through an incumbent firm's discretionary gift of unenforceable cooperation,[12] and will produce inefficient rent-seeking by entrants more interested in getting underpriced leases than in efficient competition. The worst outcome may be the one in which regulatory uncertainty persists, so that potential entrants never quite get the ability to share the incumbent's infrastructure but constantly hope to be able to, and so do not build.

Laissez-faire access reform: retail deregulation based on wholesale regulation. Besides the effects on the development of facilities-based competition, an important benefit from unbundled-element or platform competition is the possibility of what I call 'laissez-faire access reform': retail deregulation based on removal of obstacles to entry through sharing of the incumbent's network.

Ex post *analysis.* Smoothly functioning wholesale regulation permits, and indeed almost demands, retail deregulation.[13] If multiple providers can compete for a customer's business and promptly supply it at a reasonable overall cost, even if they do so by leasing the incumbent's facilities, then it would seem that prompt deregulation of all charges to the provider's end-user will be appropriate. If a carrier tries to charge too much overall to the end-user then another carrier will undercut, and by hypothesis this can happen quickly. If a carrier tries to charge a reasonable amount overall but in an inefficient manner, as, for instance, by undercharging for line rental (connection) and overcharging for usage, then (because that pricing system presumptively creates inefficiencies) another carrier can offer a more profitable alternative pricing package that is also better for the end-user. But it is important to note a major difference between this and the conventional economic advice to 'rebalance' rates: although economists can give good advice on what pricing schemes are relatively efficient and what schemes are not, the more robust lesson of economics is that of consumer sovereignty. That is, at least as competition develops, it should not be up to regulators to choose how end-users pay the cost of service—how much in flat charges, how much in usage charges, how much for special features, etc.

Implementation. If regulators continue to regulate the incumbent's retail

[12] This fear would provide one possible reason for continuing regulation, in that regulated cooperation is less susceptible to being withdrawn from a maverick competitor.

[13] By this I mean high-capacity, smoothly functioning arrangements for sharing the incumbent's network, including the so-called platform, at cost-based prices defined without reference to retail prices. Less full forms of this, such as flexible unbundling but without the platform, may or may not justify retail deregulation. Service resale of course does not in itself help here, since the prices paid by non-incumbents are based on the incumbent's retail prices.

prices and do not replicate the solution that the incumbent and the customer jointly find most beneficial, it puts the incumbent at an artificial competitive disadvantage. Thus, while there are obvious risks in premature deregulation of incumbents, there are also risks in waiting too long. Getting the timing right will not be easy for regulators. It would be surprising if the information flow and the organizational structures of regulatory agencies were optimized for this kind of challenge. Another major problem will be that, in general, provisioning of the platform or network elements will not go suddenly from 'slow' to 'immediate', so there may be an intermediate period in which either or both of the risks from wrong timing will be inevitable.

Another important implementation question will be the extent to which charges to competitors, as distinct from end-user charges, can be deregulated based on effective network sharing. This depends largely on the extent to which a carrier's charges to competitors are effectively passed through to its customers. That is a complex topic, affected by industry marketing traditions and by rules such as Section 254(g) of Communications Act, as well as by the distinction between originating and terminating charges, and possibly differing between incumbents and non-incumbents. (On the latter point, see FCC Report and Order 97-158, paragraphs 358–364.)

Whatever the details of the treatment of access, etc., the broad picture remains that retail prices could be deregulated in reliance on wholesale regulation. How valuable is this form of (semi-)deregulation? I do not think we know yet, but obviously it has its limits because it relies heavily on regulation of the prices and provisioning of 'wholesale' elements. When might we reasonably abandon it and deregulate the wholesale aspects of the incumbent's business?

Sharing and Wholesale Deregulation: Two Possible Triggers

Although allowing regulated sharing of the incumbent's network has a variety of good properties, it is not without problems and will demand continuing regulation. We should therefore think hard about when and how we can deregulate such sharing.[14]

[14] Section 10 of the Communications Act, as amended, authorizes the FCC to forbear from applying statutory provisions in light of competitive conditions, but this does not apply to Section 251 'until fully implemented'. However, Section 251(d)(2) tells the Commission, in choosing what network elements should be unbundled, to consider, at a minimum, whether unbundled access to 'proprietary' network elements is 'necessary,' and whether failure to 'provide access' would impair competitors' ability to provide service. Thus there seems to be at least some legal scope to consider the competitive implications of requiring or not requiring unbundling.

Obviously this too is a huge topic. I will limit my elf to brief discussions of two possible deregulatory triggers, or situations that might suggest deregulation of the sharing of an incumbent's facilities: bypass by a competitor and bypass or upgrade/overbuild by the incumbent itself.

Bypass by a competitor. Suppose a competitor bypasses, say, the incumbent's loop to a subscriber. Then that element is no longer a true bottleneck: there is an alternative way to get calls the last mile to and from the customer. Should this trigger deregulation of sharing of the incumbent's loop?

Ex post *competitive analysis* (that is, once bypass is achieved). Such an analysis would include contemplation of the following:

- There is now a second firm that can compete to serve the customer without leasing the incumbent's loop. Thus, even if leasing does not work at all without regulation, competition (even rapid competition) is not entirely foreclosed.
- A third firm that needs a leased loop can plausibly get one without being wholly at the mercy of an incumbent monopolist. It has two possible sources from which to lease a loop.
- If the customer can be served using only one loop, then one of the two firms with loops likely has an *idle* loop to the customer, so a third firm might well be able to get a good price on a lease.[15]
- The fact that bypass has occurred is some evidence that further bypass would be possible, so it is less likely that the third firm would somehow be subtly blocked (for instance through control of rights of way) from doing its own bypass.

Ex ante *competitive analysis*. As indicated above in Principle B, it seems useful to focus separately on incentive effects for the incumbent and for others.

Incumbent's incentives: deregulation following bypass would reward the incumbent for cooperating (for instance, in rights of way, in co-location or in number portability) with bypass. This is clearly good under the pro-bypass interpretation of the Telecommunications Act. It has good aspects under the sharing interpretation too, although this is a little less clear, since in some cases it might also give the incumbent incentives to 'encourage bypass' by hampering sharing.

Non-incumbents' incentives: I note two points here. First, as discussed above,

[15] It is worth noting, though, that the entrant would be unlikely to build if it thought that it would end up leasing to a third party at below long-run cost.

an entrant may well have stronger incentives to bypass when it knows that, should it do so, the incumbent will no longer have to lease its loop at a regulated rate. Second, with multiple (potential) entrants the rule might even create something of a race to bypass, since building a third loop will presumably be less attractive. This racing seems good if we want to drive prompt bypass; it is less clear how to evaluate it if we want to preserve efficient sharing but also efficient (and efficiently timed) bypass.

Implementation issues: naturally, implementation of any such policy contains a host of challenges; I mention just four.

- Does wireless bypass count? Congress apparently thought not yet in February 1996 (it instructed regulators to regulate sharing if voluntary negotiations fail), perhaps because wireless prices (and quality) were still not competitive with wireline. But then how much must wireless capacity, quality and/or prices change before it should count? Applying Principle A, we should not wait until prices and quality reach full parity with wireline.
- Does the presence of coaxial cable that potentially can be, but for the most part currently is not, used for telephone service, count? Applying Principle B, we ought to be willing to say it does if we confidently conclude that deregulation of the incumbent would induce cable companies to enter promptly with a cable-telephony service and stop prices rising 'too much'. (Obviously, there would be timing and scope questions to resolve here, as well as questions of how large an interim price increase we would be willing to accept.)
- How should our answers depend on the duopoly behavior we observe in such cases?[16]
- For the *ex ante* incentive effects to work at full strength, deregulation would have to come promptly upon bypass, raising the same timing questions mentioned earlier.

Again, much depends on our balance between the two views of the Communications Act's share-the-network provisions. If we aim to make sharing work as well as possible, we should be concerned that (third-firm) entrants be able to share an existing network at cost-based prices even in the long term. If, on the other hand, we view interim sharing primarily as a stepping stone to aid the gradual development of facilities-based competition

[16] In the long-distance industry, capacity is voluntarily leased to some resellers at prices that are probably fairly near competitive levels, but there are more than two facilities-based carriers: 'BellSouth said it will wind up paying "at the low end" of one cent to two cents per minute to resell AT&T's service' (*Wall Street Journal*, 1996).

and deregulation, this may be a wise place to deregulate, for two intertwined reasons: deregulation makes considerable sense once there is bypass; and such a policy likely encourages bypass.[17]

Bypass (overbuild) and divestiture by the incumbent. My second potential trigger for deregulation is a kind of bypass/upgrade by the incumbent. I have in mind, for instance, the case where the incumbent builds new high-capacity loops to some of its subscribers, leaving the old copper in place (and in good shape); or where it installs a new switch and leaves the old one 'co-located'.

One can draw fairly close analogies between advantages of incumbency that are traditionally viewed as sources of 'natural monopoly' on the one hand, and intellectual property on the other (e.g. Farrell, 1996). The interconnection provisions of the Communications Act require incumbents to share those advantages, just as intellectual property policy requires patent-holders to share their intellectual property after the patent's term expires. And, just as in intellectual property policy, this sharing is only part of the right policy: reward to investment must also be given great weight. This perspective suggests that when an incumbent creates a 'new' network element, perhaps the new one need not immediately be made available on regulated terms, provided the old one remains available to non-incumbents.

Ex post *competitive analysis*. If the improvement is relatively modest, so that the old element serves at least the stepping stone purposes of the network-sharing policies, then the *ex post* arguments for making the new element also available to competitors are considerably weaker. However, this case may be rare (why would an incumbent build a modest improvement?). If the improvement is important enough, and if there are (in the absence of regulation of sharing) important natural-monopoly characteristics, such as strong network effects and/or economies of scope, then deregulation of sharing in the new sector might re-create the bottleneck market power that today's competition policy in telecommunications works so hard to avoid. Potentially, if the improvement were great enough, the availability of the old

[17] I note, however, that my analysis assumes that the incumbent's loop is a substitute for the entrant's. This seems likely if they are indeed loops to the same customer (although there certainly are counterexamples involving demand for multiple lines with one-stop shopping). The presumption would be much less clear if deregulation were to apply to 'nearby' lines (on the grounds of administrative simplicity and/or on the argument that bypass to subscriber A makes it seem that bypass to nearby subscriber B would be possible and might be imminent—both of which, by the way, could be good arguments for extending the deregulation in that way). Then, the incumbent's loop to subscriber B might well be a *complement* to the entrant's loop to subscriber A in the entrant's competitive strategy, and the analysis would be different.

element would be only a very weak competitive force in constraining the incumbent's pricing of the new network, so *ex post* we would then have a new monopoly.

This certainly is not the end of the discussion: after all, a new monopoly is created by any drastic innovation that is not readily imitable (e.g. if it is subject to intellectual property protection), and we do not generically treat this as a strong reason to require immediate sharing of such an innovation at cost-based prices. This is, of course, because of the *ex ante* consequences (see Principle B): such a rule would gravely weaken incentives for innovation. Thus it is crucial to consider these *ex ante* effects carefully.

Ex ante *competitive analysis*. One possibility is that the prospect of an unregulated (or little regulated) *ex post* natural monopoly might induce fierce Schumpeterian competition to occupy that lucrative position. Indeed, the *ex ante* competition to occupy it first might (perhaps even inefficiently) dissipate the potential *ex post* profits. Competition 'for the market' might be fierce, even though (or rather because) competition 'in the market' would be limited. From this point of view one would concentrate attention on ensuring that all potential competitors are genuinely as well placed as possible for this Schumpeterian race: in particular, if (as seems plausible) network effects and economies of scope are initially shared as between old and new networks, one would want to ask whether the incumbent's position gives it an unassailable head start, in which case for-the-market competition would be hamstrung. (Noting this does not, of course, immediately tell us what (if anything) to do about it.)

Even if for-the-market competition were vigorous, and presumably all the more so if it were not, it might be desirable to strengthen (prospective) competition 'in the market' even if doing so may weaken competition 'for the market'. More concretely, we should consider whether or not it would be wise to require sharing of innovative (e.g. 'broadband') dominant positions after some proprietary period akin to a patent term. Or would the effect on for-the-market competition likely be more severe and more important than the in-the-market effects?

A fundamental problem here is that potential innovators may be wary of innovating before the rules are decided, because of regulatory uncertainty and more specifically because the policy trade-offs change once the innovation has been made. Therefore it would seem wise to address in advance, rather than after the fact, the policy problem of how much sharing of broadband or other innovative ILEC infrastructure should be required. As in patent and copyright policy, the trade-off between *ex ante* competition 'for the market' and *ex post* competition 'in the market' should be addressed as early as possible.

One important ingredient of that trade-off is how strong the *ex ante* competition for the market will be (for any given degree of anticipated *ex post* competition in the market). Specifically, if (for whatever reason) the incumbent has a strong first-mover advantage in broadband overbuilds, then the asymmetry of positions in the *ex ante* competition might weaken that competition to the point where it may not be worth sacrificing very much *ex post* competition for it. (In 'innovation market' terminology, if the innovation market were substantially monopolized because of a dominant position in the existing good, it would call for different innovation policies.) This would depend on a variety of factors, such as:

- whether economic 'network effects' are importantly common as between broadband and conventional networks, and, if so, to what extent today's policies succeed in making those network effects available to entrants as well as to the incumbent;[18]
- whether, in particular, standard-setting processes for broadband infrastructure and/or services would enable currently powerful players to block others' innovations;
- the ability and will of cable companies to turn their fiber and/or coaxial networks into more general broadband networks.

Ex ante *analysis*: a policy of deregulating sharing of new network elements provided the old remain available would enhance an incumbent's incentive to make such investments, and to leave the old investment in place rather than rip it out.

Such a policy would also affect non-incumbents' incentives. Leasing unbundled elements might become viewed more as a stepping stone to facilities-based competition, because a carrier who tries to rely permanently on the incumbent's facilities would risk being overbuilt out of business not only by other competitors but also by the incumbent. In other words, the contemplated policy might fit better with the 'stepping stone' interpretation than with the 'efficient sharing' interpretation; the latter would lead us to worry somewhat more about the effects on entrants' rights to share the overbuild.

Implementation: how would we ensure that the old facility is indeed maintained and made available for competition? One possible answer is that

[18] If those 'carry-over' effects are important, then today's network-sharing provisions could be seen as de-monopolization policy for the infrastructure innovation market, as well as—the more conventional view—for today's telecommunications services market, including innovation in services over today's network.

the incumbent could *divest* the old facility. Divestiture would presumably require less regulatory intervention than today's provisioning and maintenance requirements, and would increase the flexibility and entrepreneurial spirit with which the asset would be offered to the market. On the other hand, there could be problems of collusion; two is not necessarily enough for competition.

5. *Limiting the Scope of Subsidies (Principle D)*

In telecommunications, some end-users currently are charged below cost—in some cases much below cost. This kind of entitlement creates competitive problems if those subsidies are funded by implicit cross-subsidies from other users who pay above cost, or if they are funded explicitly but not all competitors are equally able to receive the subsidy. As Lawrence White has quotably noted, 'cross-subsidies are the enemy of competition, because competition is the enemy of cross-subsidies'.

Congress addressed this problem in Section 254 of the Communications Act, instructing regulators to produce a system of explicit subsidies. As instructed, in May 1997 the FCC (broadly following the recommendations of a Federal–State Joint Board) adopted a plan for such a system. It will go a long way towards addressing the problem, compared with today's system of implicit subsidies. By making large parts of the old system of implicit subsidies explicit instead, it will make it possible in principle for competition not to threaten desired subsidies, and will thus make it possible for those who desire the subsidies not to fight competition.

Nevertheless, regulators probably cannot identify and make explicit *all* implicit subsidies (and it might well be damaging to try). Even within a relatively small area, customers differ greatly in how profitable they are to serve. Thus, as long as incumbents are subject to carrier-of-last-resort obligations, they will have colorable claims that competition is at least partly inefficient 'cream-skimming'.[19]

Perhaps in an attempt to resolve this problem, Section 254(e) of the Communications Act states that only a carrier declared 'eligible' under Section 214(e) may receive the subsidy, and Section 214(e) says that eligibility requires a carrier to offer service throughout a state-defined 'service area'. (This is a necessary, though seemingly not a sufficient, condition for

[19] This problem is, of course, reduced by access reform and other rebalancing initiatives that bring prices closer to costs, and by regulatory flexibility that lets incumbents set prices closer to costs. On the other hand, it is likely exacerbated by policies that facilitate competitive entry.

eligibility.) These two subsections partially protect remaining implicit cross-subsidies by restricting the forms of competition that can receive explicit subsidies, thereby discouraging other forms, perhaps including those most threatening to the remaining implicit subsidies. Some kinds of geographic specialization are permitted: those who serve only customers within a single state, for instance, are apparently eligible. But other kinds of specialization, such as service offered only to Internet users, are ineligible. I see this as a compromise between allowing unrestricted competition and avoiding cream-skimming. As such, it inevitably compromises competition to some degree.

I am not arguing here that the subsections (e) are unwise. Rather, my point is that subsidy problems are difficult and their solutions will inevitably often be competitively troubling. Therefore I think it will be important in moving to deregulation that these broad subsidy entitlement programs be limited.

Politically, however, some entitlements may be so entrenched that a strategy that relies on eliminating them will fail. Accordingly, I want to explore the idea that we can say at some point 'The subsidy buck stops here'.

By this I mean that in defining the services to be subsidized, we should be rather slow to include 'new' services. Such a policy will remove an important obstacle to deregulating (or not regulating) those services. Moreover, as more people move to the deregulated sector because the offerings are more appealing, it will help even in limiting subsidy/competition problems in the old, regulated sector (just by reducing the size of the required subsidy fund, if nothing else). Because of this, I fear that provisions such as Sections 254(b)(2), 254(b)(3) and 254(c)(1) of the Communications Act could be very damaging to competition and deregulation if too enthusiastically interpreted.

An Illustrative Specific Proposal

Moving to specifics, I would like to propose that there is no need to subsidize second lines. A regulatory version of this proposal would involve moving the (still regulated) prices for second lines 'to cost'. I think that would be a valuable step in the right direction. However, in part because many households are wired as a matter of course with two (sometimes more) lines even if only one is initially used, it is somewhat unclear what is the right concept of 'cost' of the second line. To establish conceptually a limit on the scope of subsidy, perhaps it hardly matters psychologically what measure of cost is used.

But here is a possible test of our willingness to change the presumption of regulation: perhaps we should actually *deregulate* the provision of second

residential lines, establishing a conceptual limit not merely on subsidy but on regulation. Applying Principle A, this proposal is a little like the 'immediate deregulation option' in Section 2 above, but the trade-offs seem much less threatening because it is limited to a part of the market where (i) there is more immediate competitive discipline (so the economics may be better) and (ii) there is less reason to worry about harm to low-income or otherwise highly vulnerable consumers (so the politics are surely better; cf. Principle D); moreover, I have in mind deregulating only end-user charges, so no issues of prices to competitors (potentially implicating Principle C) need arise.

For several reasons, I doubt that the prices charged for such lines would go up very dramatically if deregulated (while first lines remain regulated). First, few households *must* have a second line. For some users, especially those who plan to use their second line for 'overflow' conversation (that is, when more than one household member wants to make calls at once), wireless would be an acceptable, and in some ways better, substitute for a second wireline;[20] at low usage levels, wireless is already not very expensive, and wireless companies already claim some success in marketing as alternatives to second lines. For some other users (who use second lines largely for data, perhaps especially Internet use), cable modems are or will be very attractive once the cable industry gets its telecommunications act together. Multi-line households will presumably be among the first to become attractive to competitors. And no doubt 'cheating' by putting a second line in a second name (thus getting the still-regulated first-line price) would often be easy.

Obviously it is possible that, despite those sources of demand elasticity, an incumbent would raise second-line prices significantly (and well above costs). But the fact that there are some reasonable alternatives might make it politically easier to overcome objections from those who want to keep subsidized rates. To get this effect, however, it would probably be important to deregulate soon, while second lines are still generally viewed as a luxury,[21] so that people feel at least a hint of shame in arguing that they must be subsidized.

Reverting to Principle A and to economists' two messages for regulators, one must note that allowing incumbents to increase the price of second lines, which probably have considerably lower incremental costs than first lines and surely have much higher demand elasticity, goes against the traditional advice

[20] This might be particularly true as wireless providers develop products that function as 'cellular' or 'mobile' phones when far from home and as 'cordless' phones when near it.

[21] FCC staff have estimated that ~15% of US households had additional residential line(s) as of December 1995, and the number seems to have been growing rapidly (Common Carrier Bureau, FCC, 1997, Table 19).

to base prices on incremental costs and to follow Ramsey on linking mark-ups to elasticities. More concretely, it will inefficiently deter households from having second lines, hurting parent–teenager relationships and slowing the growth of residential Internet use, among other things. Despite this, I think it is wise policy, partly because (Principle B) any such price increases may attract more competition, but largely for symbolic reasons: it is a feasible immediate step away from the culture of entitlement and towards the possibility of deregulation, which I believe is more important (as well as more likely to happen) than regulatory respect for Ramsey.

Acknowledgements

On May 9, 1997, I gave a speech as Chief Economist at the FCC, on prospects for deregulation in telecommunications. This article is a re-organized and revised version of that speech. I thank Glenn Woroch and Alfred Kahn for helpful comments on a previous draft; of course they are not implicated in my views nor in my attempts to be provocative. I thank Mario Bergara for research assistance and the Consortium for Telecommunications Policy for funding his assistance.

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Interconnection Pricing, Stranded Costs, and the Optimal Regulatory Contract

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Given the potential for strategic gaming inherent in network providers' reliance on their competitors for the supply of vital inputs, interconnection pricing or the setting of prices at which networks sell access to their facilities and their customers to other networks has become a critical issue in the design of policies to promote competition in telecommunications markets. Debate has focused on the prices entrants should pay for access to the facilities and customers on the incumbent local exchange carriers (ILECs) who until recently were protected monopolies. A critical question is the size of the contributions competitors should make to incumbents' fixed costs and regulatory burdens in the prices they pay for network elements and services purchased from ILECs.

1. *Introduction*

Networks must be interconnected if the policy goal of ubiquitous connectivity for customers is to be realized. But interconnected networks sell absolutely essential inputs to their competitors—access to their own subscribers and access to the transmission facilities required to connect to still other networks and those networks' subscribers. Given the potential for strategic gaming inherent in firms' reliance on their competitors for the supply of vital inputs, it is not surprising that interconnection pricing—the setting of prices at which networks sell access to their facilities and their customers to other networks—has become a critical issue in the design of policies to promote competition in telecommunications markets.

To date, most of the policy attention, research and academic debate over interconnection pricing has focused on the prices entrants should pay for access to the facilities (and customers) of the incumbent local exchange carriers (ILECs) who until recently were protected monopolies. The intense

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STRATEGIC POLICY RESEARCH

UNE PRICES AND TELECOMMUNICATIONS INVESTMENT

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1. INTRODUCTION

In earlier comments, we observed that unbundling requirements reduce the profitability of incumbent local exchange carrier ("ILEC") investments and thereby afford disincentives to make such investments.[1] These disincentives almost surely make a large difference with respect to discretionary infrastructure investment. Such investment, itself, generates unbundling requirements to which the ILEC would otherwise not be subject. If the ILEC does not make the investment, the new facilities will not exist and therefore cannot be subject to unbundling requirements. Unbundling requirements afford ILECs the incentive to do just that—not make the investment. More generally, unbundling requirements inherently reduce ILEC profitability and thereby make all ILEC investments less attractive.

As a theoretical matter, this argument seems unexceptionable. How could it be otherwise? *Ceteris paribus*, a firm is more likely to make infrastructure investments that do *not* come with

[1] John Haring and Harry M. Shooshan, "Reorienting Regulation: Toward a More Facilities-Friendly Local Competition Policy," before the FCC, *In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability* in CC Docket Nos. 01-338; 96-98 and 98-147, Attachment A to *Comments of Qwest Communications International Inc.*, April 5, 2002.

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an unbundling obligation attached than those that do. A firm is likely to invest more if investments are more profitable than if they are less profitable.

The only issue, it would seem, is the empirical magnitude of the likely diminution of investment and whether that diminution is balanced by comparably important public-policy goals.

We believe that unbundling requirements have already substantially curtailed ILEC investment. For example, SBC's withdrawal from Project Pronto, together with cut-backs in other ILEC investments to support mass DSL deployment, amount to billions of dollars.[2] This amount is quite sizable, in itself. Moreover, the preliminary statistical evidence we present herein suggests that the adverse consequences of unbundling for ILEC investment may be even more pervasive and substantial.

At the same time, we believe that extreme unbundling requirements do little to further the competitive goals for which they were designed and are thus uneconomic. In particular, they provide an attractive alternative to CLEC investments in their own facilities. UNEs involve far less risk than facilities investments and can be quite profitable, given the low levels of UNE prices.[3] Nonetheless, UNE-based competition is not nearly as beneficial to the public as facilities-based competition.

AT&T posits a view that is contrary to ours. Their reasoning, as we understand it, is as follows:

> Low UNE prices stimulate UNE-based entry. The UNE-based competitors will ultimately migrate from the use of UNEs to their own facilities. The ILECs will then be stimulated to make investments to modernize their networks to be competitive.

Unlike the unexceptionable theory that we proffered above, this theory is a parlay of events of questionable likelihood. Low UNE prices may, indeed, stimulate UNE-based entry. But:

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[2] John Haring and Jeffrey H. Rohlfs, "The Disincentives for Broadband Deployment Afforded by the FCC's Unbundling Policies," presented before the FCC, *In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability* in CC Docket Nos. 01-338; 96-98 and 98-147 as Attachment to *Comments of High-Tech Broadband Coalition*, April 5, 2002.

[3] *See, for example*, Strategic Policy Research, Inc., *TELCOMP© Model Version 1.4*, submitted before the FCC, June 17, 1999 (available at www.spri.com).

- It may be a long time, if ever, before UNE-based competitors migrate to using their own facilities. UNEs are cheap and involve little risk. Also, the customers may be dispersed, so that construction of facilities is not cost-effective—given the attractive alternative of UNEs.
- The hoped-for ILEC investments may not be profitable. In the future world in which competition is much more intense, ILECs will often have to give up customers to competitors, because doing what is necessary to retain the customers will be unprofitable. It is especially likely to be unprofitable if the investments are subject to onerous unbundling requirements and especially if UNE prices are below cost.

Since the reasoning underlying AT&T's theory is far from conclusive—indeed, in our view, highly speculative—the theory requires particularly strong empirical support to be at all persuasive. (Of course, empirical support would be desirable, even if the theory were much more strongly grounded.) Without such empirical support, the theory would simply be a set of improbable self-serving speculations.

AT&T sought to meet the need for empirical evidence by filing an econometric study by Robert D. Willig, *et al.*[4] The Willig study, however, suffers from a number of serious defects, which make its results suspect. These defects include the following:

- The model of ILEC investment is based on a "back-to-the-future" process, whereby future events reach back and change the past;
- The dependent variable in the equation for CLEC investment—number of firms—is an inadequate measure of degree of competition;
- The model includes too many explanatory variables, relative to the number of supporting observations. The results of such models are neither robust nor reliable; and
- Notwithstanding Willig's use of many explanatory variables, the model omits some obvious variables (in particular, loops and level of state economic activity) that likely have more explanatory power than many of the included variables. We believe that Willig's model would be substantially improved by including these critical variables and omitting several of the less significant variables; and

[4] Declaration of Robert D. Willig, before the FCC, *In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability* in CC Docket Nos. 01-338; 96-98 and 98-147, Attachment F to *Comments of AT&T Corporation*, April 5, 2002 (hereinafter "Declaration").

- The model additionally has several debilitating technical defects, described herein.

2. CRITIQUE OF WILLIG

The dependent variable in the Willig model is growth of per-capita ILEC net plant from 1996 to 2000. Willig seeks to explain this growth in investment in terms of a variety of influences: per-capita ILEC net plant in 1996, the percent of each state's labor force that is employed in finance, insurance and real estate industries, the growth in statewide population from 1990-2000, the average unemployment rate for the period 1996-2000, average total residential revenues per line, the unbundled network element platform ("UNE-P") price in zone 1 for 2001,[5] total element long-run incremental cost ("TELRIC") of the UNE-P from the FCC's Synthesis Model, total service resale discount for 2001, and the regulatory treatment of ILEC retail services in 2000, according to an NRRI table.[6]

2.1. BACK TO THE FUTURE

The Willig model embodies the illogic of relying upon data from future years, primarily 2000 and 2001, to "explain" past ILEC investment decisions (1996-2000). It simply defies commonsense, however, to suggest that ILECs determined their investment levels in 1996 based on as-yet-nonexistent UNE-P prices that prevailed in 2001.

In particular, AT&T has clarified in an *ex parte* filing that Willig relied explicitly upon the UNE-P prices for 2001 as an explanatory variable of ILEC investment back as far as 1996.[7] Willig gives no explanation of how the UNE-P prices "reach back" and affect investment in *earlier* years. UNE prices were generally not set in 1996 and had not been completely resolved in as many as 19 states as of late 1999.[8] In those early years, even the methodology for determining

[5] The source for UNE-P prices was clarified when AT&T filed with the FCC a "Description of the Data and Econometric Processes Used in the Analysis Prepared by Professor Willig," (June 28, 2002) (hereinafter "Further Description").

[6] Willig describes his data and methods in Exhibit 2 and presents his results in Exhibit 3 to his Declaration.

[7] Willig acknowledges the shortcoming of the use of UNE prices for 2001 and says that the UNE rate and discount rates that reflect the 1996-2000 period of interest would be ideal. Willig was "not aware of a source for such average data" ("Further Description" at 3). We are surprised by this lack of data given that AT&T is presumably well positioned to know what those rates have been over the course of the period in question. AT&T has been a participant in UNE pricing proceedings and arbitrations in almost every state.

[8] These conclusions are based on SPR's survey of UNE rates across the 50 states in 1998 and update in 1999. In many instances there were "temporary" prices to be replaced with "final" prices following extensive cost *(footnote continued)*

UNE prices had not yet been established. Indeed, TELRIC pricing methodology was confirmed by the Supreme Court only as recently as May 2002.[9] In the meantime, the prices, themselves, changed from "temporary" prices to "final" prices, and then changed again in response to remands from courts. Willig's reliance on UNE-P prices, rather than (say) the UNE loop price compounds this problem. UNE-Ps are a relatively recent development, and even now, it is far from clear that they can survive the recent court remand.[10] There is certainly no economic basis to conjecture or theorize that ILEC investment decisions from 1996-2000 were caused by the 2001 UNE-P price.

Similarly, the use of the resale discount and number of CLECs operating in each state in June 2001 to explain ILEC investment in *prior* years, suffers the same infirmities as the use of the 2001 UNE-P price. No one in 1996 could have predicted resale discounts or the extent of competition (or other variables) over the next 4 years with any precision on a state-by-state basis.

2.2. NUMBER OF CLECS IS AN INADEQUATE MEASURE OF THE DEGREE OF COMPETITION

A serious defect of the Willig CLEC entry equation is its measure of the degree of competition; *viz.*, the logarithm of the number of CLECs. It is well understood among economists that the number of firms in an industry is, in itself, often not indicative of much of anything. Economic consequences always depend on the size of firms, as well as their number. One would, for example, never measure industry concentration in terms of the number of firms in an industry.[11] The measure works poorly in the instant case for the same reasons. In particular, a few large CLECs could be far more consequential than many small ones.

Better measures of the degree of competition are number of total CLEC lines or number of facilities-based CLEC lines. These measures indicate the success that CLECs have had to date in attracting customers. In contrast, a larger number of CLECs does not necessarily indicate greater success in attracting customers.

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proceedings. Some states such as Pennsylvania, New Mexico and Idaho had no prices in place that we were able to observe as late as 1999. We noticed even further changes (reductions primarily) in UNE loop prices in 2002 from 2001 levels in Commerce Capital Markets, Inc., studies of November 12, 2001 and May 1, 2002.

[9] Supreme Court of the United States, No. 00-511, *Verizon Communications et al. v. FCC et al.* (decided May 13, 2002).

[10] *USTA et al. v. FCC et al.*, United States Court of Appeals for the District of Columbia, No. 00-1012 (decided May 24, 2002) (hereinafter *USTA v. FCC*).

[11] Commonly used alternatives are the Hirschman-Herfindahl Index ("HHI") or the concentration ratio.

Another important measure of the degree of competition is the capacity of facilities-based CLECs.[12] This measure indicates how much competitive pressure facilities-based CLECs can put on ILECs. Such CLECs can take business away from ILECs to the extent that they have facilities in place to handle the business. Again, the number of CLECs does not indicate the degree to which facilities-based CLECs have capacity in place to take business away from ILECs.

2.3. TOO MANY VARIABLES

Willig's model is a cross-sectional analysis consisting of 37-38 observations. At the same time, the ILEC investment equations include *12* explanatory variables, in addition to the constant term. While the specific number of variables that should be included in a model is a subjective judgment, the use of 12 variables to explain 37 or 38 observations is excessive and makes it virtually impossible to obtain robust results.

In the most general terms, the goal of econometric modeling is to explain a lot with a little. A model with 38 observations and 12 explanatory variables is an extreme case of the opposite: explaining a little with a lot.

That approach is especially problematic in statistical analysis. With so few observations relative to potential explanatory variables (or combinations thereof), one can "prove" almost any desired result—certainly to the level of "marginal significance" that the Willig study reports. This is so, even if the variables are constrained to the seemingly "reasonable." There are so many combinations of seemingly reasonable variables that at least one combination is likely to yield the desired result, simply through random chance.[13]

2.4. MISSING VARIABLES

While including many variables in the ILEC investment models, Willig leaves out some critical and, in fact, rather obvious candidates: number of loops served by the ILEC(s) (included in the study) in each state and gross state product ("GSP") of each state.

It is reasonable to treat the number of ILEC loops as exogenous. Demand for loops is very inelastic, and ILECs are required to meet increases in demand. Loops are probably the best indicator of the amount of non-discretionary investment the ILEC must make. The required

[12] Measures of capacity might, for example, reflect the numbers of lines that could be supplied in particular geographic areas without deploying additional fiber.

[13] For example, if there are 10 candidate seemingly reasonable variables, they can be entered in the equation in 3.6 million possible combinations.

switching investment, as well as the required loop investment, to accommodate growth are closely related to the growth in loops.

GSP is another variable that can explain a significant part of ILEC investment. Demand for telecommunications services, and the associated need for ILEC investment, are related to the level of economic activity of the state. ILEC investment depends on the "permanent" level of state income as well as on macro-economic fluctuations, which might be picked up in Willig's unemployment variable. For example, New York has higher per-capita income than Mississippi, even when the unemployment rates in the two states are equal.

The Willig model does not include either of these very plausible variables. Nor does Willig report any further statistical tests involving alternative model runs including these variables.

Thus, the possibility exists that substituting these variables for some of the variables that are used in Willig's study, but have little explanatory power (especially when the additional variables are included), might make a significant difference in the results of the study. It could conceivably have the effect of reversing Willig's results.[14]

2.5. MISMATCHED GEOGRAPHICAL COVERAGE

Willig, in his "Further Description" states that he obtained total plant in service ("TPIS") and accumulated depreciation for "each of the major ILECs in Table 43-02 B6 Summary of Investment and Accumulated Depreciation."[15] A review of the list of ILECs on that table shows that only Regional Bell Operating Companies ("RBOCs"), including former GTE and SNET properties, as well as Puerto Rico Telephone Company are represented. Major ILECs missing from that table include Sprint, Alltel and Citizens, which have large study areas in many states. Further, Rochester Telephone and Cincinnati Bell each serve a fairly large metropolitan area in their respective states, New York and Ohio, and are not included in the database that Willig relies upon. Small ILECs are entirely excluded.

This incomplete coverage is not, in itself, a problem. It becomes a problem, because Willig scales the data by dividing by *statewide population*. In some states, such as Nevada, where Sprint has a major presence, normalizing net plant data by statewide population skews the data. Nevada Bell's per-capita net plant is low for reasons completely unrelated to the model. Comparisons to Verizon's per-capita net plant in Delaware or Rhode Island, for example, where Verizon is the only ILEC, make little sense. This improper scaling leads to biased results.

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[14] We received the data underlying the Willig study on July 12, 2002 and have only begun our review of these data. We anticipate conducting analyses and reporting our findings to the FCC in the fullness of time.

[15] "Further Description" at 1.

2.6. INVESTMENTS REQUIRED TO SUPPORT UNE-BASED ENTRY

The data upon which Willig relies, ARMIS data, include all investment made by ILECs. This investment includes the investments that ILECs have been *required* to make to support UNE-based CLECs. In particular, ILECs have made significant investments to accommodate collocators in their central office and remote terminals.[16] Such investment—unlike investments to support innovative new services—provides no direct benefit to customers. They are simply part of the cost of UNE-based competition.

Our view, stated above, is that unbundling requirements reduce discretionary ILEC investment, which directly benefits the ILEC's retail customers. To refute this view, Willig would have to show that the alleged increase in ILEC investment exceeded what was required to accommodate UNE-based competitors. The Willig study cannot make this demonstration on the basis of the data analyzed.[17]

2.7. SIZE OF STATE

There is no variable in the CLEC entry equation to account for the variation in size among states, particularly in terms of population. One would presumably expect more competitors in a larger state, such as New York, than in a smaller state, such as Utah. The Willig model does not reflect this consideration.

Moreover, none of the explanatory variables reflect the level of economic activity in a state. (An example of such a variable is GSP (or its logarithm), as discussed earlier.) Thus, Willig is trying to model the number of CLECs in a state without reference to the amount of economic activity in the state (or to its population).

In general, a model that omitted key variables would have little chance of fitting the data satisfactorily. As discussed above, however, one can get just about any desired result in a model with 12 explanatory variables and only 38 observations.

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[16] SBC has described the remote terminals that are a component of its broadband deployment plans (see *ex parte* letter of James K. Smith, SBC, to William F. Caton, Acting Secretary, FCC, March 25, 2002). In this presentation, SBC states that "providing CLEC access as described will increase initial [broadband] infrastructure costs alone by at least 20 percent." SBC estimates the financial impacts of requirements of the "Pronto Waiver Order" to be over $200 million.

[17] The D.C. Circuit raised this very question: "How such investment [made with unbundling policies in effect] compares with what would have occurred in the absence of the prospect of unbundling." While the court did not necessarily require econometric models, as we are exploring in this proceeding, it did "expect at least some confrontation of the issue and some effort to make reasonable trade-offs." *USTA v. FCC.*

2.8. ECONOMETRIC IDENTIFICATION

Willig posits a two-step process whereby low UNE prices lead to an increase in ILEC investment. The first step is that low UNE prices lead to increased CLEC competition. The second step is that increased CLEC competition leads to increased ILEC investment.

To estimate this model, Willig specifies two equations for ILEC investment. The first is the reduced form, in which all explanatory variables are presumed exogenous. The logarithm of the number of CLECs, which is endogenous, does not appear in the reduced form. The second equation is a structural equation, which includes both exogenous and endogenous variables. In the Willig model, this equation includes the endogenous variable, the logarithm of the number of CLECs.

A well-known theorem in econometrics is as follows: The coefficients of a structural equation are "identified" and can be estimated only if the equation excludes one or more exogenous variables that are in the reduced form.[18] For identification, the exclusion must be *a priori*. That is, it cannot simply be based on a lack of correlation in the sample. One must be able to reason on the basis of one's general understanding of the market that the excluded variables do not affect the dependent variable. Examples of excluded variables are as follows:

- Wage rates affect supply, but they are excluded from the demand equation; and
- Consumer income affects demand but is excluded from the supply equation.

In both these cases, the endogenous variable would be the price of the good. In each equation, the excluded variable does not affect the dependent variable *directly*. It does, however, affect it *indirectly* through its effect on the endogenous variable.

In the Willig model, the excluded variables are the UNE price and the resale discount. The underlying theory is that these variables affect ILEC investment *only* through their effect on the degree of competition.

This theory is completely implausible. The UNE price and the resale discount both affect ILEC profits directly. The higher the UNE price, the more profit the ILEC makes on sales of UNEs. The lower the resale discount, the more profit the ILEC makes on resold services. It is completely unreasonable to specify that these effects on profits have no influence whatever on

[18] *See, for example,* Jack Johnston and John Dinardo, *Econometric Methods*, Fourth Ed. (New York: McGraw-Hill, 1997) at 309-316. In certain special circumstances, a model may be identified by restrictions other than the exclusion of variables, but these circumstances do not apply to the Willig model.

ILEC investment. Yet, that is precisely the specification of the Willig structural equation for ILEC investment.

Given that the UNE price and the resale discount are not really excluded from the ILEC investment reduced-form equation, Willig's structural equation is not identified. Thus, the estimates of the coefficients of the structural equation are biased.

In general, if a structural equation is not identified, the estimated coefficients include effects from the other equation(s). In this case, the estimated coefficients in the ILEC investment equation include effects relating the same variables in the CLEC equation. This bias remains, no matter how large the sample. It cannot be detected by standard statistical tests. Consequently, ensuring that structural equations are really identified is a critical part of econometric technique.

This consideration completely invalidates the results of Willig's structural equation for ILEC investment.

2.9. PRICE REGULATION

Willig includes regulatory conditions faced by major ILECs in his model to explain ILEC investment from 1996-2000. Often, whether a price cap plan is approved for an ILEC, as well as its terms, depend on the ILEC's agreeing to make certain investments in its network in that state. In this sense, a price cap plan *causes* the investment that may *follow*—again here we have the back-to-the-future issue—in the next period.[19] On the other hand, the state regulator may regulate more stringently or decline to permit price cap regulation based on *past* performance of the ILEC in terms of maintaining service quality through necessary upgrades and repairs to its network. In this latter sense, investment *causes* the regulatory condition that would be faced in the future. A further point is that ILECs are more disposed to make infrastructure commitments if those investments are likely to be profitable; e.g., because unbundling requirements are less onerous.

For these reasons, the method of regulation should be regarded as endogenous. It should not be included in the reduced form equation for ILEC investment, as it is in the Willig model. To properly include these regulatory variables, Willig would need to specify an identified structural equation. In this regard, the preceding section noted that Willig's structural equation for ILEC investment is not really identified, as it stands. Treating additional variables as endogenous would make the identification problem even more difficult to solve.

[19] Our review of the state regulatory conditions faced by ILECs shows that not many significant changes occurred between 1996 and 1999. A number of state price regulation plans were renewed or revised during 1999-2001. *See State Telephone Regulation Report*, February 15, March 1, and March 15, 2002.

3. ALTERNATIVE ECONOMETRIC MODELS

In light of the infirmities of the Willig model, we have developed an alternative model to explain ILEC investment. Our goal is the same as Willig's: to explain ILEC investment, paying special attention to the effect of the UNE price. This exercise involves controlling for other variables that materially affect ILEC investment. We attempted to carry out the estimation, avoiding the many debilitating weaknesses of the Willig analysis.

The dependent variable in our analysis is similar to Willig's—net plant. Willig has a cross-sectional model in which the dependent variable is (incremental) investment between 1996 and 2000. Our model is a cross-sectional model for 2001. The model has 48 observations[20] and only 4 explanatory variables, in addition to the constant term, and corrects for heteroskedasticity. The model fits the data better than the Willig model and has far superior statistical properties, in particular regarding statistical significance of coefficients.[21] It also avoids the modeling defects of the Willig model, as described above.

Our results are preliminary and certainly do not reflect a comprehensive analysis of ILEC investment. Nevertheless, they suffice to show that Willig's results are not implied by the data. On the contrary, they derive from the many defects of the Willig model. An alternative formulation that does not embody those defects yields opposite results.

3.1. SPR'S ANALYSIS

We restricted our analysis to RBOCs, because more data are available for RBOCs than for other carriers. In particular, we found data on UNE loop prices not to be readily available except for RBOCs.

For our dependent variable, we use the level of net plant. We could not scale net plant by statewide population because in many states RBOCs do not serve the whole state. (See Section 2.7 above.) Because the data are not scaled, we corrected for heteroskedasticity to reflect that model errors are likely to have greater variance in larger states than in smaller states.

[20] The only states excluded were Alaska, Connecticut and Hawaii, which do not contain original RBOC study areas, and thus lack UNE price data and, in the case of Alaska and Hawaii, also lack relevant ARMIS data. All references to RBOCs are to original RBOC study areas.

[21] As we describe in the Appendix, we were able to obtain some of the same data that Willig relied on. We also collected data for important explanatory variables that we thought were improperly excluded from the Willig model: RBOC loops and GSP.

We lacked adequate time-series data (particularly of UNE prices) to develop a stock adjustment model or a model with lagged explanatory variables. The 2001 observations for which we had complete UNE loop price data became the observations in our cross-sectional analysis. Our explanatory variables are contemporaneous. We used the UNE loop price in the same period since the UNE loop remains a widely-used means of CLEC entry, and the UNE loop price is by far the largest component of the UNE-P price.[22] The data that we relied on are available to any interested party from SPR's website at http://www.spri.com.

We found that RBOC investment decisions in 2001 were driven by four major exogenous factors: the number of loops served by the RBOC in that state; the average annual number of unemployed persons in each state during 2001; the level of real GSP; and the UNE loop price in RBOC zone 1 multiplied by the number of RBOC loops. This last variable was constructed so that an increase of $1 per month in the UNE-loop price would have the same impact on ILEC investment *per loop* in Nevada as in New York. This formulation is reasonable. In contrast, a UNE price variable that was not multiplied by loops would have the unreasonable implication that $1 per-month increase has the same *overall dollar impact* on ILEC investment in Nevada as in New York.

We adjusted statewide variables of GSP and the number of unemployed persons by the ratio of RBOC switched loops in each state to total ILEC switched loops in that state. This adjustment reflects the fact that RBOC study areas cover varying portions of each state in which they operate. Further, since our model relies on levels instead of ratios (i.e., data not weighted by some relevant units), the number of unemployed persons is a more appropriate measure of unemployment than the unemployment rate.

These results rely upon exogenous variables that are not intertwined with various interdependent regulatory policies and are significant in their relation to the level of net plant in each RBOC study area. The explanatory variables are fairly obvious and have an economic basis for their inclusion.

The key finding of our analysis is that the UNE loop price has a positive relationship to ILEC investment, in direct contradiction to Willig's results, and is statistically significant at the 1 percent level—far from marginal. Thus, our results support what should be regarded as the expected result. Low UNE loop prices, which diminish the profitability of ILEC investment,

[22] It appears that resold lines nationwide dropped by more than 20 percent from December 2000 to June 2001, while reliance on UNE-P's ("UNEs with switching") increased by almost 70 percent. See FCC, Industry Analysis Division, "Local Telephone Competition: Status as of June 30, 2001" (February 2002) at Table 4. UNE loop use increased by over 75 percent as well, suggesting that the very low prices of the UNE loop and UNE-P have become far more desirable means of entry than resale.

lead to a reduction in that investment. These results contradict Willig's contorted theory that diminished profitability leads to an *increase* in ILEC investment through increased CLEC competition. The results from our primary econometric model are presented below in Table 1.

Table 1

SPR Econometric Results: Model 1 Dependent Variable: RBOC Net Plant		
Variable	**Estimated Coefficient**	**t-statistic**
Constant	66,938,095	0.76
RBOC Loops	340	2.87**
Number of Unemployed Persons	-3,934	-1.12
Real Gross State Product ($M)	5,731	2.11*
RBOC Loops x UNE Loop Price Zone 1	18.05	4.50**
R-squared	0.99	
Adjusted R-Squared	0.98	
F-statistic (4, 43)	729	
Number of Observations	48	

* Significant at the 95 percent confidence level.

** Significant at the 99 percent confidence level.

The variables for RBOCs loops and real GSP have the expected positive signs and plausible estimated values. The two coefficients are significant, at the 1 percent and 5 percent levels, respectively. The variable for the number of unemployed persons has the expected negative sign and a plausible estimated value. It is not, however, statistically significant.

The unemployment variable may materially (negatively) affect RBOC investment, notwithstanding its lack of significance in Model 1. Nevertheless, it is interesting to examine the effect of omitting the variable. In Table 2, below we present the result for Model 2 without the number of unemployed persons.

Table 2

SPR Econometric Results: Model 2 Dependent Variable: RBOC Net Plant		
Variable	**Estimated Coefficient**	**t-statistic**
Constant	53,899,352	0.59
RBOC Loops	275	2.59*
Real Gross State Product ($M)	4,407	1.60
RBOC Loops x UNE Loop Price Zone 1	19.89	4.63**
R-squared	0.98	
Adjusted R-Squared	0.98	
F-statistic (3, 44)	942	
Number of Observations	48	

* Significant at the 95 percent confidence level.

** Significant at the 99 percent confidence level.

With the omission of the unemployment variable, real GSP became less significant in Model 2. The variable appears to work better in conjunction with the unemployment variable, as in Model 1. GSP and unemployment can then separately reflect the differential effects of permanent and transitory income. In any event, the omission of the unemployment variable has little effect on the estimated coefficient for the UNE-loop price.

Table 3 shows results without *either* the GSP variable or the unemployment variable. In this model, the coefficient for RBOC loops probably serves, in part, as a proxy for size-of-state effects. Thus, the large coefficient for RBOC loops probably overestimates the effect of loops on RBOC investment. In this model, as in Model 2, the coefficient for the UNE-loop price remains approximately the same as in Model 1.

Table 3

SPR Econometric Results: Model 3 Dependent Variable: RBOC Net Plant		
Variable	**Estimated Coefficient**	**t-statistic**
Constant	-1,381,844	-0.02
RBOC Loops	453	11.65**
RBOC Loops x UNE Loop Price Zone 1	19.23	4.19**
R-squared	0.98	
Adjusted R-Squared	0.98	
F-statistic (2, 45)	1,208	
Number of Observations	48	
** Significant at the 99 percent confidence level.		

Our results appear to be robust. In the three models the UNE loop price estimated coefficient has remained stable, between 18 and 20, as less significant variables are removed. This range does not depend on any single model.

3.1.1. DISCRETIONARY AND NON-DISCRETIONARY ILEC INVESTMENT

The number of loops served in a given year captures incremental changes in net plant that results from an incremental change in the number of loops served. The estimated coefficient of this variable reflects the largely non-discretionary investment required to accommodate increases in demands for basic telephone services. The estimated coefficient in Model 1 indicates that each additional loop served by the RBOC causes an increase of $340 in RBOC net plant.

The variables of GSP (in Models 1 and 2) and average number of unemployed persons provide measures of the level of economic activity in the state. These reflect a combination of discretionary and non-discretionary investments. As economic activity rises, businesses and residents in the state demand more telecommunications services. In addition, increased economic activity may make it profitable for the ILEC to offer advanced innovative services.

Finally, the UNE loop price variable performed the best in Models 1 and 2, and remained highly significant in Model 3. These reflect discretionary investments that become profitable and are made if the UNE loop price is higher, but are deterred by a low UNE price. As discussed above, low UNE prices may be associated with greater non-discretionary ILEC expenditures to accommodate interconnection of UNE-based competitors. The positive coefficient in the equation is *net* of all such effects. Even so, it is large, positive, and highly statistically significant.

The impact of the UNE price on RBOC net plant in all of our models is directly the opposite of the result obtained by Willig. According to our Model 1 results, as the UNE loop price rises by $1 a month (per loop), RBOC net plant increases by about $18 *per loop*.[23] The inference from these results is that the effect of the UNE price on RBOC investment can become very sizable. For example, if the UNE price increased by, say, $5 per loop per month, the addition to RBOC net plant would be $90 per loop. This is over 25 percent of the additional net plant per additional loop.

3.2. CLEC ENTRY MODELING

It is unnecessary for us to develop our own CLEC entry model, because models that effectively refute the Willig model already exist. Two of particular interest are Ros-McDermott (R-McD)[24] and Eisner-Lehman (E-L).[25] These studies avoid many of the defects of the Willig study. Thus, the Willig model can be considered a step backward in the ongoing econometric analysis of CLEC entry.[26]

The key finding of these studies is that lower UNE prices did not necessarily yield greater CLEC entry. Further findings included evidence that higher residential rates appeared to encourage CLEC entry in general, and residential competition, in particular.

Unlike the Willig model, these models include some variable or variables relating to the size of the state. For example, R-McD consider population density, loop density, and the relative mix of GSP among major sectors of the state economy as determinants of CLEC entry. E-L used the level of and the change in employment (i.e., the number of persons employed) in the state. The use of the level of employment in particular provided a means of scaling among the states.[27]

Though these models are single period cross-sectional models, they each reflect the best data available to the authors at the time of their studies. For example, E-L had the advantage of

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[23] This interpretation derives from dividing both the unscaled UNE loop price and the RBOC net plant by the number of RBOC loops.

[24] Agustin Ros and Karl McDermott, "Are Residential Local Exchange Prices Too Low?," *Expanding Competition in Regulated Industries* Michael Crew, Ed. (Kluwer Academic Publisher: 2000).

[25] James Eisner and Dale E. Lehman, "Regulatory Behavior and Competitive Entry," for presentation at the 14th Annual Western Conference Center for Research in Regulated Industries (June 28, 2001).

[26] The analysis by FCC staff members Zolneirek-Eisner-Burton is an early model relying on the number of CLECs as the dependent variable as does Willig. Therefore, it does not provide much useful guidance for evaluating the state of the art in modeling CLEC entry today. [James Zolneirek, James Eisner and Ellen Burton, "An Empirical Examination of Entry Patterns in Local Telephone Markets," (August 23, 1999).]

[27] E-L at 11.

detailed data available to FCC staff only.[28] E-L went beyond earlier studies by examining each of the following: the number of resold lines, the number of UNE-based lines, the number of facilities-based lines, and total CLEC lines. E-L models of number of CLEC facilities-based and resold lines were of fairly good fit (with high R-squared).

The most interesting finding of E-L is that, contrary to expectations, there was no evidence that lower UNE rates would promote non-facility-based entry. The only evidence that lower UNE rates were associated with more entry (in general) is in states where 271 relief has been granted.[29] With regard to the effect of retail residential pricing on CLEC entry E-L obtained similar results as R-McD. R-McD found that, in states where residential and business retail rates were more balanced, there was greater evidence of facilities-based entry by CLECs.[30] Though E-L did not find evidence of the significance of the ratio of business to residential retail prices (they used different measures of business rates), they did find that higher retail residential rates tended to promote facilities-based competition.[31]

These earlier models, particularly E-L, obtained results contrary to that of Willig regarding the impact of UNE prices on CLEC entry. They suggest that it is debatable as to whether lower UNE prices increase competitive entry, even by use of UNEs. More generally, they have found that low UNE prices do *not* promote competition, especially facilities-based competition.

It is surprising that Willig did not reference these studies as he constructed his own model. In reality, these models are more advanced in important respects than Willig's and should be included in the public discourse on unbundling policies.

4. CONCLUSION

We reviewed herein the econometric models of Willig, *et al.*, which were filed in this proceeding by AT&T. We found that those models suffer from a number of fatal defects, which make their results suspect. These defects include the following:

[28] E-L at 6. E-L acknowledge some of their results differ from those of R-McD mostly because R-McD did not have access to the data available to E-L through Eisner's employment at the FCC. Different measures of business retail rates led to some different results as well.

[29] E-L at 20-21.

[30] See, R-McD at 15-17.

[31] E-L at 11.

- The model of ILEC investment is based on a "back-to-the-future" process, whereby future events reach back and change the past;
- The dependent variable in the equation for CLEC investment—number of firms—is an inadequate measure of degree of competition;
- The model includes too many explanatory variables, relative to the number of supporting observations. The results of such models are neither robust nor reliable;
- Notwithstanding Willig's use of many explanatory variables, the model omits some obvious variables (in particular, loops and level of state economic activity) that likely have more explanatory power than many of the included variables. We believe that Willig's model would be substantially improved by including these critical variables and omitting several of the less significant variables; and
- The model additionally has several debilitating technical defects.

In light of these defects, we developed our own econometric model of ILEC investment. It avoids the defects of the Willig model and has far better statistical properties. We found that contrary to Willig's model, low UNE prices repress ILEC investment. Our result is the opposite of surprising, since low UNE prices reduce the profitability of ILEC investments. In our model, UNE prices were one of the two most significant explanatory variables for ILEC investment, with total RBOC loops in service being the other. We found that an increase in the UNE loop price of $5 per month is associated with increased ILEC investment of $90 per line.

We did not develop our own model of CLEC entry. We did, however, review previous econometric studies that avoid many of the defects of the Willig model and get the opposite result. Those studies suggest that, contrary to Willig's result, low UNE prices do not promote CLEC competition.

STRATEGIC POLICY RESEARCH

DATA SOURCES

SPR's model of ILEC investment relies on a cross-sectional database of observations from each Regional Bell Operating Company ("RBOC") state for which complete data were available.[1] SPR obtained from the FCC's ARMIS database total plant in service ("TPIS") and accumulated depreciation for each RBOC study area for 2001.[2] We calculated net plant for each study area each year as the difference between TPIS and accumulated depreciation.

We employ total RBOC loops in service in 2001 for each study area as an explanatory variable.[3] We obtained the average annual number of unemployed persons for each state for 2001 from the U.S. Bureau of Labor and Statistics.[4]

We relied on the RBOC Zone 1 UNE loop prices in each state for 2001 as reported by Commerce Capital Markets, Inc., in November 2001.[5] We then multiply this by total loops to scale the variable, comparable to other variables in the model. We estimated 2001 real GSP for each state using real GSP from 1996 to 2000. We also calculated the GSP index for each state to adjust UNE prices to real values.[6]

To calculate a ratio of RBOC to total ILEC loops in each state, we obtained total ILEC switched access lines in each state from the FCC's Trends in Telecommunications Report for 2000.[7] We

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[1] That is, each state in which an original RBOC (not including GTE, SNET or Cincinnati Bell properties) provides incumbent local exchange service. This excludes Alaska, Connecticut and Hawaii.

[2] Federal Communications Commission ("FCC"), *ARMIS Database 43-02: Table B6. Summary of Investment and Accumulated Depreciation.*

[3] FCC, *ARMIS Database, 43-08: Table III: Access Lines in Service.*

[4] U.S. Bureau of Labor and Statistics, *State and Regional Employment and Unemployment, 2001 Averages,* USDL 02-97 (February 22, 2002).

[5] Anna-Maria Kovacs, *et al.*, "Status and Implications of UNE-Platform in Regional Bell Markets," published by Commerce Capital Markets, Inc. (November 12, 2001).

[6] We obtained current dollar GSP as well as real GSP for each state for the years 1996-2000 using the U.S. Department of Commerce, Bureau of Economics online database (data released June 10, 2002).

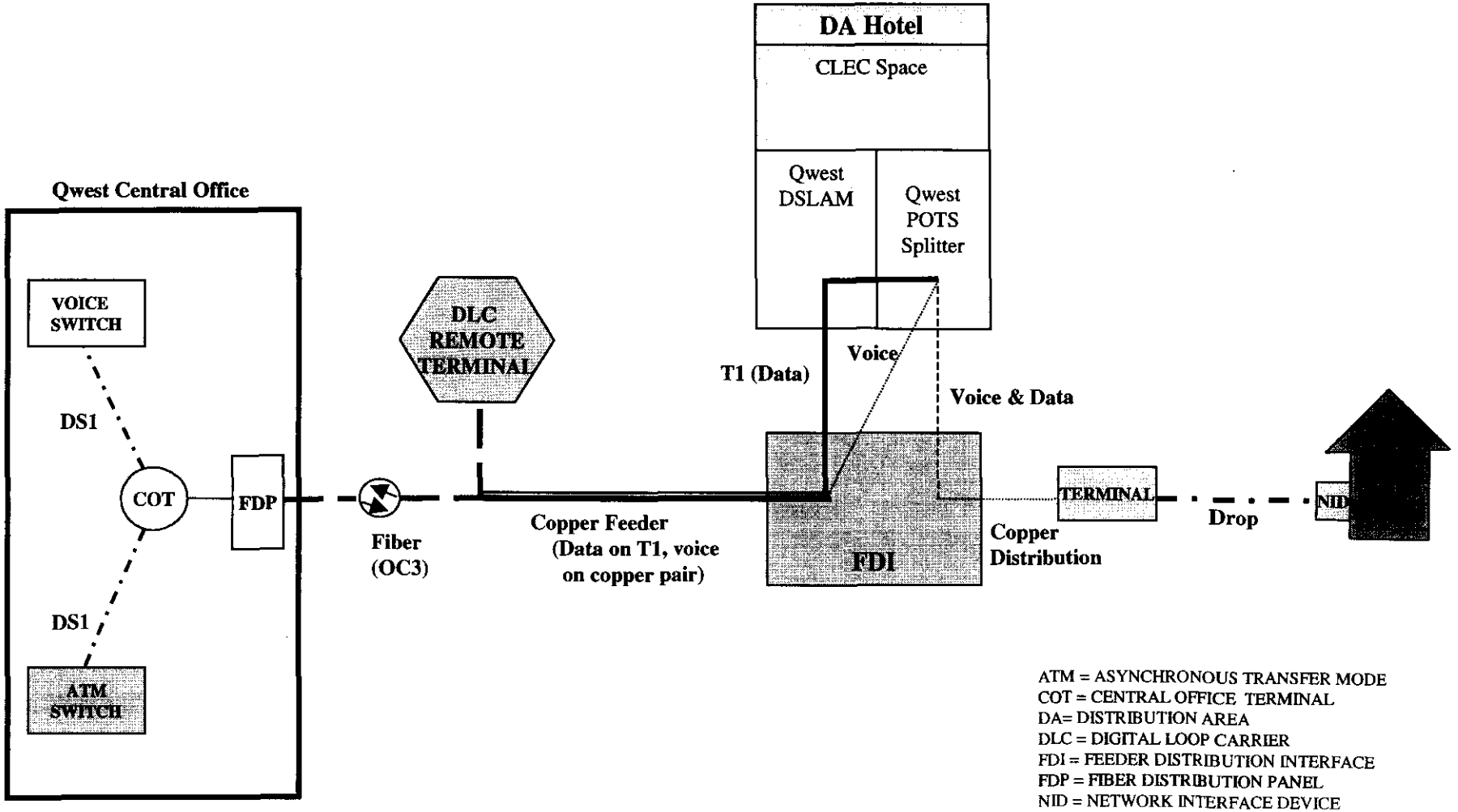
[7] FCC, Common Carrier Bureau, *Trends in Telephone Service*, Table 8.2, Telephone Loops of Incumbent Local Exchange Carriers by State, (May 22, 2002). These appear to be switched access lines, rather than switched plus special access lines.

also obtained original RBOC study area switched access lines for 2000 to arrive at a consistent ratio of RBOC to total ILEC switched access lines in each state.[8] Since we relied on different sources for the data, there were some instances where the ratio exceeded one (these were states where Verizon is the only ILEC). We set those ratios equal to one.

These data are available to any interested party from SPR's web site: http://www.spri.com.

[8] FCC, *ARMIS Database, 43-08, Table II: Switched Access Lines in Service by Technology.*

REMOTE DIGITAL SUBSCRIBER LINE ARCHITECTURE



ATM = ASYNCHRONOUS TRANSFER MODE
COT = CENTRAL OFFICE TERMINAL
DA= DISTRIBUTION AREA
DLC = DIGITAL LOOP CARRIER
FDI = FEEDER DISTRIBUTION INTERFACE
FDP = FIBER DISTRIBUTION PANEL
NID = NETWORK INTERFACE DEVICE