLE 9: DESCRIPTIVE STATISTICS OF AVERAGE PRICE PER MINUTE FOR CUSTOMERS IN NEW YORK, 2000

	Verizon	Big Three IXCs
Observations	123	1,105
Minimum	0.068	0.050
Maximum	0.100	0.260
Standard Deviation	0.005	0.054

Note: We have eliminated the bottom and top five percentiles so as to prevent any possibility that outliers skew the results.

As Table 9 shows, the standard deviation for the big three IXCs was more than ten times the size of the standard deviation paid by Verizon customers in New York (0.054 cents per minute versus 0.005 cents per minute).[44] It is reasonable to conclude, therefore, that customers of the big three IXCs paid widely varying prices for the same service.

Even if an RBOC were to engage in price discrimination, its mere presence as a branded long-distance supplier would undermine the ability of the big three IXCs to price discriminate to the same degree. Standard oligopoly models (and subsequent game-theoretic models) in industrial organization demonstrate that entry of any form undermines the ability of incumbent firms to sustain pre-entry profit margins. Here the RBOCs have an incentive to decrease prices below those of the existing competition because the RBOCs (unlike the IXCs) have an incentive to eliminate double marginalization; thus, we except prices to decrease even more than in the usual oligopoly situation.[45] Entry into the cellular/PCS industry has had a similar effect of decreasing prices.[46]

V. CONCLUSION

We have found statistically significant inverse relationships between the price per minute paid for direct-dial interLATA MTS and the customer's household income and level of education. Poorer consumers and less-educated consumers pay more for this long-distance service. Although the available data do not permit us to identify the cause of this correlation, one possible explanation is differential pricing by the long-distance carriers. That possibility has implications for regulatory analysis of the interLATA market.

44. We also computed the standard deviation for the entire sample. Using the entire sample, the standard deviation for the big three IXCs was ten times the size of the standard deviation for Verizon (0.1 cents versus 0.01 cents).

45. For a discussion of how the incentive to eliminate double marginalization leads to price reductions when a BOC enters the in-region interLATA market, see Hausman, Leonard & Sidak, *supra* note 39.

46. *See* Robert W. Crandall & Jerry A. Hausman, *Competition in U.S. Telecommunications Services: Effects of the 1996 Legislation*, *in* DEREGULATION OF NETWORK INDUSTRIES (Sam Peltzman & Clifford Whinston eds., AEI-Brookings Joint Center for Regulatory Studies Press 2001); Jerry A. Hausman, *Mobile Telephone*, *in* 1 HANDBOOK OF TELECOMMUNICATIONS ECONOMICS 564 (2002).