Competition and Regulation for Internet-related Services: Results of Asymmetric Regulation

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Broadband services for residential customers and for small businesses are currently provided by DSL by incumbent local telephone companies (ILECs) and broadband competitive local telephone companies (CLECs) and by cable modems over HFC networks by cable television operators. The ILECs have been required to share or “unbundle” their networks, offering unbundled network facilities to new entrants at regulated rates. However, cable providers typically have not been required to share their networks. This creates an environment referred to as asymmetric regulation.

This paper explores the implications of asymmetric regulation and asks if it serves the interests of consumers. It compares the experience of Korea, a country without such a regulatory regime, with that of the United States. It also examines the experience of the competitive CLECs in providing these services and their subsequent financial distress. In addition, it addresses the effects of asymmetric regulation of the type used in the U.S. on investors. But I begin with an examination of the recent experience of different countries in securing broadband access for their businesses and consumers.

I. Broadband Internet Access

Korea is Number 1! Korea has by far the largest penetration of high-speed, “broadband” Internet access on a per capita basis of any country. According to the most recent OECD statistics, Korea had 4.32 million broadband Internet connections in November 2000, with about 64 percent over DSL lines and the other 36 percent over cable modems. Thus, Korea had 9.2 broadband Internet connections per 100 inhabitants.
in 2000, or a penetration equal to of 9.2 percent of its population. Canada was next with a 4.5 percent penetration, and the U.S. was third with a 2.2 percent penetration. Surprisingly, the U.S. penetration was less than one-fourth the penetration achieved in Korea. Thus, the runner-up countries were far behind Korea. Some advanced economies had extremely low penetration rates, such as Germany at 0.2% and the UK at 0.09%. Figure 1 demonstrates the wide disparity in broadband penetration for the larger countries (greater than 10 million).

Figure 1 Here

Korea has no required regulatory network unbundling such as is required in the U.S. and Canada to allow CLECs to compete better with the ILECs that offer DSL to their customers. However, among the worst outcome countries, the UK and Germany do require network unbundling for their ILECs.4

Of course, potentially important demographic differences exist among the countries. A higher proportion of people live in apartments in Korea, which increases population density and decreases the cost of proving a wired telecommunications network.5 However, Hong Kong, which also has a very high proportion of people living in apartments, had a penetration ratio of 3.5%, below Canada and above the U.S.6 Also, the U.S., Canada, Germany, and the UK are among the richest countries on a per capita GDP or income basis. They also have high computer penetration ratios, which should also increase demand for broadband Internet connections. Thus, Korea being Number 1 by a wide margin is remarkable.
An important factor is that Korea does not have a regulatory requirement for network unbundling such as that of the U.S. and, to a lesser extent Canada that is designed to allow CLECs to compete better with the ILECs in offering DSL to their customers. However, many of the countries with the lowest broadband penetration, such as the UK and Germany, require network unbundling for their ILECs. These outcomes suggest that unbundling may not be the best policy for promoting broadband deployment.

An econometric investigation on penetration rates across countries for the years 2000 and 2001, using data on broadband penetration, the broadband access price, the narrowband access price, and GDP per capita provides additional insights on the determinants of broadband penetration. Included also is a variable for regulation, which equals one if the regulators require the ILEC to offer use of their network to CLECs, e.g. the unbundling requirements found in the U.S., the UK and Australia. Unfortunately, the sample is not especially large with just 26 observations and even smaller sub-samples for certain of the regressions. Overall the findings are that broadband penetration depends significantly on GDP/capita with an elasticity of approximately 1.0. However, neither the narrow band access price nor the broadband access prices are statistically significant. This outcome is consistent with the fact that Korea, with by far the largest broadband penetration, has among the least expensive narrowband access prices and has a broadband price that exceeds the prices in both Australia and Canada, which have significantly lower broadband penetration. The elasticity of broadband penetration with respect to broadband price is estimated to be about -1.5 and is almost significant. Another variable estimated to have an important (but not statistically significant effect) is regulation. The regression result finds that regulation leads to a decrease in broadband
penetration or approximately –0.7 or negative 70%. Thus, per capita GDP, broadband price, and regulation appear to have the largest effects on broadband penetration. However, given the small sample and the absence of strong statistical significance of the estimated coefficients, these results should be interpreted as suggestive, rather than as definitive results.

II. Narrowband and Broadband Internet Access are in Separate Product Markets

It might be argued that narrowband (dial-up) Internet access is actually a close substitute to broadband access so that focusing on broadband access alone is misleading. Yet the characteristics of the two types of access and the services they support have important differences. Cable modems and DSL offer access speeds about 10-30 times higher than dial-up access. Many of the services supported by broadband connections are not available through narrowband connections. The demand for applications that can be supported only by high-bandwidth connections suggests that the product markets for narrowband and broadband access are distinct. A quantitative analysis of U.S. data supports this conclusion.

A. Relative Prices

Although the price of connection for broadband Internet access and narrowband access (when incorporating the price of a second line) to the Internet may be similar, the quality-adjusted price is not. In particular, a second line is not always “on,” is subject to congestion, and cannot simultaneously support several broadband applications such as streaming video and video conferencing. Second, many heavy Internet users who own a wireless telephone can avoid the cost of a second line. If the choice to subscribe to wireless is made before the decision to obtain Internet access, as would seem likely to be the case for many Internet users, the monthly price of the wireless connection should not
be included in the price of narrowband access. Third, if the price of a second telephone line should be included in the price comparison, then certainly the installation cost of a broadband connection (typically $150 for a cable modem) should be incorporated as well. Under any reasonable comparison, the prices of broadband and narrowband Internet access are different and hence support, but in no way confirm, the notion of distinct product markets.

An additional indication that narrowband and broadband Internet access are in separate product markets arises from the “natural experiment” of different narrowband prices set in the U.S. by state regulation. The data demonstrate that prices of second telephone lines vary greatly across different regulatory jurisdictions, while the price of broadband Internet access remains relatively constant. These data support the hypothesis that narrowband Internet access does not constrain the price of broadband Internet access.

B. Estimation of the Cross-Price Elasticities between Broadband Access and Narrowband Access

The definition of the product market can also be established empirically. If it can be shown that narrowband Internet access prices (including the access charge plus the price of a second telephone line) do not constrain broadband Internet access prices, then a hypothetical monopoly provider of broadband Internet access could more easily sustain a five percent price increase. This would confirm the existence of a separate broadband Internet access market.

The econometric analysis is based on August 1999 price data from 41 states and 59 cable-television MSOs who were offering either @Home or Road Runner. For cable subscribers, the broadband access price varied from $34.95 per month to $64.95 month.
The installation fee varied from $50 to $150, which is amortized over different periods for various regression specifications, depending on the predicted churn rate for broadband customers. The narrowband Internet access data were collected from the incumbent local exchange carriers (ILECs) providing service in the areas served by the local cable provider. Prices for second telephone lines (used, for instance, by many AOL customers) varied from $7.70 to $47.62 per month. Installation costs for a second telephone line varied from $16.90 to $55.30, a cost that was amortized over its expected service life. The “standard” price for the @Home cable service is $40 per month, but the price for narrowband access varies considerably because the price of a second line varies from $8 to $48 per month. These data indicate that under the Merger Guideline test for market definition, narrowband Internet access is in a separate market from broadband Internet access, because narrowband access prices differ by a factor of over 300%, while broadband access prices do not vary in any way with these differences. Thus, variations in the price of narrowband access cannot explain the variations in the price of broadband access. Otherwise, one would expect to observe a decrease in the price for the broadband access service when second telephone line rates are high and vice versa. There is no significant relationship of this kind, a result that demonstrates the existence of separate product markets for antitrust purposes.

Table 1 shows the benchmark results of a regression analysis that confirms this conclusion. The logarithm of the price of broadband access (either @Home or Road Runner) is the left-hand side variable and the right-hand side variables are an intercept, an indicator variable for Road Runner, and a variable for second telephone line prices from the ILEC, either in levels or in logarithms.
Table 1 Here

The estimated coefficient for the price of estimated narrowband access is essentially zero, -0.003, and far from statistically significant. Thus, the hypothesis that the price of narrowband access does not affect the price of broadband access (transport) and ISP service is not rejected -- lower narrowband access prices do not constrain the prices charged for broadband access. Because the price of AOL is not included in any explanatory variable, its effect is contained in the estimate of the intercept coefficient.

The findings are quite uniform across different specifications corresponding to different definitions and amortization periods for installation costs. The estimated coefficient of the narrowband access price variable is always small and statistically insignificant. The Road Runner indicator variable, however, is about –11.6 percent and highly statistically significant with a t-statistic of 8.6. Thus, Road Runner is priced significantly below @Home, on average. Similar results are found if the sample is limited to @Home MSOs, with the regression coefficient for narrowband access now estimated to be 0.0126, again extremely small with a low t-statistic of 0.3857.24

When the regression specification is expanded by including median household income, average population density, the cost of the calls from the residence to the ISP, and age of the population, these variables are not statistically significant. Moreover, the coefficient of principal interest—the effect of narrowband access price—does not change in any meaningful way.25 The coefficient of the estimated logarithm price of narrowband access is the same whether or not demographic variables are included.26 The results of three additional regressions with different specifications are presented in the Appendix.
All of these results confirm the conclusion that the price of narrowband access does not constrain the price of broadband access. Broadband Internet access is a separate product market.

III. Is Asymmetric Regulation Appropriate?

Should network elements be unbundled so that CLEC’s can provide broadband Internet access using ILEC network elements? And should similar regulation exist for cable HFC networks? Lastly, is the current situation of asymmetric regulation appropriate? If the goal is to have actual competition that benefits consumers, these choices are potentially quite important. The following analysis demonstrates that if regulators require the entire local incumbent telephone network to be unbundled, as the FCC has done in the U.S., the likely outcome will be less competition.

The principal concern in this analysis is the effect of regulation on consumer welfare. The appropriate goal is not a competitor welfare goal, as regulators often seem to believe, but a consumer welfare goal. The U.S. FCC regulates under a “public interest” rule, which should translate into a consumer welfare rule, but the FCC has used the public interest standard to provide it wide latitude in its decisions, often resulting in consumer harm in the billions and tens of billions of dollars per year.

The U.S. Telecommunications Act of 1996 established the basic principles for unbundling of network elements. Sections 251 and 252 provide a framework for the pricing of interconnection, resale, and unbundling. Section 251(c)(3) requires any ILEC (other than certain rural carriers) to offer competitors access to the ILEC’s network elements on an unbundled basis. In turn, Section 251 (d)(2) requires the FCC to consider, when determining whether to mandate the unbundling of an ILEC’s network elements
under Section 251(c)(3), “at a minimum, whether—(A) access to such network elements as are proprietary in nature is necessary; and (B) the failure to provide access to such network elements would impair the ability of the telecommunications carrier seeking access to provide the services that it seeks to offer.” Together, those two subsections are known as the “necessary” and “impair” requirements.

A. Consumer Welfare: Competition Rather than Competitor Protection

The implementation of “necessary” and “impair” should be based on the goal of furthering overall competition, not merely the economic interests of individual competitors. If overall competition is increased, consumer welfare and economic efficiency will also generally increase.

Consumers benefit from competition because it leads to greater innovation and lower prices. However, the FCC’s public-interest standard, although central to interpretation of telecommunications regulation, has not always been aligned with consumers’ interests. The primacy that economists ascribe to economic efficiency and to the maximization of consumer welfare has a related benefit: It harmonizes economic regulation and antitrust (competition) law. In 1996, Congress endorsed this view when, as noted earlier, it emphasized in the Telecommunications Act that the improvement of consumer welfare was the new legislation’s overarching purpose.

Suppose that substitutes outside the ILEC’s network are available and are being offered by competing firms. The availability of the competing services occurs because some firms have made the rational economic decision that they can efficiently provide services that employ those non-ILEC elements. Two conclusions follow from this situation. First, the element as provided by the incumbent ILEC cannot be essential for competition because competition is already occurring without ILEC provision. Thus, the
network element cannot be labeled an essential facility, and its availability to competitors at regulated prices is not “necessary” for the development of competition. Nor would a decision not to mandate unbundling at a regulated price “impair” the competitive supply of telecommunications services.

Second, competition will not be adversely affected if a given CLEC cannot procure the unbundled element from the ILEC. Other firms are providing substitutes outside the ILEC’s network, and so, in the absence of diminishing returns to scale, increased demand for the element outside the ILEC’s network can be met at the same or lower economic cost.

B. A Consumer Welfare Implementation of the Necessary and Impair Standard

Hausman and Sidak have proposed an approach to the “necessary and impair” standard of the Telecommunications Act of 1996 within a consumer welfare framework. The definitions of “necessary” and “impair” rely on the competitive analysis of demand and supply substitution that provides the primary basis for other areas of regulatory economics and, more particularly, that provides the analytical basis for modern antitrust and competition law.

1. The Hausman-Sidak Test

The FCC should mandate unbundling of a network element if, and only if:

(1) It is technically feasible for the ILEC to provide the CLEC unbundled access to the requested network element in the relevant geographic market

(2) The ILEC has denied the CLEC use of the network element at a regulated price
(3) It is impractical and unreasonable for the CLEC to duplicate the requested network element through any alternative source of supply

(4) The requested network element is controlled by an ILEC that is a monopolist in the supply of a telecommunications service to end-users that employs the network element in question in the relevant geographic market and

(5) The ILEC can exercise market power in the provision of telecommunications services to end-users in the relevant geographic market by restricting access to the requested network element.

To implement the fifth element of the Hausman-Sidak test, one modifies the Merger Guideline’s test for unilateral market power only slightly, examining whether an ILEC’s refusal to sell a particular unbundled network element to a CLEC at a regulated price would impair competition. This part of the test is based on a “critical share” analysis of the possibility of exercising unilateral market power. The critical share test is discussed in Appendix 2.

Intuitively, the impairment test asks whether the ILEC can exercise market power when restricting access to a particular network element to the CLEC in a particular geographic market. If the ILEC cannot exercise market power in the output market when declining to offer a particular network element at a TELRIC price, all of the consumer benefits associated with a competitive outcome have already been secured and the regulator should not order the network element in question unbundled. The Hausman-Sidak test is focused on protecting competition as opposed to competitors. If market
forces can protect consumers from the harms of monopolization, then the regulators should not impose mandatory unbundling.

A network element should only be unbundled when the incumbent can exercise monopoly power in the absence of unbundling. When the incumbent has such power, competition is harmed by the denial of the unbundled element, and consumer welfare is decreased because consumers will pay a supra-competitive price for the final service (barring further regulatory distortions). This conclusion is closely related to the essential insight of the economic approach to regulation. Regulation should only be used in the situation of market failure, in this case, the exercise of unilateral monopoly power.

2. **Application to the Korean Broadband Internet Access Market**

The broadband Internet access is assumed to be a separate product market for Korea, as it is in the U.S. The technology and economics for narrowband access in Korea are similar to the U.S. In Korea significant competition currently exists in the delivery of broadband access even though Korea Telecom (the ILEC) has not been required to provide unbundled elements to CLECs. Cable modem suppliers enjoy a similar freedom from mandated unbundling. Thus, no “open access” regulation or unbundling requirements have been implement to date in Korea.

Hanaro Telecom, a CLEC, was the first provider of DSL in Korea, connecting apartments to local stations by fiber-optic cable. In Korea, about half of total households are in apartments; therefore, access to Korea Telecom’s local loop was not indispensable in Hanaro’s providing DSL. In the case of non-apartment households, Hanaro can provide broadband service by cable modems.
Cable infrastructure that is capable of broadband Internet service is owned mostly by the Korea Electric Power Corporation. However, while Korea Electric is the owner of the cable infrastructure, it does not provide cable TV service or broadband Internet access service. Cable service providers use the Korea Electric infrastructure to provide both cable TV and broadband Internet cable modem service. Thrunet is the largest cable modem provider, but other operators also provide cable modem service. Although there is no regulation for open access, de facto open access exists for cable modem services because cable service providers offer open access using the common infrastructure of the Korea Electric network. Prices and entry in cable modem service are not subject to governmental regulation.

Table 2 and Figure 2 illustrate Korean DSL and cable modem penetration in 2001:\textsuperscript{32}

**Table 2 and Figure 2 here**

Thus, DSL is larger in Korea with a total of 64\% of broadband access subscribers, a situation that is the reverse of that of the U.S. where cable modems have significantly more subscribers than DSL.\textsuperscript{33} The most recent U.S. statistics from the first quarter of 2001 show cable modems with an approximate 70\% share of broadband access.\textsuperscript{34}

3. Hausman-Sidak Test Results: Korea

When elements of the Hausman-Sidak test are applied to determine whether unbundling should be implemented in Korea to increase consumer welfare, the answer
appears to be no. The last three elements of the Hausman-Sidak test provide the following results:

(1) it is technically feasible for the ILEC to provide the CLEC unbundled access to the requested network element in the relevant geographic market

(2) Since Korea does not have regulation-mandated unbundling, this factor is not applicable.

(3) It is not impractical and unreasonable for a CLEC to duplicate the requested network element through any alternative source of supply. Hanaro Telecom has provided broadband Internet access both by providing its own facilities and by using the cable network infrastructure of Korea Electric.

(4) The requested network element is not controlled by an ILEC that is a monopolist in the supply of a telecommunications service to end-users that employs the network element in question in the relevant geographic market. To the contrary, broadband Internet access is provided by seven additional providers, in addition to the ILEC Korea Telecom.

(5) The ILEC, Korea Telecom, cannot exercise market power in the provision of telecommunications services to end-users in the relevant geographic market by restricting access to the requested network element because sufficient marginal customers would shift to competing providers to make the attempted price increase unprofitable. The critical share test demonstrates that Korea Telecom does not have unilateral market power in the provision of broadband Internet access.
The overall conclusion, based on a consumer welfare standard, is that the ILEC should not be required to unbundle its network for CLECs to provide broadband Internet access. Competition in the market is substantial, output is extremely high as discussed in the first section of the paper, and Korea Telecom cannot exercise unilateral market power. Thus, no role for regulation to protect consumers is evident.

4. Application to the U.S. Broadband Internet Access Market

In the U.S., DSL is offered in most areas by ILECs over their networks and by broadband CLECs who typically rent network elements from ILECs at prices set by regulators below economic costs. Broadband Internet access is also offered over cable HFC networks. The cable operators (MSOs) are essentially unregulated and are not required to share their network with competing firms. Thus, U.S. broadband is subject to asymmetric regulation: the CLECs are highly regulated and required to share their networks while the cable operators are unregulated and not required to share their networks.

The cable operators have refused to permit competing broadband access providers to use their networks. Moreover, the largest cable operators have signed exclusive contracts with Internet Service Providers (ISPs) that “tie” their high-speed broadband Internet access to the use of cable-owned ISPs. Thus, if most cable customers want to use a non-cable owner ISP, they must “pay twice”—once for the Internet access and use of the cable-owned ISP and again for the independent ISP.

In the U.S. approximately 6.9 million subscribers used broadband Internet Access in the first quarter of 2001. Thus, the U.S. penetration rate for broadband Internet access was only 23.2 percent of Korea’s penetration rate at the same time period. Of the
total subscriber base in the U.S., about 70 percent used cable modems and 30 percent used DSL. Of the DSL customers, 84 percent were served by ILECs, 15 percent by CLECs, and 1 percent by long-distance carriers in the second quarter of 2001.37

Cable modems’ recent growth rate has been approximately equal to the growth rate of DSL at about 23% per quarter.38

Currently, AT&T is the nation’s largest cable multiple system operator (MSO). AT&T has also controlled Excite@Home Corp., the largest provider of residential broadband service with approximately 3.3 million subscribers in July 2001. Prior to declaring bankruptcy in 2001, Excite@Home had an exclusive contract rights to provide residential broadband service over the cable facilities of its three principal equity holders, AT&T, Comcast Corporation, and Cox Communications, Inc., which collectively account for over 35 percent of the nation’s cable subscribers.39 Similarly, AOL/Time-Warner is the second largest cable provider and has an exclusive contract with Road Runner, the second largest provider of broadband Internet service with 1.1 million subscribers in November 2000.40

5. Results of the Hausman-Sidak Test for the U.S.

The application of the Hausman-Sidak (1999) test to the U.S. broadband market is summarized in Table 3.

[Table 3 here]
(1) It is technically feasible for U.S. ILECs to provide CLECs unbundled access to the requested network element in the geographic market. Also it is technically feasible for the cable MSO to provide access to its HFC network in the geographic market.

(2) ILECs have not denied CLECs use of the network element at a regulated price; however unregulated cable MSOs have refused access to competing broadband access providers and to non-affiliated MSOs.

(3) It is impractical and unreasonable for a CLEC to duplicate the requested network element, the customer loop, through any alternative source of supply in certain geographical areas. However in other geographical areas economic duplication is possible. For cable modems, in most areas of the U.S. it is impractical and unreasonable for a competitive ISP to duplicate the cable HFC network. In certain areas duplication is possible. For both ILECs and CLECs RCN has constructed a competing fiber optic network on the East Coast and West Coast in certain urban areas. However, RCN has recently curtailed its expansion because of financial stringencies.41

(4) The requested network element is not controlled by ILECs that monopolizes the supply of a telecommunications service to end-users that employs the network element in question in the relevant geographic market. In most geographic markets the ILEC is not a monopolist in provision of broadband Internet access. Instead, the ILEC competes with cable operator’s HFC network over which broadband Internet access is provided. Indeed in July 2001 about 65 percent of US customers purchased broadband Internet access over cable
networks and about 35 percent purchased broadband Internet access using DSL over ILEC networks. Similarly, in most geographic markets, cable modems have a competitor in DSL.

(5) ILECs cannot exercise market power in the provision of telecommunications services to end-users in the relevant geographic market by restricting access to the requested network element. ILECs could not exercise unilateral market power because sufficient marginal customers would shift to competing cable modem providers to make the attempted price increase unprofitable. The critical share test, described in Appendix 2, demonstrates that the ILEC does not have unilateral market power in the provision of broadband Internet access. Whether the cable modem operator has unilateral market power is discussed below.42

The relatively slow deployment of DSL to date has limited the ILECs’ ability to discipline any price increase by cable-based providers of broadband Internet access. DSL deployment is constrained by technical impediments, because it is sensitive to the distance that transmissions must travel between the home and central office. DSL does not work (or work well) if the copper segment of the customer line exceeds approximately 3-3.5 miles, which encompasses about 25-35 % of ILEC customers. Also, DSL cannot be provided on telephone that uses digital loop carrier technology, which includes a large part of the southern United States, without substantial investment in electronics at remote terminals.

Even if DSL providers were to overcome these technological limitations, significant regulatory barriers prevent them from competing effectively against the
cable broadband providers. The regional Bell operating companies (RBOCs), which are the primary providers of DSL, operate within an entirely different regulatory environment than their cable competitors. First, the RBOCs are excluded entirely from the core backbone market because of their exclusion from interLATA services under Section 271 of the Telecommunications Act. The RBOCs also face separate-subsidiary requirements that may make it more expensive to provide Internet search engines or content of any kind, and the Telecommunications Act requires RBOCs to unbundle their network. The FCC has even indicated its intent to extend unbundling requirements to broadband Internet services, which decreases the economic incentives to provide these services. Finally, the RBOCs’ retail broadband rates are regulated; cable modem rates are not. This asymmetric regulation prevents DSL from being an effective competitor in the broadband Internet access market for residential customers.

Thus, under current regulation cable MSOs are able to exercise unilateral market power, a conclusion that is consistent with the cable operators’ ability to tie their broadband Internet access to customers. In the absence of such market power one would expect a sufficient proportion of marginal cable-modem customers to shift to DSL and to force the cable MSO to provide customer choice for a non-affiliated ISP. The ability of the cable MSOs to require these customers to “pay twice” demonstrates their market power.

A further difference exists between the ILECs and cable MSOs. ILECs are not content providers so that they do not have an economic incentive to distort competition for content – the material that is downloaded by subscribers. Cable operators provide
content – video programming -- both over the cable channels that they own and over their affiliated cable systems. Indeed, cable operators exercise significant monopoly power as the research of many economists has demonstrated. Internet “video streaming” competes and will compete even more in the future with video programming offered by cable systems. Cable system broadband Internet providers currently place significant restrictions on Internet video streaming to limit its use. Competition between cable operators and other broadband Internet content providers will now be discussed.

Possible Anti-competitive Strategies by Cable Providers

Full-service broadband providers integrate four services or “inputs”: (1) broadband content (e.g., streaming video and audio, movies, video conferencing, interactive games), (2) the aggregation of broadband content and complementary services (e.g., chat rooms, instant messaging) by a broadband portal, (3) connectivity to the Internet supplied by a broadband Internet service provider, and (4) high-speed transport from the home to the ISP supplied by a cable provider, telephone company, or other broadband conduit provider.

A vertically integrated firm, offering both broadband transport and portal services, could profitably pursue two anticompetitive strategies. First, an integrated provider could engage in conduit discrimination—insulating its own conduit from competition by limiting its distribution of affiliated content and services over rival platforms. Conduit discrimination could involve a range of anticompetitive strategies, from refusing to distribute an affiliated portal over competing conduits, to making popular content available only to customers using an affiliated conduit. Second, an integrated provider could engage in content discrimination—insulating its own affiliated content from competition by blocking or degrading the quality of
outside content. Content discrimination could involve a range of strategies, from blocking outside content entirely, to affording affiliated content preferential caching treatment.

Both or these strategies are potentially costly—but the benefits could outweigh the costs in certain situations. For example, a firm engaging in conduit discrimination will forgo revenues from content distribution over rival platforms. However, there are potentially countervailing benefits, because with conduit discrimination, customers will perceive the cable conduit as more valuable. This, in turn, will increase the demand for cable transport relative to other forms of transport. Hence, a cable broadband provider will engage in conduit (or content) discrimination if the gain from additional access revenues from broadband users offsets the loss in content revenues from narrower distribution. To the extent that cable transport providers compete against DSL and other broadband transport providers, the reduction in revenues from lost customers will be greater.

There are several ways in which a vertically integrated broadband provider can discriminate against unaffiliated content providers. First, it can give preference to an affiliated content provider by caching its content locally. Such preferential treatment ensures that affiliated content can be delivered at faster speeds than unaffiliated content.

Second, a vertically integrated broadband provider can limit the duration of streaming videos of broadcast quality to such an extent that they can never compete against cable programming. Stated more generally, a vertically integrated firm like AT&T can block any competing content that it wants to. Currently AT&T and other cable providers limit video streaming to less than ten minutes.

Third, a vertically integrated firm such as AT&T or AOL-Time Warner could impose proprietary standards that would render unaffiliated content useless. The academic literature
on standards and network externalities provides theoretical and empirical support for the conjecture that AT&T could impose proprietary standards that would raise the switching costs for its subscribers and stifle competition in vertically related software markets.

AT&T’s (and previously TCI’s) traditional cable strategy has been to use its market power in the delivery of programming to expand its control over the programming itself. Time-Warner has also previously used a similar strategy to limit competition in programming.46

C. Is Asymmetric Regulation Appropriate?

The current asymmetric regulation framework requiring ILECs to sell their network elements to CLECs at below-cost prices while cable modem operators are not regulated has no reasonable economic basis. This conclusion flows from the Hausman-Sidak test and the evidence that demonstrates that cable modem operators have the economic incentive and the ability to exercise unilateral market power and to discriminate against competitive content providers. In most geographic markets, one might conclude that no regulation is necessary since DSL and cable modems compete against each other. However, the preferred outcome is to require both ILECs and cable modem operators to provide access to their networks where technically feasible. Prices would be unregulated. Instead, prices would be determined by commercial negotiation between the parties. As demonstrated below, current FCC regulation has led to an outcome where ILECs are forced to sell the use of their networks to CLECs at significantly below economic prices.
IV. Setting Regulated Prices for Unbundled Elements

The FCC has established the basis for setting the prices of unbundled elements incorrectly, leading to less competition, rather than the desired result of increased competition. 47

A. Current FCC Approach to Regulation of Unbundled Elements

The legislative framework for ILEC network unbundling was established in the 1996 Telecommunications Act. The Federal Communications Commission (FCC) has instituted numerous regulatory rulemakings to implement the Act, the most important of which has been the Local Competition and Interconnection Order of August 1996.48

One way to analyze the problem of setting appropriate regulated prices for unbundled elements is to examine a new investment by an ILEC. Suppose a competitor wants to buy the unbundled elements associated with such an investment. The ILEC could offer the new competitor a contract for the economic life of the investment—say 10-20 years for investment in the local loop. The price of the unbundled element would be the total investment cost plus the operating costs each year for the unbundled element. If demand did not materialize or prices fell, the new entrant would bear the economic risk of this outcome.49

However, regulation by total element long run incremental cost (TELRIC) as applied by the FCC typically allows the new entrant to buy the use of the unbundled element on a month-by-month basis.50 Thus if demand does not materialize or prices fall, the ILEC has to bear the risk for the business case of the new competitor. The ILEC has been required by regulation to give a free option to the new entrant, where an option is the right, but not the obligation, to purchase the use of the unbundled elements. The monthly price of the unbundled element should be significantly higher than the TELRIC
price of the element to reflect the risk inherent in the sunk investments, or equivalently the value of the option given to the new entrant.\textsuperscript{51}

B. Regulation Set Prices for Unbundled Elements

Under the 1996 Act, the FCC mandated forward looking cost based prices for competitors to use unbundled LEC facilities. The FCC did not permit any markup over cost to allow for the risk associated with investment in sunk assets; instead, it used a total element long run incremental cost (TELRIC) type approach that attempts to estimate the total service long run incremental cost on a forward looking basis. TELRIC is supposed to allow for recovery of the cost of investment and variable costs of providing the service over the economic lifetime of the investment; however, TELRIC makes no allowance for uncertainty or the sunk and irreversible nature of telecommunications investment. The FCC assumed a “perfect contestability” market in which no sunk costs exist. The perfect contestability standard is not the appropriate model to determine correct economic incentives for efficient investment once technological and economic uncertainty exist.

C. The Effect of Sunk and Irreversible Investments\textsuperscript{52}

TELRIC assumes\textsuperscript{53} that all capital invested now will be used over the entire economic life of the new investment and that prices for the capital goods or the service being offered will not decrease over time. With changing demand conditions, changing prices, or changing technology, these assumptions are not necessarily true. Thus, TELRIC assumes a world of certainty where the actual world is one of uncertainty in the future. Significant economic effects can arise from the uncertainty and the effects that the sunk nature of investment has on the calculation of TELRIC.
TELRIC calculations makes the following assumptions: (1) the investment is always used at full capacity, (2) the demand curve does not shift inwards (or outwards) over time, and (3) a new or improved technology does not appear that leads to lower cost of production. Of course, these conditions are unlikely to be valid over the life of the sunk investment. Thus uncertainty needs to be added to the calculation because of the sunk nature of the investment.\(^54\)

Given the fundamental uncertainty and the sunk nature of the investment, a "reward for waiting" occurs because over time some uncertainty is resolved. The uncertainty can arise from at least four factors: (1) demand uncertainty, (2) price uncertainty, (3) technological progress (input price) uncertainty, and (4) interest rate uncertainty.\(^55\) The fundamental decision rule for investment becomes:

\[
P^* > \frac{\beta_1}{\beta_1 - 1} (\delta + \lambda) I = m(\delta + \lambda) I
\]

where \(P^*\) is the output price net of operating costs, \(\delta\) is the exponential depreciation rate, and \(\lambda = r + \alpha\) is the sum of the risk adjusted interested rate and he expected change in the price of output. The extra term that arises from sunk costs is the markup term \(m = \beta_1/(\beta_1 - 1) > 1\) since \(\beta_1 > 1\). The term \((\delta + \lambda) I\) is the usual term in an investment rule that takes account of discounting and expected price changes (economic depreciation). The parameter \(\beta_1\) takes into account the sunk cost nature of the investment coupled with inherent economic uncertainty.\(^56\) Parameter \(m\) is the markup factor required to account for the effect of uncertain economic factors on the cost of sunk and irreversible investments. Note that the markup factor equals unity, \(m=1\), for fixed, but not sunk
investments because such investments can be moved easily to other uses. Thus, rearranging equation (1):

\[ \frac{P^s}{m} > (\delta + \lambda)I \]  

(2)

Equation (2) demonstrates that the value of the investment is discounted by the factor m to take account of the sunk costs, compared to the fixed (but not sunk) cost case of m = 1. Investments that result in sunk costs must have higher threshold present values than investments that result in fixed, but not sunk costs, other things equal, to be economic to undertake.57

Using the appropriate parameters for various components of ILEC networks, taking account of the decrease in capital prices due to technological progress, and allowing for the expected negative change in (real) prices of most telecommunications services given the decreasing capital prices, the value of m is around 3.2 to 3.4. Thus, a markup factor must be applied to the investment cost component of TELRIC to account for the interaction of uncertainty with sunk and irreversible costs of investment. Depending on the ratio of sunk costs to fixed and variable costs the overall markup on TELRIC will vary, but the markup will be significant given the importance of sunk costs in most telecommunications investments.

When the markup for sunk and irreversible investment is applied, it should only be used for assets that are sunk, e.g. potentially stranded. Other investments that are fixed, but not sunk, would not have the markup. Applying this methodology to transport links and ports, which are treated as unbundled elements by U.S. regulation, and whose proportion of sunk costs is 0.59, results in a markup factor for the overall investment of approximately 2.35 times TELRIC. This estimated markup would be close to the
appropriate markup for the regulated price of unbundled elements for DSL, which mainly comprise the loop from the central office to the customer premise. Thus, FCC regulation has set the regulated price for unbundled loops at less than half the economically correct price when the sunk cost nature of loop investment is taken into account. Failure by the FCC to set correct regulated prices has led to economically inefficient investment incentives for investment in local broadband infrastructure in the U.S. This outcome of deficient infrastructure investment in the U.S. is an outcome of government regulation as the FCC Chairman Michael Powell recently recognized.

By contrast, the proportion of sunk costs for ports is about 0.10 so that the markup factor becomes 1.23 times TELRIC. The markup over TELRIC that takes account of sunk costs and uncertainty is the value of the free option that regulators force incumbent providers to grant to new entrants; e.g. 1.35 times TELRIC for links and 0.23 times TELRIC for ports. This calculation demonstrates that the proportion of sunk costs has an important effect on the correct value of regulated prices when sunk costs are taken into account.

V. Regulatory Failure: The Demise of the U.S. Broadband CLECs

Soon after passage of the 1996 Telecommunications Act and the implementation of the FCC regulations on network unbundling, a number of CLECs began operations to provide DSL broadband Internet access. These CLECs typically did not build network infrastructure to any significant degree. Instead, they used the ILEC loops, for which they paid TELRIC prices. The three largest, Covad, Northpoint and Rhythms, floated initial public offerings (IPOs) and at their peak each had a market valuation in excess of 1 billion dollars. All three have now filed for Chapter 11 bankruptcy. Northpoint has
ceased operations and Rhythms also has ceased operations. Covad had one-third of a million DSL lines in service as of June 30, 2001. Covad’s market valuation in August 2001 was $90 million, while at its peak in the spring of 2000 its market valuation exceeded $10.5 billion. Covad subsequently declared Chapter 11 bankruptcy, but it has now plans to reorganize and exit bankruptcy. The FCC reports that growth in demand for broadband Internet access continues to grow rapidly. A major reason for these companies’ failure against the background of rapid overall market growth is FCC regulation. I do not mean to imply that the FCC regulation caused the “telecom bubble”. But FCC regulation caused the broadband CLECs to engage in a wasteful business strategy that led to their demise.

As Crandall and Hausman (2000) discuss, these broadband CLECs had ready access to capital markets, until 2001 when financing became more difficult due to the overall deterioration of the profitability of telecommunications markets and the increasingly large cash flow losses of each of the companies. FCC regulation established the framework for these companies’ demise. To provide DSL each company faced a “rent or buy” decision. Did it make more economic sense to rent the unbundled elements from the ILEC or to buy (invest) in network infrastructure? Because the FCC set the price of unbundled elements well below the economic cost of the elements as discussed in the previous section, the answer was to rent from the ILEC. Essentially, the CLECs were exercising their free options, provided to them by the regulators.

Given the lack of required investment, the economic incentive for each of the broadband CLECs was to expand as fast as possible. But none of the broadband CLECs had a sustainable competitive advantage because they were “playing with the house
money”—the free options granted to them by the FCC. Thus, they spent large sums of money on marketing, but customer churn remained high because none had a superior product to sell. Indeed, the quality of the DSL service was determined primarily by the quality of the ILEC loops, many of which are quite old since the copper loop technology is rarely replaced except when service interruptions occur. On the other hand, the ILECs did not have an economic incentive to invest in improving the quality of the loops since the FCC had set prices for the loops well below the correct economic level. Thus, the broadband CLECs spent large amounts of money on customer acquisition, but they were not able to keep a sufficient proportion of the customers they gained. The result was increasingly large amounts of money spent on customer acquisition without a concomitant return now, or one expected in the future. The equity values of the broadband CLECs plummeted and capital market became closed to them. The result was bankruptcy.64 Faulty regulation led to a large expenditure of money with little remaining in terms of real assets.65 Neither consumers, who had significant service disruptions when the broadband CLECs ceased operations, nor investors, who have little or nothing remaining from their investments, benefited from FCC regulation.66 Thus, the results of the FCC asymmetric regulation policy must be considered a failure with the economic waste of billions of dollars.

VI. Conclusions

In terms of broadband Internet access Korea is number one by a wide margin. Yet Korea has not required regulatory network unbundling nor regulated the prices of the service. Broadband Internet access is a separate product market from narrowband access (where the ILEC is dominant) only when a firm can exercise unilateral market power is regulated network unbundling necessary. Korea does not satisfy the conditions of the
Hausman-Sidak test for deciding when regulated network unbundling should occur.

Thus, regulated network unbundling should not be required in Korea.

In the U.S. it is not clear that the conditions for regulated network unbundling are satisfied since ILEC-provided DSL competes with cable modem service. Indeed, cable modems have a significantly larger customer share than DSL. Given the cable operators’ superior technology (for now) and their demonstrated ability to distort competition, the current asymmetric regulation, where the ILECs are regulation, but cable operators are unregulated does not make economic sense. Both ILECs and cable operators should provide access to their networks. However, the price for access should be unregulated and should be established by commercial negotiation.

The correct regulatory rules for setting regulated prices of unbundled elements requires an allowance for the role of sunk costs. Yet regulators have ignored the effect of sunk and irreversible investments when they set TSLRIC-based prices. Thus, the prices are set below correct economic levels, and a free option has been given to CLECs.

The result of this mistake in regulation has been to distort the broadband access market, and in particular the provision of DSL. The broadband CLECs did not benefit from the incorrect FCC policy. To the contrary, the large broadband CLECs have all gone into bankruptcy with two of the three ceasing operations. Thus, misguided regulatory policy has led to the waste of billions of dollars of investor funds. This outcome is hardly a “victory” for regulation and the goals set by Congress when it enacted the Telecommunications Act of 1996.
References


APPENDIX 1: ALTERNATIVE SPECIFICATIONS OF REGRESSION OF BROADBAND ACCESS PRICES ON NARROWBAND ACCESS PRICES

**Specification 2**
Left hand side variable: Log of Excite @Home access price plus amortized monthly cost of installation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Est. Coefficient</th>
<th>Est. Std. Error</th>
<th>Est. t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.98</td>
<td>.107</td>
<td>37.2</td>
</tr>
<tr>
<td>Log Price of Narrowband Access*</td>
<td>0.012</td>
<td>.031</td>
<td>0.382</td>
</tr>
<tr>
<td>Number of observations</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard error of regression</td>
<td>.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>.004</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Narrowband access price is the log of the price of a second telephone line plus second-line fees plus amortization of the installation cost.*

**Specification 3**
Left hand side variable: Log of cable broadband access price plus amortized monthly cost of installation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Est. Coefficient</th>
<th>Est. Std. Error</th>
<th>Est. t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.86</td>
<td>0.564</td>
<td>8.62</td>
</tr>
<tr>
<td>Log Price of Narrowband Access*</td>
<td>-0.029</td>
<td>0.033</td>
<td>-0.877</td>
</tr>
<tr>
<td>Log Population Density</td>
<td>0.001</td>
<td>0.010</td>
<td>0.057</td>
</tr>
<tr>
<td>Log Median Household Income</td>
<td>-0.028</td>
<td>0.064</td>
<td>-0.433</td>
</tr>
<tr>
<td>% Population Age 65 and Older</td>
<td>-0.006</td>
<td>0.006</td>
<td>-1.16</td>
</tr>
<tr>
<td>% Population Age 35 to 54</td>
<td>-0.009</td>
<td>0.009</td>
<td>-0.979</td>
</tr>
<tr>
<td>% Population Under Age 5</td>
<td>-0.016</td>
<td>0.022</td>
<td>-0.757</td>
</tr>
<tr>
<td>Road Runner Indicator</td>
<td>-0.114</td>
<td>0.014</td>
<td>-8.07</td>
</tr>
<tr>
<td>Number of observations</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard error of regression</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Specification 4**

Left hand side variable: Log of @Home access price plus amortized monthly cost of installation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Est. Coefficient</th>
<th>Est. Std. Error</th>
<th>Est. t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.81</td>
<td>0.653</td>
<td>7.36</td>
</tr>
<tr>
<td>Log Price of Narrowband Access*</td>
<td>-0.0003</td>
<td>0.041</td>
<td>-0.007</td>
</tr>
<tr>
<td>Log Population Density</td>
<td>0.006</td>
<td>0.012</td>
<td>0.506</td>
</tr>
<tr>
<td>Log Median Household Income</td>
<td>-0.077</td>
<td>0.083</td>
<td>-0.929</td>
</tr>
<tr>
<td>% Population Age 65 and Older</td>
<td>-0.001</td>
<td>0.007</td>
<td>-0.157</td>
</tr>
<tr>
<td>% Population Age 35 to 54</td>
<td>-0.001</td>
<td>0.011</td>
<td>-0.112</td>
</tr>
<tr>
<td>% Population Under Age 5</td>
<td>0.002</td>
<td>0.028</td>
<td>0.110</td>
</tr>
</tbody>
</table>

Number of observations | 43  
Standard error of regression | 0.002  
$R^2$ | 0.056
APPENDIX 2: The Relevant Product Market and Critical Share

The 1992 U.S. Merger Guidelines specify that relevant markets for merger analysis may be defined for classes of customers on whom a hypothetical monopolist of the merging firms’ products would likely impose a discriminatory price increase. According to the Merger Guidelines, the task of defining the relevant product market when price discrimination is not feasible involves identifying the smallest set of products for which a hypothetical monopolist could profitably raise price a “significant” amount (typically five percent) above the competitive level for a “nontransitory” period of time (normally assumed to be two years). Thus, under the Merger Guidelines, a potential market definition is too narrow if, in the face of a five percent price increase, the number of customers who would switch to products outside the “market” is sufficiently large to make the price increase unprofitable. In the previous section, I demonstrated that broadband access to the Internet is the relevant product market. This relevant product market currently contains cable modem access and DSL. In the future it may expand to contain wireless (3G) and satellite.

Customers who decide not to purchase the product (or to purchase less of the product) at the increased price are “marginal” consumers. For small price increases, they switch from the products inside the putative “market.” Not all customers, however, are marginal customers. Indeed, in the typical case, most customers would continue to purchase the product despite the higher price because their willingness to pay for the product exceeds the raised price. These customers are “inframarginal” consumers.
In the presence of high demand elasticity and high supply elasticity, a firm cannot exercise unilateral monopoly power by attempting to decrease its supply. Demand elasticity is captured by a customer’s willingness to switch to competing suppliers as relative prices change. Thus, a broad range of available substitutes would imply a high own-price elasticity of demand. Following the same logic as the market definition criteria, the Merger Guidelines provide a concrete test for evaluating the competitiveness of a market as captured in the idea of market power, which is the ability of a single firm unilaterally to increase price above the competitive level for a “nontransitory” period of time. This test is the basis for the econometric investigation and conclusion that I discussed in the previous section.

Because competition takes place at the margin, only a small proportion of the ILEC’s customers need to defect to defeat its attempted price increase. In a simple example, it is possible to calculate that necessary proportion. Suppose that an ILEC attempted to increase prices on end-user access by five percent. How much traffic would that ILEC need to lose before the increase would be unprofitable? The formula to calculate that “critical share” is:

\[(1 - \frac{MC}{P}) Q_1 < (1.05 - \frac{MC}{P}) Q_2.\]

An important empirical fact for network elements is that fixed costs are a very large component of the overall cost, so that marginal cost is a relatively small component. Assume, for example, that the ratio of marginal cost to price, \(MC/P\), is 0.2. Then \(Q_2\) would be \(0.94Q_1\), so that the critical share is six percent. Thus, if the ILEC were to
attempt to raise its price by five percent, and if, as a result, it were to lose more than six percent of its traffic, the attempted price increase would be unprofitable and thus unilaterally rescinded.\textsuperscript{70}
Table 1: Benchmark Regression of Broadband Access Prices on Narrowband Access Prices

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated Coefficient</th>
<th>Estimated Standard Error</th>
<th>Estimated t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Price of Broadband Access(^{(1)})</td>
<td>4.03</td>
<td>.090</td>
<td>47.7</td>
</tr>
<tr>
<td>Intercept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Price of Narrowband Access(^{(2)})</td>
<td>-0.003</td>
<td>.026</td>
<td>-0.102</td>
</tr>
<tr>
<td>Road Runner Indicator</td>
<td>-0.116</td>
<td>.013</td>
<td>-8.64</td>
</tr>
<tr>
<td>Number of observations</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard error of regression</td>
<td>.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>.572</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{(1)}\) Broadband access price is the natural logarithm of cable broadband access price plus amortized monthly cost of installation.  
\(^{(2)}\) Narrowband access price is the natural logarithm of the price of a second telephone line plus second-line fees plus amortization of the installation cost.
Table 2: May 2001 Broadband Internet Access

<table>
<thead>
<tr>
<th>DSL:</th>
<th>May 2001 Subscribers (million)</th>
<th>May 2001 Market Share (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea Telecom</td>
<td>2.4</td>
<td>46.8</td>
</tr>
<tr>
<td>Hanaro Telecom</td>
<td>0.75</td>
<td>14.6</td>
</tr>
<tr>
<td>Others</td>
<td>0.15</td>
<td>2.9</td>
</tr>
<tr>
<td>Total DSL</td>
<td>3.3</td>
<td>64.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cable Modems:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrunet</td>
<td>1.0</td>
<td>19.5</td>
</tr>
<tr>
<td>Hanaro Telecom</td>
<td>0.52</td>
<td>10.1</td>
</tr>
<tr>
<td>Others</td>
<td>0.31</td>
<td>6.0</td>
</tr>
<tr>
<td>Total Cable Modem</td>
<td>1.8</td>
<td>35.6</td>
</tr>
</tbody>
</table>

| TOTAL BROADBAND    | 5.13                           | 100.0                           |

Table 3: Hausman-Sidak Test: U.S. Broadband

<table>
<thead>
<tr>
<th></th>
<th>Hausman-Sidak Necessary &amp; Impair Five-part Test</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>For the ILEC, if:</td>
</tr>
<tr>
<td>1.</td>
<td>It is technically feasible</td>
<td>Yes</td>
</tr>
<tr>
<td>2.</td>
<td>It denied CLEC use</td>
<td>No</td>
</tr>
<tr>
<td>3.</td>
<td>No alternative source of supply exists</td>
<td>No</td>
</tr>
<tr>
<td>4.</td>
<td>It has monopoly supply to end-users</td>
<td>No</td>
</tr>
<tr>
<td>5.</td>
<td>It has market power</td>
<td>No</td>
</tr>
</tbody>
</table>
Figure 1: Broadband Connections per 100 Inhabitants

Source: OECD Telecommunications Database
Figure 2: Broadband Internet Access in Korea (May 2001)
Figure 3. Cable’s market share versus DSL in the U.S. residential market

Source: Telechoice

1 Macdonald Professor of Economics, MIT. Research support from KIET is gratefully acknowledged. Dr. D.H. Lee and Mr. Y.K. Kim provided helpful information on Korean telecommunications. C. Miu and A. Sheridan provided excellent research assistance. James Alleman and the editor provided helpful suggestions.

2 DSL is asymmetric digital subscriber line where data moves downstream at significantly faster speeds than it moves upstream. PSTN is public switched telephone network, and HFC is hybrid fiber coaxial network. LECs are local exchange carriers. ILECs are incumbent LECs’ CLECs are “competitive” LECs.

3 Source: OECD Telecommunications Database. At the end of June 2001 the number of subscribers had increased to 6.25 million subscribers. See Korean Ministry of Information and Communication: http://www.mic.go.kr.

4 Both the UK and Germany have high levels of computer penetration and narrowband Internet access.

5 See the presentation by R. Blois (2001) for further discussion of the reasons for Korea’s high broadband penetration.

Telecommunications.” Hong Kong requires regulatory network unbundling.

7 Both the UK and Germany have high levels of computer penetration and narrowband Internet access.

8 I used on OECD penetration and price data. I was unable to collect data on Internet subscriptions per capita. However, the use of GDP per capita should control for this variable to some extent.

9 The GDP/capita elasticity is estimate to be 1.16, the broadband access price is estimated to be –0.98, and the regulation variable is estimated to be –0.71. The $R^2$ of the regression is 0.32.

10 This section is taken largely from Hausman et al. (2001b)

11 This discussion is consistent with my empirical findings discussed above. The estimated coefficient for narrowband access price had the incorrect sign in a number of the regression specifications.

12 In particular, many college students and singles with roommates reportedly use home telephone lines for their computer modems only, and make voice calls on digital pocket telephones.

13 Some cable providers provide free or low cost cable modems. Amortized over a 36 month period the results are not sensitive to whether the cable modem price is included.

14 The paper by P. Rappaport and L. Taylor in this volume also supports the separate market hypothesis.

15 This test is the approach to market definition commonly used by antitrust authorities, e.g. in the U.S., EU, and Australia. For an explanation see Department of Justice and Federal Trade Commission Horizontal Merger Guidelines, 1992, hereafter referred to as Merger Guidelines.

16 A partial re-survey in August 2001 to re-check the data and similar conditions was found.

17 Prices for non-cable subscribers are typically $10 per month higher. Consideration of these prices for customers who do not subscribe to cable had no significant effect on the results.

18 These data cover the price of monthly telephone access, not the price to the ISP. Although @Home and Road Runner provide both services in their price, because many narrowband ISPs provide national service at a single price, the price of ISP service was included in the intercept coefficient in the regression specification.

19 For residential customers who do not use a second (or higher) telephone line, the marginal price of access is zero, everywhere but in New York City, so long as a local network node (PAD) exists. I used different weighted averages for use of first and second telephone lines in some of the regression specifications, but
the results were not sensitive to the particular weights used.

20 The installation cost only captures the connection fee and does not reflect the costs of re-wiring the telephone jack.

21 The standard price of broadband Internet access over cable has recently increased to $50 per month. The price of AOL access has increased to $23.95 per month.

22 Some narrowband Internet customers do not use a second telephone line. The data using a weighted average of customers who use a first or second telephone line was analyzed. The results do not differ significantly, as discussed in the previous footnote.

23 The ILEC’s price of second telephone line service is treated as predetermined in the regression specification because it is set by regulation, not by market forces. Also, a Hausman specification test did not reject exogeneity. See J. Hausman, “Specification Tests in Econometrics,” *Econometrica*, 46, 1978. Furthermore, regulation requires ILEC tariffs for residential lines to be identical across a given service area.

24 To help interpret the coefficient estimate, even if it were statistically different from zero (which it is not by a long shot), note that a 10% decrease in the price of narrowband Internet access price would be associated with an expected decrease of 0.12% in the @Home price—essentially zero (about 5 cents per month).

25 The \( p \)-values for an \( F \) test are .105 and .235 for the two regression specifications. Both \( p \)-values are well above normal significance levels.

26 The \( p \)-values for an \( F \) test for the use of demographics is 0.63 for the first specification and 0.84 for the second specification. Neither \( F \) statistic is near the 0.05 significance level.

27 See Hausman (1998), Hausman and Shelanski (1999), and Hausman and Sidak (1999). The Australian regulator, the ACCC, has explicitly established this goal for their approach to telecommunications regulation. The ACCC refers to the goal as the “long term interests of end-users” (LTIE).


29 See Hausman-Sidak (1999) for a more detailed discussion of the Telecommunication Act and its implementation by the FCC.

30 Hausman and Sidak (1999).
The major difference is that telephone calls are charged for by the minute in Korea, so that unlimited local calling for a monthly fee does not exist as in the U.S.


According to the most recent FCC estimates, cable modems have 64.3% of broadband Internet subscribers in the U.S.


See Hausman (1997, 1999a, 1999b). This regulation is discussed in the next section.


Source: Telechoice, August 10, 2001. The ILECs have a much larger percentage of residential customers than small business customers; the CLECs are in the reverse position.

Telechoice estimates that DSL growth declined from 23% in Q1 2001 to 14% in Q2.

Excite@home is currently in financial difficulty and declared Chapter 11 bankruptcy. It has cut off AT&T’s customers and has threatened to terminate operations in February 2002.

As a settlement with the Federal Trade Commission to receive approval of Time Inc., AOL agreed to provide service to three non-affiliated ISP when it begins to offer broadband ISP service over the Time cable networks. To date, non-affiliated ISPs offer this service.

RCN had about 985,000 customers as of April 2001.

Cable companies sometimes claim that ILECs have market power for the supply of T1 lines. However, ILECs do not typically provide residential broadband service with T1 lines. Further, neither cable companies nor typically CLECs buy T1 connections from ILECs.

See Hausman (1997) for a further discussion.

Although potential competition from satellites is not discussed here, they will not provide significant constraining competition to cable providers for broadband Internet access in the next few years. According to the most recent FCC numbers as of Dec. 31, 2000, satellites provided about 1.6% of high-speed Internet connections.

The most straightforward evidence of this market power is that when RCN has entered cable market to compete with MSOs, prices have typically decreased by 10%-20% and the cable operators have moved previous premium channels into the basic tier, so that customers no longer pay extra for the premium
channels.

46 For example, see Shapiro & Varian (1999).

47 For further discussion of correct economic pricing see Hausman (1997), Hausman (1999a), Hausman (1999b).

48 FCC, "First Report and Order, CC docket No. 96-98 and 95-185", August 1, 1996. The FCC is being challenged by the incumbent local exchange carriers (ILECs) in Federal Court. The U.S. Supreme Court reversed and remanded for further consideration the FCC’s regulatory approach in January 1999. See AT&T Corp. v. Iowa Utils. Bd., 119 S. Ct. 721 (1999). In July 2000 the 8th Circuit Court of Appeals invalidated the FCC approach of basing it cost estimates on a hypothetical network, rather the actual network in use. See Iowa Utils. Bd. v. FCC, No. 96-3321, (2000). The Court decision requires the FCC to modify its approach to cost estimation. Currently, the case has been argued again to the U.S. Supreme Court, which will decide the appeal in 2002. Further legal proceedings are likely, no matter what the Supreme Court decides.

49 The contract (or regulation) could allow the new entrant to sell the use of the unbundled element to another firm if it decided to exit the business.

50 The FCC uses total element long run incremental cost (TELRIC) rather than TSLRIC. However, the basic economic approach is similar to TSLRIC.

51 In contracts between unregulated telecommunications companies, e.g. long distance carriers, and their customers; significant discounts are given for multi-year contracts.

52 This discussion follows Hausman (1997, 1999a, 1999b). For a set of papers that considers the options approach to investment in telecommunications see Alleman and Noam (1999). See also Laffont and Tirole (2000).

53

54 See Alleman in Alleman and Noam (1999).

55 The FCC incorrectly assumed that taking account of \textit{expected} price changes in capital goods and economic depreciation is sufficient to estimate the effect of changing technology and demand conditions. Thus, the FCC implicitly assumed that the variances of the stochastic processes that determine the
uncertainty are zero, e.g. that no uncertainty exists. Under the FCC approach the values of all traded options should be zero (contrary to stock market fact), since the expected price change of the underlying stock does not enter the option value formula. It is the uncertainty related to the stochastic process as well as the time to expiration that gives value to the option as all option pricing formulae demonstrate, e.g. the Black-Scholes formula.

56. This equation is the solution to a differential equation. For a derivation see e.g. Dixit and Pindyck (1994). The parameter $\beta_1$ depends on the expected risk adjusted discount rate of $r$, expected exponential economic depreciation $\delta$, and the net expected price $-\alpha$, and the amount of uncertainty in the underlying stochastic process. Note that this result holds under imperfect competition and other types of market structure, not just under monopoly, as some critics have claimed incorrectly. See e.g. Dixit and Pindyck (1994), Ch. 8, “Dynamic Equilibrium in a Competitive Industry”. Imperfect competition is the expected competitive outcome in telecommunications because of the significant fixed and common costs that exist.


58 When considering this result, one should realize that a new copper loop investment today over its 15-20 year expected economic lifetime will likely compete with wireless 3G networks offering speeds of 2 megabits per second. These 3G networks are beginning to be implemented at the current time. Indeed The next generation of wireless, 4G is being developed with planned speeds of 10 megabits.


60 See Crandall and Hausman (2000) for a further discussion of these companies and the industry.

61 Another larger regional DSL provider, Harvard Net, that served the northeastern U.S. filed for bankruptcy and ceased offering DSL service in late 2000.


63 “FCC Releases Data on High-Speed Services for Internet Access”, August 9, 2001. The FCC reported that high-speed connections to the Internet increased 63% during the second half of 2000. See www.fcc.gov.

64 Hanaro Telecom, the second largest broadband Internet access provider in Korea has a current market capitalization exceeding $600 million and positive EBITDA. Thus, Hanaro Telecom has not suffered the
financial disaster encountered by the US broadband CLECs.

65 This outcome differentiates it from the outcome in long haul markets where new providers constructed
fiber optic networks. A number of these long haul providers have experienced financial difficulty, but their
networks continue to be used so that real assets remain from the investment. To the contrary, when
Northpoint ceased operations AT&T did not acquire any of its network assets. A similar outcome appears
likely for Rhythms.

66 Of course, investors are supposed to be able to look after their own interests, without the need of FCC
regulation.

similar approach.

68 Internet access is currently offered by DBS (satellite) providers, but it is not a sufficiently good
alternative to provide a competitive constraint.

69 See the 1992 Merger Guidelines. The Merger Guidelines emphasize the own-price elasticity of demand,
while other analyses focus on the cross-price elasticity of demand. But the two elasticity measures are
closely related.

70 For a more extensive discussion of critical share, see Jerry A. Hausman et al., “Market Definition Under