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Introduction[1]

In the past several years, telecommunications regulation has been transformed. The FCC and many states have moved away from rate of return regulation, and have lightened the regulatory burden on firms under their jurisdiction. Although rate of return regulation is dying out, incumbent LECs are likely to face regulation in other forms for years to come. The economic costs imposed by this regulation are vitally important to the regulators, public interest groups, and the firms themselves.

Although the regulation of the $200 billion per year telecommunications industry is a high-stakes game, surprisingly little work has been done to measure the dynamic effect of regulation on the market. In the academic study of regulation, the majority of the literature focuses on the static question of "getting the prices right." Much less attention has been given to the ways regulation distorts incentives to innovate and introduce new products. In particular, although industry observers and researchers agree that regulation hinders innovation and the introduction of new services, few statistical studies have attempted to quantify the effects. This study does exactly that, addressing such questions as:

- How much is the introduction of a service delayed by regulation?
- By how much does alternative regulation (such as price caps) increase the rate of innovation and introduction of new services?
- What is the value to the telecommunications carrier of moving to alternative regulation?

In this study I use data from three different spheres of regulated telecommunications activity: federally regulated advanced telecommunications services, federally regulated access services, and local services regulated at the state level. In each case I find that stricter regulation hinders the innovative process whereby new telecommunications services are created and introduced to subscribers.

[1]I acknowledge the support of many people at Ameritech, LECG, and the University of California, Berkeley, without which this study would not have been possible. At Ameritech, I thank in particular Ken Dunmore, and also Gary Adams, Nancy Gallois, Richard Kolb, Terry Larkin, Carole Mailander, Kristin Schulman, and Karl Wardin. At LECG I thank Hilah Geer, Jim Green, and others. At UC Berkeley I thank my advisor, Richard Gilbert, and members of my oral examination committee: Joseph Farrell, Robert Harris, Michael Katz, and Daniel McFadden. Finally, I thank Larry Strickling (now with the FCC) for initially approving this project. The project was funded by Ameritech through LECG; the opinions expressed herein are my own.

Part I
The Comparably Efficient Interconnection Regime: Enhanced Services and the Removal of Structural Separations Requirements

The RBOCs and AT&T have introduced enhanced services integrated with their networks (such as protocol conversion, voice mail, and audiotext information services) on a restricted basis since 1987. During much of that time, the FCC required assurance, via a lengthy approval process, that the carriers were not taking advantage of the monopoly power they enjoyed over their network elements. The approval process begins with the submission of a proposed plan to offer competitors "comparably efficient interconnection", or CEI, to the network. For a few years around 1992–1995, however, such detailed plans and time-consuming approvals were not required. The carriers promised to abide by the conditions of FCC-approved open network plans and were allowed to introduce new enhanced services with no more oversight than that for any other service.

There is reason to suspect that carriers found it more attractive to introduce new services in this interim of lighter regulation. The removal of the CEI plan requirement substantially reduced the cost of introducing a new service. The CEI plans required significant amounts of technical and legal staff time to develop. Once proposed, they typically went through several rounds of public comment and rebuttals, each round but the final resulting in the FCC requesting changes to the plans. The average delay time for CEI plan approval is over 200 days. There are undoubtedly otherwise-profitable services that are not profitable to introduce under the CEI regime, which my analysis bears out.

A. History of the Comparably Efficient Interconnection Regime

In the mid 1980s, important changes in the legal environment opened the doors for regulated carriers to begin offering enhanced services. Before 1986, the industry was under a requirement of structural separation: AT&T or any RBOC wishing to offer enhanced services to its customers was required to form a separate subsidiary to do so. The rules established under the Modified Final Judgment (MFJ) and the FCC's Computer II decision erected a wall between the monopoly segment of the industry and the competitive segment of which enhanced services were a part. Through the Computer III series of orders (1986–1988), the FCC allowed the wall to be pierced.

Computer III established a long-term goal, Open Network Architecture (ONA), and a short-term plan, Comparably Efficient Interconnection (CEI), to open the network to

competitors.[2] The purpose of these orders was to encourage AT&T and the RBOCs to offer access to individual elements of the network to enhanced service providers (ESPs). To entice them to do so, the FCC presented a carrot: the regulated companies would be allowed offer enhanced services themselves on an unseparated basis. To gain the FCC's approval to offer an enhanced service, a carrier had to fulfill two requirements. First, it had to develop a plan for the service to abide by certain non-structural safeguards. The "CEI plan" allowed ESPs comparable interconnection to the elements of the network used by the particular enhanced service. Each proposed service necessitated a new CEI plan. Second, the carrier had to develop a longer range plan to open up the rest of their network by offering all the individual "building blocks" of the network to all customers (the ONA plan). After a carrier's ONA plan was approved, the requirement of structural separations would be lifted altogether, and individual CEI plans would no longer need to be submitted for each new enhanced service.

When the FCC first established the ONA/CEI schema it was an empty promise to the RBOCs because the information services ban under the MFJ was still in effect. However, Judge Harold Greene lifted the ban on gateway services (allowing transmission but not content-based information services) in September 1987[3] and the RBOCs began to submit CEI plans shortly thereafter. The first CEI plans were submitted by the regulated carriers in late 1987.

In June 1990, the "California I" decision by an appellate court[4] vacated the Computer III orders, requiring the FCC to disallow development and introduction of new enhanced services (although carriers were allowed to continue to offer existing advanced services).[5] Waivers were permitted during this time. The FCC strengthened the safeguards that were criticized in the California I decision and resumed the CEI regime in February 1992.

In 1992 and 1993, the RBOCs individually received final approval of their ONA plans and a waiver of all structural separations requirements, which granted the freedom to offer enhanced services without filing CEI plans.[6] Before the lifting of structural separations (1987–1993), 29 CEI plans for new services were approved. Including waiver requests and amendments, 47 plans in all were submitted during that time.

In October 1994, the Ninth Circuit Court found that the FCC had, without adequate justification, approved ONA plans without requiring "fundamental unbundling" as originally intended. The Court forced the FCC to remand its Computer III rules and to reinstate the CEI plan requirements. In January 1995 the FCC issued a waiver order allowing the RBOCs to continue to provide existing enhanced services on an integrated basis. However, they were required to file CEI plans for services that did not have them pursuant to

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[2]This section draws from Chapter 12 of G. Brock, *Telecommunication Policy for the Information Age* (Cambridge: Harvard, 1994) and Chapter 6 of I. Vogelsang and B. Mitchell, *Telecommunications Competition: the Last Ten Miles.* (Cambridge: MIT Press, 1997).
[3]Judge Greene lifted the remaining portions of the information services ban on July 25, 1991.
[4]California v. FCC 905 F.2d 1217 (9th Cir. 1990).
[5]CCB MO&O DA 90-980, 5 FCC Rcd 4714.
[6]Ameritech was granted a waiver of structural separations requirements June 15, 1992 (7 FCC Rcd 4104).

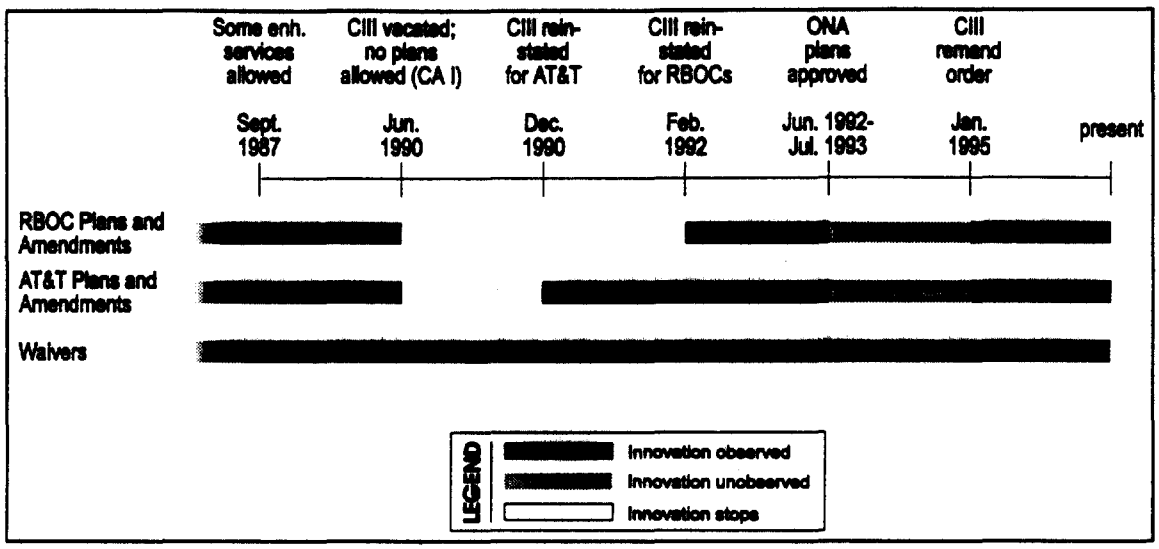

Figure 1: Enhanced Services Innovation Timeline

the regime in effect before the lifting of structural separation. Thus the RBOCs had to file CEI plans for all new services introduced after structural separations were lifted, providing an enumeration of new enhanced services during the remand period. The RBOCs filed retroactive CEI plans for 27 new or amended enhanced services. Thereafter, the CEI plan requirement has remained in effect for the RBOCs to the present time.[7] The RBOCs have filed 31 plans and waivers from 1995 through the end of 1997.

Figure 1 depicts the CEI regime, visually summarizing the history recounted above. The timeline shows when enhanced services were being developed and introduced by carriers and the activity was observable through CEI filings (the black areas), when enhanced services were being developed and introduced but the activity was not observable until a later date (the gray areas), and when development and introduction were not allowed (the white areas).

B. New CEI Plan Filings

Data

Data on all CEI plan filings and waiver requests from 1987 through 1997 were collected from the FCC Record (see Appendix 4). The CEI plans, amendments, and waivers provide a record of new enhanced services that AT&T and the RBOCs wished to introduce on an unseparated basis during that time.[8] During the interim from 1993 to 1995, when CEI plans were not required, there is no way to track the introduction date of

[7]The Telecommunications Act of 1996 did not change the CEI requirement.

[8]By using filings as a record of new services, I will necessesarily be counting only those services that are considered by the company to, first, have a chance of being approved, and, second, be worth the cost of going through the regulatory process.

Table 1:
New Enhanced Services Introduced Through CEI Plans, Amendments, and Waivers

Carrier	Initial CEI Regime (1987–1992/3)	Structural Separation Lifted (1992/3 – Jan 1995)	Remand – Back to CEI Regime (1995–1997)	Total
Ameritech	2	6	7	15
Bell Atlantic	11	1	4	16
BellSouth	6	3	4	13
NYNEX	3	2	4	9
PacBell	8	6	1	15
SWBT	4	3	9	16
U S West	2	7**	2	11
AT&T*	11	-	-	11
Total	*47*	*28*	*31*	*106*

* The FCC treated AT&T differently from the RBOCs after 1991. New services by AT&T after 1991 are not included in the data set, to preserve comparability.
** Includes a waiver filed during the interim.

new services. However, after the Computer III remand, CEI plans for services introduced during the interim were filed en masse, so one can count new services in retrospect. After the interim, CEI plans were again filed as new or amended services were introduced. Since each enhanced service required either a CEI plan or a waiver, this data set encompasses all enhanced services offered by AT&T and the RBOCs.

To use the CEI plan filings as evidence of new service creation requires care. I deemed an amended plan filing to be a new service only if it introduced new features or functionality to an existing service and if it was not mandated by the FCC.[9] The new services are summarized in Table 1. In all, 106 new enhanced services were introduced via CEI plans or waivers.

Methodology

The approach used here is to fit a statistical model to the service innovation data from before and after the sans-CEI plan interim and then to compare its predictions for number of services introduced during the interim with the actual number of services introduced. If we find that many more services were introduced during the interim under the loosened regime than a model fitted to data produced under a tighter regime predicts, then the difference is evidence consistent with the hypothesis that the lifting of structural separation requirements spurred the introduction of new services.

[9]At times the FCC requires a new CEI plan to be submitted to address concerns it has. There is typically nothing new about the telecommunications service itself in such amendments (the 1997 payphone filings were included, however). Similarly, if a plan was filed because functionality of a service was reduced, this was not counted as a new service. Finally, if two new plans were submitted because two previously distinct technologies had converged, only one of the new plans was counted. Appendix 4 has a list of all services in the data set.

The statistical model used here is a Weibull duration model fit to the interarrival times of each type of filing (plan, amendment, waiver) by each carrier (see Appendix 1).[10] Separating the filings into group by carrier and filing type this way allows the arrival processes to differ among groups. For example, services represented by Ameritech's CEI plans may be created at a different rate than services represented by PacBell's CEI waivers.

Once we characterize the new service creation process of each RBOC using data from before and after the pre-remand interim, we can use the fitted model to predict the answer to the question: if the lifting of structural separation requirements had not occurred and the RBOCs were required to continue to submit CEI plans for new services, how many would we expect them to have submitted during the interim? One way to do this is to calculate the statistical expected (average) number of service innovations during the interim using the model fitted to the data from before and after the interim. If in fact the reduced burden of regulation during the interim speeded up the introduction of new services, then we should expect that our prediction will be lower than the actual number of services introduced. This is indeed the case, as the section on results below reports.

Results

The CEI filing data, in the form of censored and complete interarrival durations, were fit to an exponential duration model via maximum likelihood.[11] The differences among RBOCs in market size, development and marketing activities, and so forth were captured by firm-specific dummy variables. Hypothesis testing supported that there was no difference between the initial CEI regime (up to 1992) and the current one (after 1995), so the observations from both periods are pooled. This finding that innovation is comparable in the two periods lends power to the results below. If an increase in new services were due solely to exogenous technical change, then there is no reason why the periods before and after the interim would be comparable. In fact, I find that innovation picked up during the interim and then fell back to its former level when the CEI regime was reinstated.

The estimation procedure generates a predicted number of new services per year per company. From the yearly predictions in the first column of Table 2 we can predict the number of new services we would expect to see during the interim under the counter-

[10]In a few cases services were filed concurrently, yielding an interarrival time a zero. Since the Weibull model does not admit durations of length zero, these durations were changed to one-half day. Six durations were so changed.

Also, some interarrival intervals are incompletely known, or *censored*, in the data. For example, consider a service such as Ameritech's Message Delivery Service (MDS), whose CEI plan, filed in June 1995, is the first to be filed by Ameritech after the 1993–1995 interim. One does not know the true interval between the arrival of MDS and the arrival of the next-most-recent new service before MDS. During the 1993–1995 interim we have no record of exactly when new services were introduced; we know only that Ameritech introduced six new services sometime during the interim. We do know, however, that no new service had been introduced before MDS but after the CEI plans were again required in January 1995. Therefore, we can use only the information that the interarrival interval preceding MDS was *at least* as long as six months.

[11]In an initial estimation of the Weibull model, I could not reject the hypothesis that the data are exponentially distributed, so all results reported here are for the exponential model. See Appendix 3, section A.

Table 2: Predicted vs. Actual New Enhanced Service Introductions

Carrier/Variable	Estimated Yearly New Plans and Amendments*	Predicted Number of New Services* During Interim Under CEI Regime	Actual Number of New Services* During Interim
Ameritech	1.21	3.11	6
Bell Atlantic	1.57	4.06	1
BellSouth	1.17	1.75	3
NYNEX	0.75	1.56	2
PacBell	0.93	1.53	6
SWBT	1.53	3.35	3
U S West	0.67	1.74	6*
Total	*10.35*	*17.10*	*27**
Prediction Interval		*(8.0,26.9)***	

Table notes: see Appendix 3 for details of calculations.
*Excludes waivers. Waivers requests were permitted during the interim, and thus are not included in the prediction exercise.
**95% prediction interval, based on Monte Carlo prediction errors given asymptotic variance of the predictor (5.8) and the estimated intrinsic (finite sample) variance (17.1). Prediction interval chosen as the smallest interval that covers 95% of the simulated distribution.

factual assumption that the CEI regime was still in place. The interim was about two and a half years long (the length differs for each firm because the waivers granted structural separations relief were on different dates). Multiplying the figures in Table 2 by the length of the interims for each firm yields the prediction. The results are in the second column. If the structural separations requirements had not been lifted, we would expect to have seen about 17 new services introduced by the RBOCs during the interim before the remand.[12] In fact, we saw 27, or about 60% more than expected. The actual number of new services during the interim lies outside the 95% prediction interval,[13] which means that if the statistical model is correct and that incentives to innovate did *not* change during the interim, there is a less than 5% chance of observing 27 new services. Thus it is highly likely that the incentives to innovate *did* change during the interim.

The evidence presented above is consistent with the hypothesis that the added costs of regulation due to the CEI plan requirements significantly hampered the introduction of new services. Almost 1.6 times as many services were introduced in the interim of no special oversight as we predict would have been innovated under the CEI regime. This result provides evidence for the often invoked (but rarely supported) truism that regulation reduces the incentives to introduce new products.

[12]Although AT&T was included in the estimation procedure, I do not include it in the prediction exercise because the FCC treated AT&T differently from the RBOCs after 1991.
[13]The prediction interval accounts for variation from two sources: the estimation error in the predictor and the instrinsic variation of the Poisson stochastic process itself.

C. CEI Plan Approval Delay

Data

The data set also contains the time to approval ("approval delay") for each CEI plan amendment, or waiver request. Each approval delay ends in one of two ways: approval by the FCC, or withdrawal by the carrier. In no case does the FCC issue a notice in the FCC Record that a CEI plan has been rejected. Instead, the FCC notifies the carrier of what it objects to, the carrier modifies the plan, and then resubmits it. In such cases the approval delay was calculated as the time from the submission of the first plan to the final approval of the last plan; each observation has a variable recording the number of refilings to be used in later analysis. The approval delays were sizable: of the 64 completed delays[14] (i.e., spells ending in final approval or rejection) the average was around 190 days and the longest (AT&T SPECS waiver) was 22 months. Of the withdrawn plans and ongoing delays, the observed delays average 275 days. The longest ongoing delays (as of December 1997) are two CEI plans (Fast Packet and Internet Access) Ameritech first submitted in March 1995.[15]

Other variables collected for each observation (when available) attempt to capture heterogeneity across services. Along with the number of refilings, I also tracked whether a plan is an amendment of a previously approved plan, and whether it is a "me too" filing.[16] One expects that delays will be longer the more complex the issues underlying the CEI plan and the number of interested parties that are affected. I also proxy these characteristics of a plan by counting the number of pages in the FCC record reporting the approval and by the number of interested parties submitting comments for the public record.

Methodology

The same statistical methodology used for the new service creations suffices for the approval delays. In this case the Weibull duration model is fit to the approval delays. Plans that are not approved but are withdrawn by the carrier are marked as censored observations; whatever the true time to approval would have been, we know that it is *at least* as long as the observed time until withdrawal. Similarly, delays ongoing as of the end of the sample period (December 1997) are marked as censored.

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[14]In this analysis I will exclude the *en masse* filing in February 1995 for the services from the interim period. The FCC approved all CEI plans at the same time (except for Ameritech's Fast Packet and Internet Access); it is an exceptional event.

[15]These two services have not been approved because of a disagreement between the FCC and the company concerning the classification of an underlying service as basic or enhanced. These cases highlight that one should not necessarily assign blame for the "approval delays" to the FCC– if Ameritech agreed to the FCC's position it is probable that the services would have been approved by now. The fault for the delays lies most directly with the regulatory regime itself; it is the regime that necessitates such arguments over arbitrary classifications. These service were not included in the statistical exploration of the delay (see previous footnote).

[16]A "me too" filing is a CEI plan that is substantially similar to a previously approved plan filed by another carrier. The FCC rules allow expedited approval for such plans.

One small change was made to the Weibull model for the estimation of delays. The statistical model explains the random part of the delay, but some of the delay time is "certain". For example, no plan will be approved within one day because the FCC allows time for public comments and reply comments before approval. Similarly, if a plan is not approved on a Friday, presumably it will not be approved over the weekend. I adjust the duration model by subtracting the number of certain delay days from the total delay times (see Appendix 1). Since we do not know exactly how many certain delay days there are, I treat it as a parameter, common to all observations, to be estimated. It is reported with the results in Table 3 as "minimum delay."

Results

I find that several variables have statistically significant effects on the approval delay. As reported in Table 3, amendments of previous plans are approved in 46% less time than the normal delay and waiver requests are approved 45% slower than otherwise. "Me too" filings are approved in 29% less time than other plans. Neither of the variables proxying the complexity of a plan (number of refilings and number of pages in the FCC Record reporting the approval) are statistically significant, although both have the expected sign. Every extra page in the Record means 1% longer approval delay. Each additional interested party lengthens approval delays by 2%. Finally, RBOCs appear to have 39% shorter approval delays compared to AT&T's experience.

The estimation of the non-random part of the delays [*minimum delay (days)*] turns out to be about 20 days. This is a reasonable figure, given that comments by interested parties and such usually take a few weeks.

The estimate of the Weibull shape parameter indicates that there is duration dependence in the delays: the longer the delay lasts, the less likely it is to end the next day. I interpret this as a consequence of the unobserved heterogeneity of CEI plans. There are several long-delay outliers; some plans open complex issues that the FCC will take many rounds of questions and public comment cycles to resolve to their satisfaction. The longer the delay, the more likely that the FCC has stumbled across a "sticky issue" that will drag out approval even more.

D. Conclusion

The results of this part of the study illustrate the two ways that relaxed regulation benefits consumers of telecommunications services. First, many more new advanced telecommunications services were introduced when the CEI regime was suspended — 58% more. One can conclude that the restrictive and onerous requirements of the CEI regime prevented many services from being introduced. Consequently, hundreds of millions of dollars of benefits could have been lost by consumers while the CEI requirements were in effect.

Table 3: Weibull Regression Results – CEI Plan Approval Delay

Variable	Coefficient (Standard Error)	Change in Average Delay***
intercept	5.490 (0.249)**	—
amendment	-0.573 (0.269)*	-46.3%
waiver	0.370 (0.169)*	44.8%
me too	-0.336 (0.185)	-28.5%
refiled	0.334 (0.281)	39.7%
RBOC (vs. AT&T)	-0.493 (0.222)*	-38.9%
approval pages	0.011 (0.016)	1.1%/page
commenters	0.018 (0.011)	1.8%/party
minimum delay (days)	20.883 (8.274)*	—
p (Weibull shape parameter)	1.954 (0.240)**	—
Average predicted delay (minimum + random)	193.0	
Observations	64	

* Significant at the 5% level.
** Significant at the 1% level.
*** Change in average stochastic delay. Weibull mean is $\exp(x'\beta)\Gamma(1/p)/p$

The second effect of suspending the CEI regime, the avoidance of the long delays associated with approval of a CEI plan, meant that not only did consumers have more new services from which to choose, but each new service became available much faster. The average predicted delay under the CEI regime was almost 200 days. Adding this delay to the wait associated with tariffing any underlying basic services can push the time to introduction to over a year. The elimination of these long introduction delays no doubt contributed to the RBOCs' decisions to introduce more services, to the benefit of consumers and the companies alike.

Part II
Price Caps and New Services in the Federal Access Tariff

Since divestiture in 1984, each RBOC has been required to submit an annual tariff to the FCC listing the rates for all federally regulated telecommunications services. The services fall into three main categories. One category comprises switched access services provided to interexchange carriers. These services allow long distance carriers to connect to the local switch at both ends of a long distance call. The FCC spells out in detail the switched access services it allows the RBOCs to offer, and any new service requires either a rulemaking or a "Part 69 waiver", both of which take much time and expense. The second category contains special access services, which allow high-volume customers to connect to IXCs directly without routing through the local switch. Typically the IXC purchases the special access service from the RBOC and then offers the direct connection to its high-volume business customers. In many cases, a service in the first category is technologically *identical* to a service in the second category; the distinction is due to regulation and not the technology. The third category includes all other federally regulated services, which might pertain to data services, collocation options, or database services.

Any new service that the RBOC wishes to offer must first be added to its federal tariff. The RBOC is required to submit detailed documentation on cost and demand to support its proposed price. After a minimum delay period, during which the FCC can suspend the process (on its own motion or by request of the RBOCs competitors), the addition to the tariff becomes effective. If the new service belongs in the switched access category, it can only be added to the tariff if the FCC waives its rules spelling out what can and cannot be offered (a waiver of 47 CFR Part 69) or implements a rulemaking to change those rules. The RBOC usually files for a waiver, because it is quicker, and its rivals will often request a rulemaking, to slow down the whole process.

In 1991 the FCC switched from traditional rate of return regulation to price caps. Many economists argue that price caps speed the introduction of new technology by allowing firms to retain as profit a greater part of the economic benefit created by the service.[17] Indeed, the FCC designed its price caps so that new services are not included in the cap in the first year of introduction, to allow even greater appropriation of the benefit.

[17] E.g., L. Cabral and M. Riordan, "Incentives for Cost Reduction Under Price Cap Regulation," *Journal of Regulatory Economics* 1, 133-147 (1989).

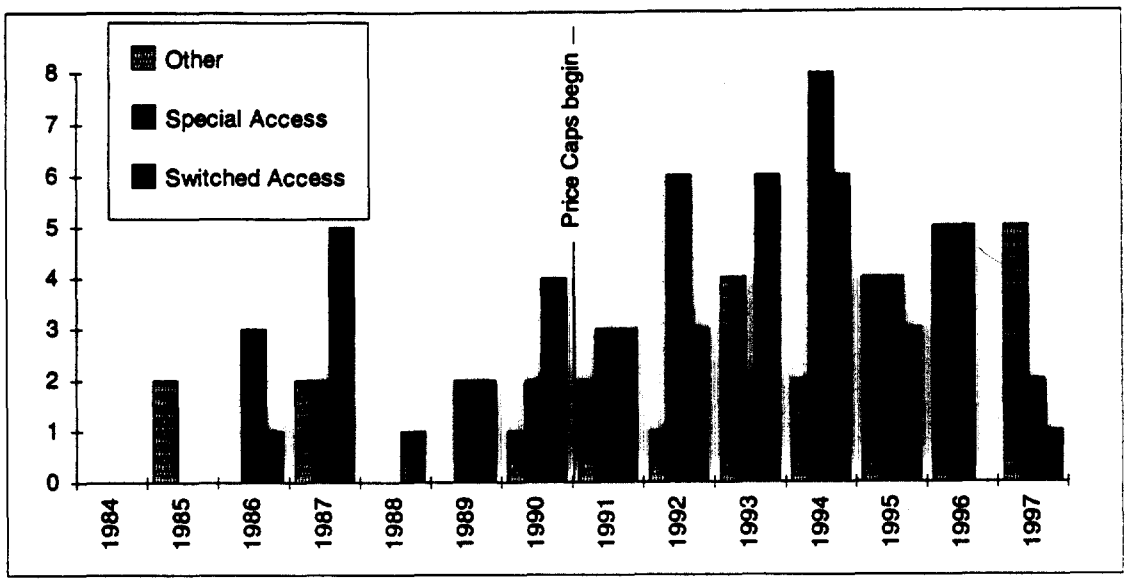

Figure 2: New Access Service Tariff Filings by Ameritech

A. New Tariff Filings

Data

In this part of the study I examine new access services introduced by Ameritech in its operating territory, the Great Lakes region (Illinois, Indiana, Michigan, Ohio, and Wisconsin). Ameritech provided me with access to all of its tariff filings since 1984 (the advent of the consolidated tariff). These tariff filings are part of the public record. From January 1984 to June 1997, Ameritech filed 1,107 tariff revisions with the FCC. From these tariff revisions I picked out all the filings pertaining to new service offerings. Since no new access service can be offered without a filing, I have a complete record of all new access services since 1984 (see Appendix 5).

Ameritech filed tariff revisions for 284 new access service offerings. This figure includes 163 individual case basis (ICB) filings, which are one-of-a-kind deals put together for a single customer. Most of the ICBs are for the provision of DS3 high-capacity special access lines, before their inclusion as a standard tariffed service in 1989. The figure does not include special construction items (e.g. telecom services provided for the 1996 Democratic National Convention in Chicago) or non-access services (e.g., interstate intraLATA local message transport services). Because I want to count truly new services, and not new customers for existing services, I remove all ICBs from the data set. Removing filings that are merely resubmissions of previously rejected filings, filings for existing services offered in new areas, and filings of new pricing options for existing services (all of which are filed as "new services" under FCC rules) leaves 102 new service filings. The timing of these new services is charted in Figure 2.

Table 4: Exponential Regression Results -- Federal Access Tariff (Service Innovation)

Variable	Estimated Coefficient	Standard Error	Average Estimated Arrivals per Year (per Category)
intercept	5.652**	0.200	1.28
price.cap:other services	-1.016**	0.289	3.54
price.cap:special access	-1.281**	0.271	4.62
price.cap:switched access	-0.971**	0.292	3.39

Total New Services / Year	Estimated	Actual
Before Price Caps	3.85	4.55
After Price Caps	11.54	13.64

Notes: Dependent variable is the length (in days) of time between federal access tariff filings, individually within in each category (switched, special, other). Scale parameter λ modeled as $\exp(-x'\beta)$. Observations represent 102 new services. "Total New Services/Year" calculated from theoretical average using estimated coefficients. See Table 3 for additional notes.
**Significant at the 1% level.

Methodology

Again I use a Weibull duration model fit to the interarrival times of each type of filing: switched, special, and other (see Appendix 1). Separating the filings into groups by filing type this way allows the arrival processes to differ among groups. To determine the effect that switching to price caps had on the creation of new services, I include a dummy variable for the price cap era for each individual filing type. This specification allows price caps to impact each category of services differently.

Results

In an exploratory data analysis phase, I experimented with various covariates that could affect the rate of new service creation. Economic variables included total real personal income in the Great Lakes region (to measure the level of economic activity in Ameritech's territory), per capita real income (which might affect household demand for telecommunications services), and number of telephone lines of various types (business, residential, etc., which might proxy for the size of the market). None of these variables was statistically significant. Although they probably have real effects on the arrival rate of services, the effects are not identifiable with this short time series. In any event, such variables would be most important for distinguishing among RBOCs. Since my data are all from Ameritech, they are not as important. I do not include these economic variables in the results below, to avoid using up degrees of freedom. The lesson here: the increase in the number of new services cannot be explained away in these data by economic variables other than regulation.

Hypothesis testing indicates that simplification to the exponential model is permissible. Results in Table 4 are for the exponential model. The intercept represents the period before price caps, and the "price cap:category" variables represent the changes after price caps, individually for three classes of services (switched access services, special access services, and others). I did not include dummies for the service categories before price caps because analysis in the exploratory phase indicated it was not necessary.

Each of the estimated coefficients in the model is highly statistically significant, as shown in Table 4. Given the validity of the postulated model, the chance that price caps had no effect on the number of new services is less than one percent for each service category.

A final column helps to interpret the coefficient estimates by giving the average number of arrivals expected per year for each category. The effect of price caps is greatest on special access services (3.3 additional services per year, compared to before price caps), and least on switched access services (2.1 additional services per year). Other access services gain 2.3 additional services per year in the price cap era. It is not unexpected that switched access services benefit the least from price caps, since they still faced the formidable Part 69 waiver process in the price cap era. Altogether, the model estimates that moving to price caps increased the average number of services introduced by almost eight per year (from 3.9 to 11.5), which matches well the actual observed increase of nine per year. Price cap regulation clearly spurred many new services to be introduced, to the benefit of consumers.

B. Tariff Approval Delays

Data

The access tariff data set also contains the effective date of the tariff, so that the approval delay can be calculated. Until the passage of the Telecommunications Act of 1996, a tariff filing for a new service was generally not eligible for approval until 45 days after submission.[18] Delay in excess of this minimum was caused by staff investigation of the tariff and the public notice and commenting cycle. After February 1997 new services could be tariffed 15 days after submission under new expedited approval rules. The average delay for all services over the entire period was 72 days, the median was the minimum 45 days, and the maximum was 771 days. Switched access services took longer to approve on average (103 days), about twice the average delay of special access services.

There are also available characteristics of each filing: the number of rate elements in the filing, the number of tariff pages changed by the filing, and number of pages composing the filing. These will be used as proxies for the unobservable complexity of the filing.

[18]Exceptions were some individual case basis filings and services mandated by the FCC, which were approved sooner than 45 days.

Methodology

The actual analysis was performed on adjusted delay periods, which have the non-random parts of the delay (the minimum required regulatory delay days) removed. Removing the minimum required delay days leaves 60 observations with an adjusted delay of zero, which means that these services were approved with no more than the minimum mandated delay.

A simple Weibull process is inappropriate here; there is no chance of observing a zero delay in a Weibull or exponential model. To extend the Weibull model for such cases I use a *selected for delay* model (see Appendix 1). In this model each tariff filing is first "selected" to be delayed or is approved without delay (beyond the regulatory minimum). Selection of filings is a function of observable characteristics of the filing, the regulatory regime, and a normally distributed random component. Those filings selected for delay then enter a Weibull duration process to determine time remaining until approval.[19] The selection equation is a probit model and the duration parameters can be estimated separately with the usual Weibull or exponential model.

Results

The results are in Table 5. In the first-round probit selection model, tariff filings are chosen to be delayed or not. A dummy variable for the price cap regime was significant; the average probability that approval would be delayed fell from roughly 0.72 before price caps to 0.24 in the price cap era.[20] In the second round, those filings selected for delay enter a duration process to determine the length of the delay. Anticipated delays were shorter in the price cap era. Combining the selection and the delay results, expected delay time fell from 107 days before price caps to 40 days after.[21]

To interpret the effects of the other covariates, note that negative coefficients in the probit model mean that a variable has the effect of making a service *less* likely to be delayed. Similarly, in the second-round exponential model, negative coefficients mean that a variable has the effect of shortening the expected delay of a service. For example, the positive coefficients on switched access services in both rounds show that they are delayed more often and longer than special access services (the excluded dummy variable). Of the variables proxying for the size and complexity of the filing (number of rate elements, changed tariff pages, and filing pages), most of them appear to have no statistically significant effect.

[19]The error in the selection equation is not deemed to be correlated with the subsequent duration process.
[20]The probability of delay is $\Phi(x'\beta)$, where Φ is the normal cumulative density function. Probabilities calculated as average fitted probability from the probit estimation.
[21]Figures calculated as average fitted probabilities from the probit and exponential estimations.

Table 5: Estimation Results for the Federal Access Tariff Approval Delay Process

	Probit Selection Equation	Exponential Delay Process	
Variable	Estimated Coefficient (Standard Error)	Estimated Coefficient (Standard Error)	Change in Average Delay
Intercept	-0.4800	4.2881	
	(0.4032)	(0.6117)**	
Price Cap	-1.1100	-1.3140	-73.1%
	(0.3337)**	(0.4235)**	
Switched Access	0.7703	0.3301	39.1%
Services	(0.3610)*	(0.4478)	
Other Services	0.7578	-0.2908	-25.2%
	(0.4016)†	(0.5433)	
No. of Rate Elements in	0.0016	-0.0030	-0.3%
Filing	(0.0039)	(0.0022	per element
No. of Tariff Pages	0.0287	-0.0134	-1.3%
Changed by Filing	(0.0146)†	(0.0089)*	per page
No. of Pages in Filing	-0.0049	0.0503	5.1%
	(0.0156)	(0.0195)	per page
Dependent Variable	0 = Filing not delayed 1 = Filing delayed	Adjusted delay days (delayed services only)	

Notes: Excluded category dummy is Special Access. See Table 3 notes for "change in average delay".
† Significant at the 10% level.
* Significant at the 5% level.
** Significant at the 1% level.

C. The Welfare Effects of Price Caps

The price cap regime appears to have reduced both the incidence and the duration of approval delays. Both the probability of immediate approval and the speediness of approval when delayed improved during the price cap regime. One would like to estimate the incremental welfare that consumers received from these changes. Consumer surplus from new services is often very large, because the incremental (gross) benefit from a new product is the entire area under the demand curve up to the quantity purchased. Unfortunately, it is not possible to estimate directly consumer surplus from all these new services. These services, because they are new, have been in the market for a short time only and the data do not exist for demand curves to be estimated for all of them. Although one cannot directly estimate the surplus consumers enjoy, one *can* provide a lower bound to the gross benefits accruing to consumers by looking at their expenditure. For example, if consumers spend $5M on a new service in a year, then we know that the benefits they enjoyed from the service were *at least* $5M, and potentially much larger.[22]

[22]For one particular family of demand functions (isoelastic), the relationship between consumer surplus and revenue to the firm is even closer: the two are proportional. More generally, movements in revenue may give clues as to movements in consumer benefit.

One factor complicating this approximation of consumer welfare is that the customers buying these services are often other telecommunications carriers, such as interexchange carriers (IXCs). IXCs use access services as an input to produce an end-user service. To use expenditure on the new services as a proxy for gross consumer benefits requires an assumption that any cost savings or service improvements accruing to the IXC flow through to end users. This assumption will hold when the final end-user market is perfectly competitive. The assumption will also hold when the intermediate input service enables a new end-user service (e.g., a video access service that enables long distance teleconferencing). In this case, consumer expenditure on the new end-user service will be at least as great as the expenditure on the input by the IXC (the IXC will at least cover its cost of inputs), so expenditure on the input service is still a valid lower bound to incremental gross consumer benefits from the new service.[23] It is important to note that in many cases consumers of special access services are high-volume end-users themselves, for whom this caveat does not apply.

To measure the impact of the change in terms of expenditure, I did a simple exercise. Given the service innovation and approval delay processes as estimated above, what is the expected value of spending by customers on new services spurred by the switch to price caps? Such spending increases after price caps for three reasons: first, more services are introduced; second, fewer approvals are delays (beyond the minimum mandated delay); and third, approvals that are delayed are delayed shorter amounts of time.

For the exercise, I assume that customer expenditure per year from a new service is $1.68M. This figure is the average projected first-year revenue from a new service, as reported in the tariff transmittal supporting documentation sent to the FCC by Ameritech. I use this figure for expenditure each year after introduction of a service in the exercise. Given the estimated models, the expected expenditure (and therefore the lower bound on gross consumer benefit) under the counterfactual assumption that price caps were not implemented during the 1991–1997 period is $120M for the 6.5 year period.[24] Under the (factual) assumption that price caps were in place during that time, expected spending is $391M for the period. The difference, which may be attributed to the onset of price caps, is $271M for the period, or $42M per year. Thus, by the argument above, consumers making this expenditure valued the incremental benefits from the new services at more than $42M per year.

[23]If the new service is used as an input by IXCs merely to offer an existing end-user service in a cheaper way, *and* the end-user market is not competitive, then some of what I label here as "consumer benefits" may accrue to the IXC.

[24]I do not discount revenue in this simple calculation. Furthermore, the revenue/year is only an approximation, since it is based on first-year revenue projection. In some cases revenue will fall after the first year, but in many cases it will continue to grow as the market for the service expands. See Appendix 2 for the mathematical details of the exercise.

D. Conclusion

These results from the investigation of federal access tariff services highlight the benefits stemming from lighter forms of regulation. The model estimates that moving to price caps almost tripled the number of services introduced per year. No doubt part of the reason for the surge in new offerings is that expected approval delay times fell by over 63% (from 107 days before price caps to 40 days after); quicker time to introduction makes a proposal to introduce a new service more attractive. Gross consumer benefits from the change to price caps are estimated to be at least $42M per year during the study period.

Part III
Alternative Regulation at the State Level: Opportunity Indiana

After years of rate of return regulation, for the last three and a half years Ameritech Indiana has operated under an alternative form of regulation, Opportunity Indiana. One of the important provisions of Opportunity Indiana is that new services may be introduced with a minimum of regulatory delay. Opportunity Indiana reduced the cost of introducing a new service by decreasing the amount of supporting material required with a filing and by hastening approval of the filing. There are undoubtedly services that are profitable to introduce under Opportunity Indiana that were not profitable to introduce under the prior regime, and we should expect to see the number of new services increase.

This part of the study tests the effects of Opportunity Indiana on the pace of service innovation and the speed of tariff approval. The goal is to discern which factors helped or hindered these processes, and to quantify the impact of Opportunity Indiana on new service introductions.

A. New Tariff Filings

Data

Ameritech Indiana provided data on new tariff filings in Indiana for the three-year periods before and after the start of Opportunity Indiana (see Appendix 6). The data include all tariff filings for new services filed between July 1991 and June 1997. In this section I again take the filing date of the tariff for a new service to be the date of innovation. In the three years before the start of Opportunity Indiana (July 1994) tariff filings were received for 13 new services. In the three years after July 1994, there were 38 tariff filings for new services (Figure 3). All filings were eventually approved.

Methodology

Again I use a Weibull duration model fit to the interarrival times of the tariff filings. To determine the effect that Opportunity Indiana had on the creation of new services, I include a dummy variable for the Opportunity Indiana era (July 1994 – June 1997).

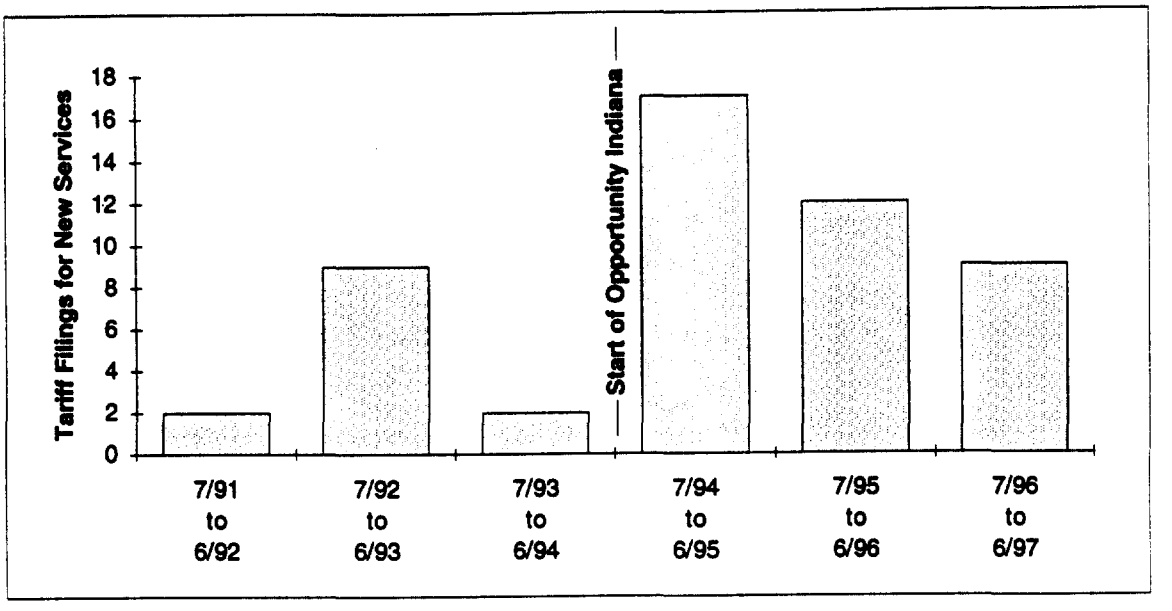

Figure 3: New Service Tariff Filings by Ameritech Indiana

Results

Estimation of the Weibull interarrival model indicates that simplifying to the special case of the exponential distribution is not appropriate, so the results presented here will be based on the Weibull model. The central result is that the increase in new service filings during Opportunity Indiana appears to be a result of the change in regulation and cannot be explained away by changes in other economic and demographic variables alone.

Table 6 contains the results from estimation. The predictions from the estimated model match the data well. Opportunity Indiana triples the number of new services predicted by the model. This matches the observed tripling of new services that actually occurred. The prediction interval for the period before Opportunity Indiana does not include the 38 services actually seen in the Opportunity Indiana period. Thus there is little chance of

Table 6: Estimation Results for the Service Innovation Process in Indiana

Time Period	Predicted Number of New Services (Yearly)	Predicted Number of New Services (3 Years)	Actual Number of New Services (3 Years)
July 1991 - June 1994	3.9	12.6	13
prediction interval		*(0,22)*	
July 1994 - June 1997	11.7	37.7	38
prediction interval		*(18,58)*	

Notes: Prediction intervals are based on Monte Carlo prediction errors, and are chosen as the smallest interval that covers 95% of the simulated distribution.

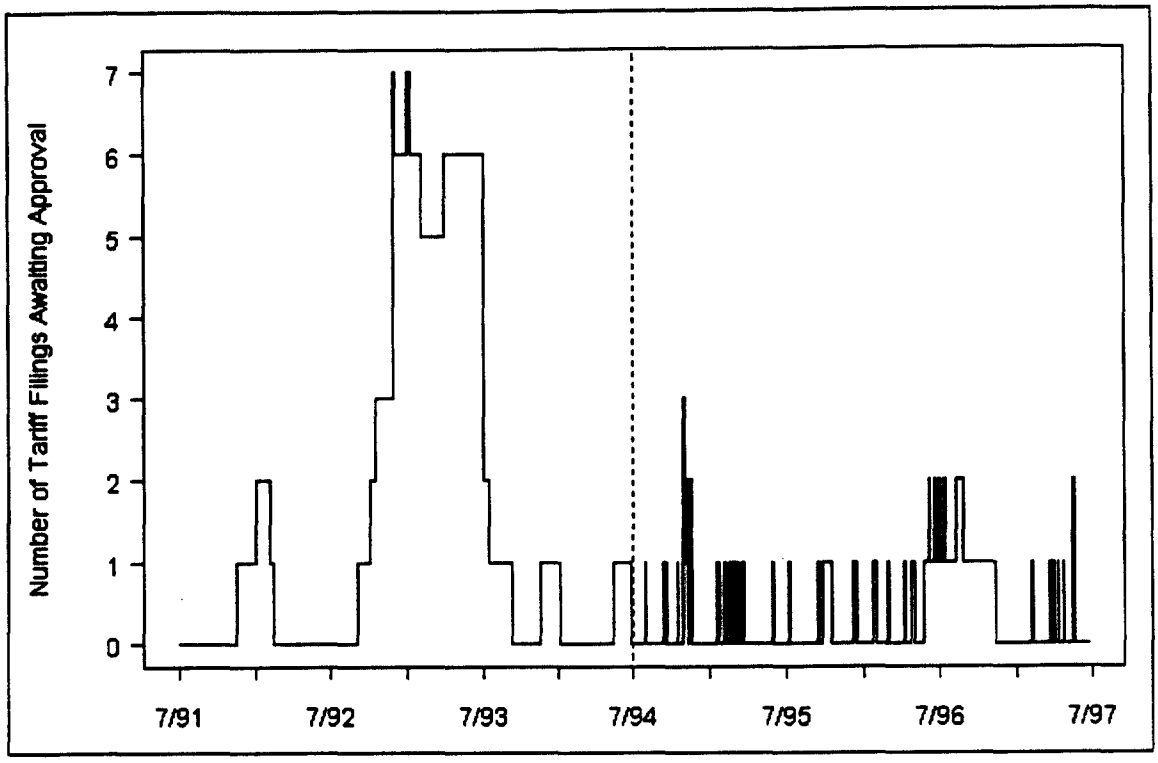

Figure 4: Number of Ameritech's New Services Awaiting Approval in Indiana

observing that many services given the innovative process in place prior to Opportunity Indiana. Therefore there indeed appears to be a true change in innovative activity in the Opportunity Indiana era.

Other economic and demographic variables were not found to be statistically significant (see Appendix 3, section C). I tested the following variables for influence on new service arrivals: number of telephone lines served by Indiana Bell, state population, per capita income, manufacturing, financial, and real estate industry income (to measure demand for telecommunications services), and the amounts Ameritech spent on product management, R&D, and legal services. I also separately checked for individual year effects and a linear time trend. In the present data set and model one cannot reject the hypothesis that they have no influence when Opportunity Indiana is also included as a variable. Thus the increase in services appears to be due to Opportunity Indiana and not to other factors.

B. Tariff Approval Delays

Data

The Opportunity Indiana data set also contains the effective date of the tariff, so that the approval delay can be calculated. Before Opportunity Indiana, a new tariff filing was not eligible for approval until 30 days after it was placed on the agenda of the State Commission. Delay in excess of this 30 day minimum was caused by staff investigation of the tariff before it was placed on the agenda and by further delay while on the agenda.

Table 7: Estimation Results for the Tariff Approval Delay Process in Indiana

	July 1991 to June 1994	July 1994 to June 1997
Number of Observations	13	38
Actual Approval Delay in days	average = 134 median = 126	average = 8.2 median = 3
Probability that Approval is Delayed	1.00	0.47
Predicted Approval Delay in days (ave. for period)	132.08	7.91
Predicted Approval Delay in days (ave. for period)—excluding minimum regulatory delay and weekends	72.92	4.93

During Opportunity Indiana, new services were effective one day after filing unless delayed by the commission. Average delay time is reported in Table 7. The average delay decreased from 134 to 8 days after Opportunity Indiana was put into place.

The effect of the approval delays can be starkly seen in Figure 4, which shows the number of new services submitted by Ameritech Indiana to the regulatory commission but not yet approved. Before Opportunity Indiana (the onset of which is marked by the dotted line), as many as seven services at a time were awaiting approval. For more than half a year around the beginning of 1993, no fewer than five services were stacked up in the regulatory system. After Opportunity Indiana began, the situation improved markedly. No more than three services awaited approval at any one time, and that many only briefly. This is especially remarkable given that three times as many services were being submitted to the regulator during Opportunity Indiana.

Methodology

As with the federal access tariff data, the statistical analysis was performed on adjusted delay periods, which have the non-random parts of the delay (the minimum required regulatory delay days) removed. Removing the minimum required delay days leaves 20 observations with an adjusted delay of zero, which means that these services were approved with no more than the minimum mandated delay. All of these services were in the Opportunity Indiana period.

As before, I use the *selected for delay* model. Recall that in this model each tariff filing is first "selected" to be delayed or is approved without delay (beyond the regulatory minimum). Since in this case there are no observable characteristics of filings (other than the indicator for Opportunity Indiana), I do not use a probit model but an even simpler binomial model. In the binomial model, there is a fixed probability that a filing will be delayed (I allow the probability to change during the Opportunity Indiana period). Those filings selected for delay then enter a Weibull duration process to determine time remaining until approval.

Results

Estimation of the Weibull model indicates that simplifying to the special case of the exponential distribution is appropriate in this case. The covariates here are a dummy variable for Opportunity Indiana and a variable that measures the average number of other tariffs awaiting approval during the approval delay of an observation.

The main result is that delays decreased dramatically during Opportunity Indiana. The estimated delay time dropped by 124 days during Opportunity Indiana compared with the previous period, as reported in Table 7. Also, when the regulators' case load climbs, so does the approval delay (when delay occurs). If there is one other tariff (above average) awaiting approval, the expected duration of the tariff approval increases one and a half times (in either regime).

C. Innovation and Delays: The Effect On Consumer Welfare

Combining the results of the two previous sections, we can examine the effect of Opportunity Indiana on Ameritech Indiana's service revenues. Since Opportunity Indiana both increased the number of new services and accelerated their approvals, service revenue for comparable time periods should be higher under Opportunity Indiana.

Ultimately, of course, one would like to measure increases in consumer welfare. With the present data this is not possible—these are new services for which demand cannot yet be accurately estimated. However, as explained in part II section C, one can provide a lower bound to the gross benefits accruing to consumers by looking at their expenditure. Note that with these services, the caveat pertaining to new services as intermediate goods (explained in part II.C) does not apply; these new services are not access services and are all for end users.

On the basis of figures in the tariff filings, the projected spending on new services introduced during Opportunity Indiana averages about $2.6M per year per service, which

Table 8: Estimated Increase in Customer Expenditure from Opportunity Indiana (Lower Bound on Gross Consumer Benefits)

Assumed Expenditure per Day per Service	Estimated Expenditure Before Opportunity Indiana *from new services in 3 Year period*	Estimated Expenditure During Opportunity Indiana *from new services in 3 Year period*	Increase in Expenditure from Opportunity Indiana *difference between periods*
$1,000	$6,646,720	$24,821,600	$18,174,880
$2,500	$16,616,800	$62,054,000	$45,437,200
$5,000	$33,233,600	$124,108,000	$90,874,400
$7,200	$47,856,384	$178,715,520	$130,859,136
$10,000	$66,467,200	$248,216,000	$181,748,800