

Broadband Openness Rules Are Fully Justified by Economic Research (*)

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Abstract: This paper is an outgrowth of the filings in the FCC's broadband openness proceeding that focused on the issue of networks neutrality. Newly available data confirm that competition in the broadband access marketplace is limited. Wireless broadband access services are unlikely to act as effective economic substitutes for wireline broadband access services and instead are likely to act as a complement. Nor will competition in the Internet backbone marketplace constrain "last mile" broadband access providers. The last mile's concentrated market structure, combined with high switching costs, provides these providers with the ability to engage in practices that will reduce social welfare in the absence of open broadband rules. Allowing broadband providers to charge third party content providers will not necessarily result in lower prices being charged to residential Internet subscribers. The effect of open broadband rules on broadband provider revenues is likely to be small and can be either positive or negative. Price discrimination by broadband providers against third party applications and content providers will reduce societal welfare for numerous reasons. This reduction in societal welfare is especially acute when price discrimination is taken to the extreme of exclusive dealing imposed on content providers. Antitrust and consumer protection laws are insufficient to protect societal welfare in the absence of open broadband rules.

Key words: Network neutrality, Internet, two-sided market, discrimination, prioritization, market power, broadband, access pricing, AT&T, Verizon, Google

JEL Classifications: L1, D4, L12, L13, C63, D42, D43

Providers of residential broadband transmission access networks have significant market power that, in the absence of regulation, can be used to impose fees on content providers and limit efficiency and innovation

Providers of last mile broadband access networks have significant market power for a number of reasons.¹ First, residential customers typically can

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choose from only two providers of last mile broadband access - a telecommunications company and a cable television company. FCC data, the opinion of the United States Department of Justice ("DOJ"), and even filings by economists attached to comments opposing open broadband rules substantiate the existence of this "duopoly."

Second, the academic literature, as well as DOJ, strongly supports the position that a duopoly market confers greater market power and ability to charge higher prices and to engage in other anticompetitive practices than markets with more competitors. In the broadband context, market power possessed by residential broadband access network providers allows them to impose fees on content and applications providers to the detriment of social welfare. Third, customers face significant switching costs when changing Internet access providers. This confers additional market power on access network providers and would confer this market power even if the number of access network providers was larger.

Fourth, once a customer has subscribed to a broadband access network provider's services, the customer is effectively "captured" and can be used to extract surplus from the other side of the network. This is akin to the terminating monopoly problem of voice telecommunications networks. Fifth, similar concerns about abuse of market power also apply within the wireless market, and there is only a limited possibility that wireless broadband services will constrain wireline broadband duopoly providers' market power. Wireless broadband is not an effective economic substitute for fixed (wired) broadband and does not constrain wireline duopolists' market power. Wireless itself is not robustly competitive, and has high barriers to entry and high switching costs. Furthermore, the two largest wireless carriers are also among the largest wireline broadband providers. This implies that the wireless market severely limits the wireless affiliate's incentives to constrain the market power of the other wireline duopolist. Moreover, consumers face significant switching costs that are technology- (e.g., having to pay for a new handset) and contract-based (e.g., long-term contracts with exit penalties) that limit competition among wireless providers.²

¹ This is in contrast with the opinion of some commentators who argue that there is significant competition in the last mile broadband access market. See e.g., SCHWARTZ (2010, p. 6); BECKER & CARLTON (2010, pp. 5, 12).

² The effective tying of wireless service with handsets implies that customers who change providers have to pay for a new handset even when it is not technologically necessary.

Residential broadband access competition is limited. Several sources in addition to those cited in ECONOMIDES (2010a) provide evidence of the duopoly nature of wireline broadband service competition. According to FCC (2009), "At most 2 providers of fixed broadband services will pass most homes."³ Citing this, DOJ (2010, p. 13) asserts "[t]he enormous sunk cost of wireline broadband networks makes it unlikely that additional wired broadband competitors will enter many geographic areas other than those with the greatest density of users." The FCC's National Broadband Plan explains: "Given that approximately 96% of the population has at most two wireline providers, there are reasons to be concerned about wireline broadband competition in the United States." (FCC, 2010b, p. 37, "National Broadband Plan"). Recent FCC data on broadband deployment at the census tract level confirms this. For services with download speeds from 3 mbps up to 6 mbps, DSL and cable modem services have 93.6% share.⁴ For speeds from 6 mbps up to 10 mbps, DSL and cable modem services have 99.7% share (FCC, 2010, p. 14, Chart 11). FAULHABER & FARBER (2010, p. 11), who filed for AT&T in the FCC proceeding, also recognize the duopoly nature of the market: "We would be remiss in not mentioning that in most markets, there are only two wireline broadband ISPs." SCHWARTZ (2010, p. 6), who also filed for AT&T, refers to the residential broadband market's "duopoly structure in many local areas." Moreover, due to the speed limitations of at least one of these options, many areas effectively have only a single choice. As FCC (2009, p. 135) states, "50 - 80% of homes may get speeds they need from one provider," and "in areas that include 75% of the population, consumers will likely have only one service provider (cable companies with DOCSIS 3.0-enabled infrastructure) that can offer very high peak download speeds." (*National Broadband Plan*, p. 42)

Duopoly implies greater market power and higher prices. Almost all theoretical economic models show significant reductions in market power and prices as the number of active firms increases.⁵ The relationship

³ FCC September Commission Meeting slides, Sept. 29, 2009. http://www.fcc.gov/Daily_Releases/Daily_Business/2009/db0929/DOC-293742A1.pdf (p. 135).

⁴ Similarly, DOJ (2010) at 6 observes, "[i]n the near term, it appears reasonable to expect that most consumer demand will be met by services offering actual speeds of 3 - 4 Mbps. Over the long term, consumers may demand substantially greater speeds to take advantage of newer applications, such as HD video streaming."

⁵ The major exception is Bertrand oligopoly with perfect substitutes (identical products) and no fixed costs, market frictions, or switching costs. In such a model, entry beyond two firms does not affect price because a perfectly competitive outcome with zero profits results even with two active firms. Clearly, the level of competition in the provisioning of last mile broadband

between number of firms and market power has been tested empirically in studies that structurally estimate entry and evaluate its impact on pricing and profits.⁶ These studies confirm the positive relationship between concentration and market power, as evidenced by prices charged and profits earned.⁷

DOJ recognizes the importance of the number of firms in enhancing consumer welfare.

"Based in large part on its extensive experience in evaluating horizontal mergers, the Department starts from the presumption that in highly concentrated markets consumers can be significantly harmed when the number of strong competitors declines from four to three, or three to two. This same experience teaches us that consumers can enjoy substantial benefits when the number of strong competitors rises from two to three, or three to four, especially if the additional competitor offers products based on a new and distinct technology." (DOJ, 2010, p. 15).

Fewer firms in an industry not only generally leads to higher prices, but also facilitates explicit and implicit collusion. Fewer firms lower the

transmission does not fit this simplistic model. There are significant frictions and switching costs, and providers have significant fixed costs and reap significant profits.

⁶ These studies use the observed number of firms in different-sized markets to infer the firms' variable profits. The advantage structural empirical models of entry is that they are carefully done and are not subject to significant criticisms of earlier empirical literature on the relationship between concentration and prices. For a discussion of the limitations of this earlier literature, called the Structure-Conduct-Performance paradigm, see CARLTON & PERLOFF (2005, pp. 265- 267).

⁷ BRESNAHAN & REISS (1991, p. 977) estimate the effects of the number of firms on pricing and profits using a structural model of entry. Using data on geographically-isolated monopolies, duopolies, and oligopolies across several industries, they study the relationship between the number of firms (N) in a market and competition. The authors state: "Our empirical results suggest that competitive conduct changes quickly as the number of incumbents increases," with prices and profits falling with increases in the number of firms. They find "that prices fall as N increases." See *id.* at 1006. They also find that the largest price declines occur in moving to more than two firms in a market. They conclude, "To summarize, our tire price data confirm that entry lowers margins. Markets with three or more dealers have lower prices than monopolists and duopolists." A similar effect in moving from two to more than two firms is found in a separate study on geographically isolated retail automobile markets. BRESNAHAN & REISS (1990, p. 522) conclude that "the entry of a second dealer does not cause variable profits or margins to fall by much" but prices do fall with more than two firms. There is also a separate literature that estimates firm conduct in oligopoly industries taking the number of firms as given. In surveying this area of literature, BRESNAHAN (1989, pp. 1043, 1052) concludes, "These studies confirm the existence of a relationship between price and concentration, which is at least suggestive of market power increasing with concentration." He concludes that there is a positive relationship between concentration and pricing and that markups in these industries can be quite high. "There is a great deal of market power, in the sense of price-cost margins, in some concentrated industries."

organizational costs of collusion, (CARLTON & PERLOFF, 2005, pp. 134-135, 379) make it easier for firms to monitor adherence to the collusive arrangement, and generally increase the incentive to collude (CARLTON & PERLOFF, 2005, pp. 136-137, 148-149, 379; TIROLE, 1988, pp. 247-248). CARLTON & PERLOFF (2005, p. 135) cite empirical evidence on the relationship between the number of firms and collusion and find that "empirical evidence supports the view that cartels are more likely in concentrated industries."

While these empirical studies primarily focus on measuring price as evidence of market power (because it is easily measured), market power also conveys the ability to engage in the practices that open broadband rules are designed to protect against and described in Economides (2010a). Market power conveys the ability to create artificial congestion and foreclose competing content services from the network. On the Internet, in the absence of open broadband rules, broadband networks' market power can lead to the imposition of fees on content and applications providers that will reduce content provision as well as consumers' welfare. Most importantly, such fees will reduce the network effects on the Internet that create the virtuous cycle that has sustained the Internet's growth and tremendous positive impact on the U.S. economy.

In the broadband Internet access market, a larger number of competitors would not necessarily result in a competitive outcome in the market. A particularly important factor limiting the effects of entry is the switching costs at the customer level. As explained in ECONOMIDES (2010a), customers face significant costs in changing last mile broadband access networks. Lower customer churn in a market in the presence of switching costs has been shown both theoretically and empirically to be associated with a less competitive and higher-priced outcome.⁸

High prices and low churn confirm market power of last mile broadband access providers. Schwartz, while stating that the wireline broadband access market is a duopoly, (SCHWARTZ, 2010, pp. 6, 31) claims that there is

⁸ KLEMPERER (1987) shows theoretically that if customers face switching costs between two providers of a differentiated good, pricing is likely to be more competitive the greater the fraction of customers that move into the market or across firms. SHARPE (1997) generalizes this result to an industry with any number of firms and tests it empirically using data from retail banking. He finds that the amount of customer migration (churn) has a significant competitive influence on price markups.

"vigorous competitive rivalry."⁹ However, his arguments are based on examples that do not hold up to scrutiny. First, while comparative advertising does occur, it is targeted mostly at marginal consumers in areas where consumers have access to more than two service providers. As noted above, FCC (2009) states that "50 - 80% of homes may get speeds they need from one provider." Further, Pew shows an average monthly bill of \$44.70 for consumers served by only one provider, of \$42.80 for consumers served by only two providers, of \$38.10 for consumers served by only three providers, and of \$32.10 for consumers served by four or more providers. (PEW, 2009, pp. 26-27). This data shows that duopolists charge 4% less than in monopoly, triopolists charge 14% less than in monopoly, and four or more competing access firms charge on the average of 28% less than in monopoly. This shows significantly accelerating reductions in price as more firms are added to duopoly, which unfortunately most consumers cannot benefit from as they find themselves in duopoly broadband access markets.

Second, while technological upgrades of broadband access networks have been taking place, they lag behind upgrades occurring in other countries. The U.S. has been falling behind dramatically in international comparisons (ECONOMIDES, 2010a). Third, SCHWARTZ (2010) provides no reliable evidence that consumers change providers frequently, as discussed below. Fourth, prices have been increasing over time, as PEW (2009) reports for both average and median prices (see average prices in Table 1). Finally, while the percentage growth numbers in wireless may seem impressive, wireless broadband adoption is low and limited only to certain areas of the United States. FCC (2010) notes that less than 10% of all residential broadband connections are from mobile wireless. (ECONOMIDES, 2010a, 15, using the BTOP/BIP definition).

PEW (2009) reports average monthly prices of residential broadband services as shown in Table 1.¹⁰

⁹ He describes this rivalry in SCHWARTZ (2010, pp. 31-38) discussing comparative advertising, technology upgrades in response to competitors, price responses to competitors, customer switching, and quick growth in wireless broadband.

¹⁰ Filing for Verizon to the FCC, BECKER & CARLTON (2010, 5) argue that the "rapid growth in recent years in broadband subscribers, Internet usage, service quality and reductions in price indicate that consumers have derived significant benefits from competition and innovation.". BECKER & CARLTON (2010, p. 13) cite a source for the claim that prices for DSL service fell from \$40 in 2002 to \$31 in 2006 and that prices for cable modem service have fallen as well. This trend is reversed in the more recent Pew data.

These data show that competition has weakened and prices have increased across the board. According to Pew, not only did the average price across all service levels increase from \$34.50 in 2008 to \$39.00 in 2009, but the average price paid for premium service also has increased from \$38.10 in 2008 to \$44.60 in 2009 (PEW, 2009). Table 2 below, adapted from PEW (2009), illustrates these price increases. The survey conducted by Pew further reveals that a full third of all consumers who have not adopted broadband cite price as the barrier they face. The U.S. has been falling behind over time in international comparisons of penetration, and currently fourteen OECD countries have higher penetration than the U.S. - even though the vast majority of them have lower per capita income than the U.S. (ECONOMIDES, 2010a).

Table 1 - Average price of U.S. residential broadband service

Year	Average Monthly Price of U.S. Residential Broadband Service
2004	\$39.00
2005	\$36.00
2008	\$34.50
2009	\$39.00

Source: PEW (2009) ¹¹

Table 2 - Broadband Internet prices have been increasing both in mean and median

<i>Mean and Median Prices Paid for Broadband and Dial-Up Services, 2008-2009</i>				
	<i>2008</i>		<i>2009</i>	
	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>
All Internet Users	\$32.70	\$30.00	\$37.60	\$35.00
Broadband	\$34.50	\$32.00	\$39.00	\$38.00
Dial-up	\$19.70	\$18.00	\$26.60	\$20.00
By Connection Type				
DSL	\$31.50	\$30.00	\$33.70	\$30.00
Cable	\$37.50	\$38.00	\$43.20	\$40.00
Other High-Speed	\$38.50	\$40.00	\$37.50	\$35.00
Service Type				
Basic	\$32.80	\$30.00	\$37.10	\$35.00
Premium	\$38.10	\$35.00	\$44.60	\$40.00

Source: PEW (2009, p. 29)

The terminating access monopoly further undermines competitive responses to third party paid prioritization. Local exchange carriers ("LECs")

¹¹ See PEW (2009, p. 25). Pew did not collect data for years 2006 and 2007.

have "captive customers." Each LEC acting as a monopolist is able to charge termination fees to interexchange carriers ("IXCs"). This causes significant reductions in social welfare that have been widely understood. (FCC, 2001, 30-33). Similarly, in a world without open broadband rules, broadband Internet access providers can use their "captive customers" to extract fees from distant network participants, such as content and applications providers. TOPPER (2010) claims incorrectly that "the competitive environment of the broadband industry alleviates these concerns." (ECONOMIDES, 2010b) The degree of competition for last mile broadband access is limited, as discussed in detail in earlier sections and in ECONOMIDES (2010a). Broadband Internet access providers' significant market power gives them the ability to use captive customers to extract fees from content providers. This is exactly what broadband Internet access providers have proposed and why they oppose non-discrimination rules. Like LECs towards IXCs, last mile broadband providers would like to exercise their monopoly power not only towards their direct broadband customers but additionally towards other, third-party providers of Internet services, applications, and content. Broadband Internet access providers have proposed to bypass existing markets for Internet transit and impose fees on content and applications providers that have no contractual relationship with them. This would create a significant market distortion and social welfare loss (ECONOMIDES, 2008).

Additionally, exercise of terminating monopoly power by last mile broadband providers can have unpredictable effects because there are many millions of types of content and applications providers, only a small minority of which have contractual relationships with residential customers. It would be very difficult for content and applications providers to impose fees on broadband customers across the board or to add new fees to their services.¹² There would be significant informational costs on upstream providers while the distortions of monopoly pricing would remain.

Wireless is not a viable economic substitute for wireline broadband in the near future. A number of factors limit the potential of wireless broadband to serve as a disciplining force on the wireline broadband duopoly. These include factors such as high concentration and switching costs that limit

¹² For example, take a website such as the *New York Times*. Should only U.S. consumers pay or should international users pay as well? Will there be no free content? Does every visitor have to establish a contractual relationship with the *New York Times* just so they can pass on the fees imposed by the last mile provider? Clearly, it is not possible for the majority of content providers to pass on fees to residential consumers.

competition within the industry and technological and economic factors that limit the substitutability of wireless and wireline broadband.

Wireless broadband is not robustly competitive and features high barriers to entry. Scarcity of electromagnetic spectrum and very significant network investments limit the number of viable wireless competitors. Recent mergers have reduced the number of large companies so that presently the two largest wireless operators have a combined market share of 66% (before the proposed acquisition of T-Mobile by AT&T). This is a very concentrated industry. Further, competition among wireless broadband providers is limited due to high switching costs at the customer level. Incompatibility of transmission technologies limits customers' abilities to change providers without incurring the significant costs of buying a new handset. This is exacerbated by the fact that most wireless operators require that customers buy a new handset even when the old one is compatible with their network. Moreover, most customers are locked in multi-year contracts and would face significant termination fees if they were to switch to a network of higher quality or speed.

Wireless broadband is not a viable economic substitute for wireline broadband in the near future. FCC filings opposing open broadband rules hypothesize that competition from wireless broadband will solve the problem of market power of the wireline broadband duopoly.¹³ However, this is speculative at best because wireless broadband has not yet emerged as a viable competitor, and is unlikely to do so in the near future. First, because of different demand and supply characteristics, wireless likely will remain a complement rather than a substitute to wireline broadband. For speeds at or above 3 mbps, mobile wireless access has a negligible market share. Lower economies of scale at the network access level in wireless compared to wireline significantly limit wireless broadband providers' ability to match wireline prices. Second, even if wireless were a viable technological substitute for wireline broadband Internet access, wireless would not be an economic substitute for wireline broadband in many areas because the same company owns and controls both networks. Third, competition within the wireless industry is limited by large switching costs at the customer level.

¹³ See SCHWARTZ (2010, p. 6): "Wireless broadband already has multiple competitors, is rapidly growing, and there is increasing competition between it and landline broadband access to attract consumers." See also SCHWARTZ (2010, p. 31): "[...] with the spread of wireless broadband and all four national carriers upgrading their networks, the trend is towards a larger rather than smaller number of competitors in the provision of broadband access."

DOJ (2009) notes that fourth generation wireless services are only just now emerging in a few areas and therefore, "we do not yet know... whether wireless broadband offerings will be able to exert a significant degree of competitive constraint on cable modem, DSL or fiber optic-based services." (SCHWARTZ, 2010, 8) This observation is reflected in data from FCC (2010a, p. 14). Mobile wireless access has a negligible market share for services with download speeds at or above 3 mbps, even though approximately two-thirds of all broadband subscribers have connections at or above 3 mbps (FCC, 2010, p. 18, Chart 13).

Wireless broadband will not be a close substitute for wireline broadband in the near future for both demand- and supply-side reasons. On the demand side, DOJ (2009) notes that wireless broadband cannot yet provide speeds equivalent to those offered by wireline broadband. As a result, "Wireless may be a very attractive alternative for consumers who greatly value mobility and for consumers who do not place much value on the highest speeds." (FCC, 2010a, p. 8) On the supply side, wireless and wireline broadband have very different cost structures. Wireline involves high sunk costs to reach a customer's location and very low marginal cost to provide service to those already connected, while wireless involves smaller sunk costs but higher marginal costs to expand capacity to new customers or increase usage for existing customers (FCC, 2010, pp. 9-10). As a result, DOJ (2010) concludes, wireless broadband "appears to offer the most promising prospects for additional competition in areas where user density or other factors are likely to limit the construction of additional broadband wireline infrastructure." (FCC, 2010, p. 8). Thus, while playing an important role in some low-density areas, wireless broadband is unlikely to provide significant competition to wireline broadband in most areas in the near future.

To the extent that wireless broadband may become a viable substitute for wireline broadband, the price pressure exerted may be limited by lack of competition within wireless broadband. The two largest wireless broadband service providers, AT&T and Verizon, also offer wireline broadband services in much of the country (FCC, 2010, p. 10). In these areas, wireline and wireless services will not compete with each other because they will not be priced independently. In fact, most wireless broadband service plans are made available at prices and speeds that limit the degree of economic substitution between wireless and wireline broadband. As DOJ (2009) notes, many wireless data services impose usage caps, while wireline services generally allow unlimited usage (FCC, 2010, p. 10). Even if these emerging technologies ultimately provide a close substitute technologically, it remains

to be seen whether wireless broadband pricing practices will shift materially to make those services a closer economic substitute for wireline services.

SCHWARTZ (2010, p. 3) claims that "[...] market forces and existing norms against arbitrarily blocking or degrading traffic greatly constrain the ability to impose significant unwarranted fees." As discussed in detail above, last mile broadband providers have the market power, incentives, and abilities to impose significant fees on content providers. Market forces at the last mile broadband access level are ineffective to constrain broadband Internet access providers from imposing significant fees on content providers. Additionally, these last mile providers have publicly stated that it is their business plan to impose such significant fees and effectively to degrade traffic by creating priority lanes.

Competition in the Internet backbone market will not constrain market power in the "last mile" because broadband access is complementary and serially related to the Internet backbone. As noted by ECONOMIDES (2010a, Section 1.2), the Internet is a network of interconnected networks. In some parts of the Internet, such as on the Internet backbone, there are a number of competing networks. For those parts, we can consider the market to be effectively competitive and not raise anticompetitive concerns in terms of allocative efficiency in the short run. In other parts, such as with last mile broadband access to residential users, we observe very significant concentration and market power. Since last mile broadband networks to residential users are serially related to (i.e., complementary to and not substitutable with) the Internet backbone, competitiveness in the Internet backbone market cannot constrain distortions in the last mile broadband access market.

As further noted by ECONOMIDES (2010a, Sections 1.2 and 2.2), new tolls would allow broadband providers to bypass a well-functioning market and impose arbitrary contracts. Today, across the rest of the Internet, the collection of bilateral market relationships for network transport works relatively efficiently. Introducing new fees would circumvent the existing Internet transport market and negate the efficiency all agree it provides. Further, instead of the straightforward voluntary market transactions that we observe today, we will potentially see an exponential growth in demands by broadband providers to collect money from a large number of ISPs with which they do not have contractual relationships and from the much larger number of content and applications providers that are these ISPs' customers.

Furthermore, imposition of discriminatory fees on content providers and its consequences (for example, packet delay) will be difficult for a consumer to decipher, and to determine that the packets are delayed due to the last mile broadband access provider's actions. Therefore, consumers will be less likely to switch providers than in markets where they are perfectly informed. Lack of transparency further inhibits market forces from constraining unwarranted fees.¹⁴

Broadband Internet access providers' market power gives them the incentive and ability to impose fees on third party content and applications providers, engage in price and non-price discrimination, and exclude competing content and applications. First, wireline broadband access providers have significant market power because of the small number of competitors, the presence of significant switching costs, and the lack of competition from wireless.¹⁵ Second, broadband access providers can exercise their market power not only toward their direct customers but also by imposing fees on content providers and subjecting them to a variety of price and non-price discrimination schemes. Third, it will be very difficult for customers to discern whether a content provider's data packets are slowed down due to reasons related solely to the content provider or because the packets are being put in the "slow lane" by the customer's broadband provider.¹⁶ Fourth, in the FCC proceeding the major broadband providers are proposing to start discriminating toward content and applications providers.¹⁷ It is reasonable to assume that all major last mile broadband

¹⁴ ECONOMIDES (2010a) also notes that many consumers buy Internet service in a bundle with telephone service or cable service or with both, and these packages and combinations vary across providers. Thus it is less likely for consumers to switch providers based on the deterioration of quality of only one of the products in a package. Additionally, AT&T and Verizon offer bundles that include wireline broadband service and wireless service. The inclusion of wireless service in the bundle, besides increasing switching costs, underlines the fact that these companies consider wireless service a complement rather than a substitute to wireline broadband service.

¹⁵ This is evidenced by limited churn and relatively low market penetration.

¹⁶ The loss of customers that BECKER & CARLTON (2010) assume would result from broadband providers' "bad acts" is likely not to materialize. See BECKER & CARLTON (2010, p. 12), "As a result of this competition [between broadband access providers], attempts by a broadband access provider to limit access to Internet content would be likely to result in the loss of subscribers that prefer unrestricted access, which provides a competitive constraint that limits incentives for such actions."

¹⁷ See, e.g., Comments of AT&T, p. 10; Comments of Comcast, pp. 39-40.

providers will seek additional revenues from third party paid prioritization.¹⁸ Thus, the consumer cannot avoid the invidious practice by changing broadband providers.

Antitrust and consumer protection will be insufficient to protect social welfare. Some, including KATZ (2010), filing in the FCC proceeding for Verizon, propose not to codify non-discrimination but to rely on "[...] an antitrust and consumer protection backstop to correct situations in which the market can be shown to have failed."¹⁹ I believe that the sectoral regulator should enact the open broadband rules now rather than wait for resolution of antitrust suits later for a number of reasons. First, litigation takes time and irreversible damage may be done before it is resolved. Second, each suit would typically deal with only a single issue, between only two litigants and based only on the particular facts of that case. Delays may be compounded by the need for multiple suits to be fully adjudicated and for a coherent body of case law to be developed. Third, the Internet is a key essential network for growth of the economy with very significant network effects and positive spillovers. Waiting years for the outcome of one or more lawsuits would create investment uncertainty for all participants and be highly detrimental to economic growth. Fourth, introduction of last mile discrimination likely will have significant negative consequences on innovation on the Internet, whether or not antitrust violations occur in connection with the loss of openness. Therefore, it is in the public interest to enact rules to prevent discrimination.

Even if open broadband rules negatively affect broadband Internet access providers' revenues, the effect is likely to be small; it is also possible that the open broadband rules will have a positive impact on these revenues

Broadband providers' last mile infrastructure is used for a variety of purposes and services. As a result, only a small portion of revenues from the infrastructure derives from Internet access service, as shown below. Therefore, even if open broadband rules reduce broadband providers' Internet access revenues, this will have a limited impact on these firms'

¹⁸ Therefore, BECKER & CARLTON's (2010) assumption that only one of the two last mile duopolists would initiate price discrimination (and customers who objected could switch to the other provider) is inappropriate.

¹⁹ KATZ (2010, p. 67) states: "A pro-consumer approach to policies that address the broadband industry would rely primarily on competitive market forces to deliver innovation and investment with an antitrust and consumer protection backstop to correct situations in which the market can be shown to have failed."

overall revenues. From a social welfare standpoint, this limited impact is greatly outweighed by the positive impact of regulation, as discussed in ECONOMIDES (2010a) - preventing firms from creating artificial congestion to charge for prioritization and encouraging improved network investment. Moreover, it is invalid to assume that open broadband rules will reduce broadband Internet access revenues.

The revenues from residential broadband Internet access represent only a small portion of total revenues from the overall usage of last mile infrastructure. Infrastructure for cable modem broadband service is shared with residential cable television service and VoIP service. Infrastructure for telco-based broadband service is shared with regular phone service and, increasingly, for multichannel video services. Both telco and cable broadband infrastructure also may support enterprise and specialized IP services to businesses and institutions. Most of the last mile providers' revenues are derived from these other, non-broadband Internet access, services.²⁰

Industry-wide, OECD (2009) estimates that there were 81,170,428 residential broadband subscribers in the U.S. as of June 2009 (OECD, 2009). A similar number, 71,547,819, is obtained from Pew (2009).²¹ Call these the "high" and "low" estimates of subscribers. For broadband, OECD estimates the average monthly price as \$45.52 in October 2008, and PEW (2009) estimates it as \$39.00 in April 2009. Call these the "high" and "low" prices. Multiplying the "high" price by the "high" number of subscribers and the "low" price by the "low" number of subscribers, the range of annual revenues from U.S. residential broadband services is between \$33.5 and

²⁰ It is difficult to get estimates of telco and cable companies' revenues attributable to broadband Internet access because typically companies do not break down their revenues in this way. However, a range of estimates can be established. For example, Verizon reports \$46.1 billion in "wireline" revenues in 2009 of which \$6.0 billion, or 13.0%, were derived from "broadband and video." See Verizon Communications 2009 Annual Report at 14 and 68. Comcast reports \$85.5 billion in revenues from "video, high-speed Internet, and phone" services from 2007 through 2009. Of this, \$21.4 billion, or 25.0%, was derived from "high-speed Internet." See Comcast 2009 Annual Report at 24.

²¹ See PEW (2009, 9). Pew estimates that 63% of adults have broadband at home. Assuming one broadband line per household and that Pew did not survey adults from the same household twice, this implies 71,547,819 subscribers because there are 113,567,967 households in the U.S. based on Census numbers.

<http://www.census.gov/population/projections/nation/hh-fam/table1n.txt>

\$44.3 billion. Residential broadband revenues are a small percentage of total providers' revenue.²²

Incumbent broadband providers have not shown that their broadband Internet access revenues will be diminished as a result of the proposed open broadband regulations. Without data, it is unclear what the effect of the proposed rules will be on broadband Internet access revenues. Additionally, demand for prioritization has not materialized, and so the market reaction to its possible introduction may be minimal. Also, even if the effect on revenues is negative, it will likely have only a small overall effect on last mile broadband providers' revenues. This is very small relative to the large social welfare gains to be achieved through open broadband rules that I detail in ECONOMIDES (2010a).

Effects of two-sidedness of the market on social welfare

Introduction of fees to third party content and applications providers can lead to higher prices for consumers.

In general two-sided markets models, charging fees to third party applications and content providers may lead to price increases for consumers.²³ But SCHWARTZ (2010, pp. 16-18, 24-25) claims that "the implication that some price reduction [to consumers] will occur is quite general" as a result of imposing a price increase on the third party content providers' side of the market. He states that this "follows simply because the two sides of the market are complementary." This claim is incorrect. The fact

²² We compare these revenues to total revenues for cable and telecommunications companies. NCTA (2009) estimates cable industry revenues as \$90.2 billion in 2009 and the FCC (2008) estimates telecommunications industry revenues as \$299.5 billion in 2007. Revenues include local, wireless, intrastate, and interstate phone service revenues. Adding the cable and telephone industry revenues together we obtain total revenues of \$389.7 billion. Therefore, using the "low" and "high" estimates of broadband revenues, residential broadband Internet access revenues as a percentage of their total revenues from the infrastructure range from $33.5/389.7 = 8.6\%$ to $44.3/389.7 = 11.4\%$. These are comparable to the Verizon number of 13.0% and the Comcast number of 25.0%.

²³ Opponents of open broadband rules argue that charging content providers will reduce broadband users' prices. They further argue that the proposed rules are equivalent to a tax on broadband consumers because they preclude a price cut by last mile broadband providers once they start imposing additional fees on third party applications and content providers. SCHWARTZ (2010, p. 3) writes "positive fees to content providers would result in lower prices to broadband consumers" and KATZ (2010, p. 42) writes "[s]pecifically, network operators might use revenue from arrangements with online service or application providers to subsidize the costs of consumer access, which would increase adoption."

that there is complementarity between provisioning content and applications and consumer access does not imply that there will be a price reduction to consumers or end-users as a result of a price increase (or introduction of fees) to third party content providers. Assuming complementarity, suppose that a broadband access provider imposes a fee on content and applications providers while keeping consumer prices the same. This will decrease the number of active content and applications providers and decrease consumers' willingness to pay for Internet access as well as their usage, because some content/applications providers will exit the market. Finding a lower demand for Internet access, the broadband provider may increase or decrease its consumer price, depending on the change in the elasticity of demand on the consumer side. As the consumer side demand shrinks, in general, it also changes elasticity.

If the new demand function by residential consumers is less elastic to price than before the imposition of third party fees to content providers, the broadband provider will increase prices to consumers. So, complementarity of the two sides of the market has little to do with whether a broadband access provider can profitably increase prices on both sides of the market. Whether increasing price to consumers simultaneously with increasing price to content providers is profitable to a broadband provider or not depends on changes in demand elasticity as prices to content and applications providers are increased. In *ECONOMIDES* (2010b), I describe a standard model of a two-sided market where, for reasonable parameter values, the broadband access provider can have incentives to increase prices simultaneously for content and applications providers and end users.²⁴

²⁴ SCHWARTZ's (2010, p. 18) claims that prices on the two sides of the market necessarily are inversely related is based on the very special demand function analyzed by ROCHET & TIROLE (2006). As WEYL (2009, pp. 22-24) shows, it is only in restricted modeling settings that ROCHET & TIROLE's (2006) reasoning holds. However, it need not hold, and hence no general inference can be made, that allowing broadband Internet access providers to impose a fee on content providers would lead to a decrease in Internet access prices. In fact, the reverse may happen with detrimental effects for both consumers and content providers. In the most general model of a two-sided market in the academic literature, WEYL (2009, pp. 22-34) shows that a last mile broadband access provider with significant market power can find it profit maximizing to increase prices in both sides of the market. Whether this action is desirable to the last mile broadband access provider depends on changes in the elasticity of end-user demand, which in turn depends on the dimensions of user heterogeneity. Thus, SCHWARTZ's (2010, p. 22) claim that pro-open broadband results in academic papers are based on limiting assumptions is incorrect. Additionally, SCHWARTZ (2010) states that existing economic models of two-sided markets assume the number of consumers is fixed on one side (p. 23): "These assumptions do not describe interactions in the Internet broadband industry today, let alone in the future. For example: (a) The number of group-1 members and their activity on the platform are assumed fixed. Thus, a price reduction to them cannot increase overall welfare, because it cannot

Even if prices to consumers would be lower, in a two-sided market setting with network effects, society may be better off under the open broadband rules, because consumers may have access to more content and applications. Because of network externalities, socially optimal prices are below the prices that maximize private profits, which do not internalize all externalities generated by the network. Hence, a zero fee policy toward third party applications and content providers corrects to some extent for an overall price level that otherwise would be too high for maximizing societal welfare.

Introducing price discrimination and prioritization will significantly harm consumers and the functioning of the Internet

BECKER & CARLTON (2010), SCHWARTZ (2010), and KATZ (2010) also claim that the introduction of price discrimination and even exclusive dealing will increase social benefits. BECKER & CARLTON argue that "price discrimination can result in prices to certain consumers that are below those that would prevail in the absence of discrimination, leading to an increase in sales to these consumers and to an expansion of total sales. Moreover, such price discrimination raises the firm's profits, which may create incentives for broadband access providers to invest in expanding or upgrading their networks compared to the investments that would be undertaken in the absence of discrimination." (BECKER & CARLTON, 2010, p. 10). This argument is about one-sided markets and tells us nothing about the paid prioritization arrangements that broadband providers want to impose.²⁵

increase 'output.' By contrast, lowering prices to Internet consumers will expand Internet penetration and use - both of which benefit also content providers." Schwartz has misread and misquoted the assumptions in ECONOMIDES & TAG (2009) and has not correctly taken into account the results of or assumptions in WEYL (2009). The two-sided market model applied to the open broadband context studied in ECONOMIDES & TAG (2009) explicitly shows that open broadband environment is preferable for society to fees imposed on third party applications and content providers when the fixed number of consumers assumption is relaxed and the number of consumers connected to the Internet and active content providers vary. See ECONOMIDES & TAG (2009, pp. 36-39).

²⁵ In one-sided markets, price discrimination has ambiguous effects on social welfare, and its introduction can decrease or increase social welfare. See, e.g., TIROLE (1988). BECKER & CARLTON (2010) also discuss the possibility that lower retail prices may increase social surplus. However, they do not address the price discrimination issue that is proposed by the broadband access providers. Last mile broadband providers are not proposing to decrease retail prices but rather to impose fees on third party applications and content providers. This is not addressed by BECKER & CARLTON at all, and there is no evidence that the introduction of such fees will lead network providers to decrease consumer prices, as discussed above.

BECKER & CARLTON (2010) state that imposing price discrimination raises last mile broadband providers' profits. However, we cannot assume that those profits will be spent on increasing network capacity. ECONOMIDES (2010a) shows that, once prioritization is introduced, broadband providers have incentives to create artificial congestion in the slow lane to make the faster lane more valuable (ECONOMIDES, 2010a, pp. 8, 13; PEHA, 2007; LEE & WU, 2009; CHOI & KIM, 2008). Other opponents of open broadband rules have similar flaws in their arguments.²⁶

In summary, existence of monopoly power in the residential broadband Internet access market is significant and imposing fees on content providers is an exercise of that power. With regard to investment incentives, I stress that telecommunications and cable companies have not suffered in terms of profitability during the last seventeen years when nondiscrimination and other fundamental tenets of open broadband generally prevailed. The codification of these existing tenets is unlikely to reduce last-mile broadband

²⁶ For example, SCHWARTZ (2010, p. 8) similarly espouses the benefits of price discrimination, but all in the context of one-sided markets: "Even monopolists regulated as common carriers have been afforded considerable latitude to engage in price discrimination, loosely defined by economists as differences in a firm's prices that do not reflect cost differences. They typically have been allowed to offer menus of options at different prices, provided the offers are made available to all similarly situated customers, although such menus can be used to implement what economists call indirect (or 'second degree') price discrimination. Some selective offers that can implement direct (or 'third degree') price discrimination have also been permitted, such as railroad rates based on the type of the commodity being shipped." KATZ (2010, p. 8) states "[e]xamples from other industries also illustrate the potential value of discrimination. For example, student discounts for software packages can increase adoption. Similarly, the practice of selling pharmaceuticals for lower prices in developing countries can make drugs available that would otherwise be financially out of reach for citizens of those nations." The problem with these examples, once again, is that they are from one-sided markets, and therefore are irrelevant. The proposed open broadband rules will not outlaw retail tiered pricing towards end-users. But, the examples of price reductions given in the quote are only half of the price discrimination picture. Introduction of price discrimination also implies increases in price to some consumers. Even in one-sided markets, price discrimination can easily reduce societal welfare. In general, the coordinated introduction of price discrimination schemes may reduce output. There is a general theorem in economics that price discrimination, which reduces total output, also reduces total surplus contingent on serving all markets under uniform pricing. See ECONOMIDES (2008) and SCHWARTZ (1990). KATZ (2010, p. 40) states "[i]n addition to generating revenues to cover fixed costs, price discrimination can generate revenues that may incent investment. In comments filed with the Commission, the U.S. Department of Justice [DOJ] cautioned against price regulation because it could undermine investment incentives. Prohibiting price discrimination is a form of price regulation that can harm the returns to investment and, thus, investment incentives." The DOJ's full statement on this was: "In particular, price regulation would be appropriate only where necessary to protect consumers from the exercise of monopoly power and where such regulation would not stifle incentives to invest in infrastructure deployment." See DOJ (2010, p. 28). Thus, contrary to what Katz argues, DOJ fully supports using price regulation "to protect consumers from the exercise of monopoly power."

providers' profitability. As I have explained in detail in ECONOMIDES (2010a), commencing paid prioritization service would encourage broadband providers to increase network congestion and would be unlikely to increase investment in infrastructure.

There are several reasons why price discrimination toward applications and content providers will not enhance welfare. First, there is no economic analysis of a two-sided market showing that price discrimination on the content and applications providers' side necessarily increases societal welfare. In fact, there is evidence of the opposite. For example, while HERMALIN & KATZ (2007) suggest that price discrimination will lead to an increase in total welfare, they also show that price discrimination can decrease welfare.

Second, in a two-sided market setting with prioritization, it is obvious that discrimination and prioritization can be harmful because last mile broadband providers now have incentives to keep the network congested in order to extract profits from paid prioritization (CHOI & KIM, 2008; PEHA, 2007; LEE & WU, 2009). Further, as ECONOMIDES (2010a, Section 2.6) points out, there is a large literature describing the incentives of firms with market power to degrade low-end products to ensure consumers buy more expensive, high-end products. The bottom line is that broadband providers have these same incentives to create differentiation between their high- and low-end services by degrading the speed of their low-end services. Further, broadband providers have incentives not to invest in new capacity or even to introduce congestion effects by slowing down the low-end service even when sufficient capacity is available.

Third, a key argument of opponents of open broadband rules is that price discrimination and prioritization can be optimal under congestion (SCHWARTZ, 2010, p. 5). However, ECONOMIDES & HERMALIN (2011) show that, even in the presence of congestion, there is a wide class of utility functions for which network neutrality is optimal. Fourth, charging differential prices to content providers for access to consumers is costly for broadband providers because they must carefully monitor and account for traffic over their network. This would divert resources away from investments in network upgrades and toward systems necessary to implement price discrimination (PEHA, 2007).

Fifth, discrimination would allow last mile broadband providers to prevent Internet-based competitors from competing with their traditional revenue sources. As ECONOMIDES (2010a, Section 2.3) points out,

telecommunications carriers' main business is phone service; cable operators' main business is providing multichannel video service. Thus, it is natural for these companies to have conflicts between traditional services and competitive Internet-based substitutes to them that consumers access via broadband last mile networks.

Sixth, if broadband Internet access providers are allowed to provide priority service to content and applications providers, the market can easily succumb to a "prisoners' dilemma" in which content and applications providers will all lose and the only winner will be broadband providers. ECONOMIDES (2010a, Section 2.5) describes this dilemma. Suppose that a broadband provider offers prioritization guaranteeing that search information in the priority lane arrives ten seconds before search information in the standard lane. Given the prospect of losing almost all of their customers if they stay in the slow lane, every search provider that can afford it will choose to pay to be in the "priority lane." As ECONOMIDES (2010a, Section 2.5) argues, such a scheme would make all other parties - i.e., surviving firms, foreclosed firms, and consumers - worse off. Society loses in three ways: from innovation that will not occur because only firms with deep pockets can survive; from reduced variety of services due to foreclosed firms that have disappeared; and from lost consumer surplus because some content providers will disappear.

Allowing exclusive dealing between broadband access providers and content/applications providers could be disastrous

KATZ (2009, 2010)²⁷ claims it is widely accepted that exclusive contracts frequently promote competition and consumer welfare and that vertical integration can stimulate investment by internalizing uncompensated spillovers from the investing stage to another stage in the vertical chain. However, there is a large literature that shows anticompetitive consequences of exclusive contracts (ELHAUGE, 2009; AGHION & BOLTON, 1987; SEGAL & WHINSTON, 2000; BERNHEIM & WHINSTON, 1998; KRATTENMAKER & SALOP, 1986a). Exclusive dealing can be disastrous on the Internet as it will allow a last mile broadband provider to select the winner on the content and applications side of the market. As Economides (2010a, Section 2.4) notes, a broadband provider may offer the following contract to search providers: only one search provider will receive prioritization, and all other search providers will go to the slow lane. This

²⁷ See KATZ (2010, pp. 8-9, 36-37); KATZ (2009), filing with Verizon, pp. 46-48

contract would create a number of distortions in the market for search: (1) the winner will be the one with the deepest pockets and not necessarily the one that is best in search; (2) it distorts the innovation race, because new companies are eliminated from the competition; (3) it raises the cost of innovation and diminishes innovation overall; and (4) in the presence of network effects and lock-in it can result in suboptimal choices in the long run. For example, if such a scheme was in effect in 2000, it may have picked Yahoo! as the winner in search and through lock-in, Google, Bing, and other search engines might never have developed. Moreover, once a winner is picked, there are technology-specific investments that broadband Internet access providers may make that will perpetuate an old winner.

Finally, problems with price and non-price discrimination of a monopolist or oligopolist in market A that is vertically integrated in market B competing with a stand-alone company that participates only in market B are well-known (ECONOMIDES & WHITE, 1995). Pricing above cost in market A has no influence on the vertically integrated monopolist but disadvantages the independent producer in market B, leading to lower output, higher prices, and lower social welfare. In terms of non-price discrimination, ECONOMIDES (1998) shows that the monopolist can employ strategies to raise rivals' costs that have very similar disadvantageous effects (SALOP & SCHEFFMAN, 1983; KRATTENMAKER & SALOP, 1986b). Exclusive contracts with one or more content providers also may allow a last mile broadband provider to (i) prevent entry in the content market; or (ii) profitably push out of the market a rival in a complementary service, say VoIP, if this reduces competition in a present or future market (AGHION & BOLTON, 1987; BERNHEIM & WHINSTON, 1998).

Concluding Remarks

Some economists claim that natural competitive forces among last mile broadband access providers will discipline the market and prevent the detrimental impact that price discrimination and foreclosure of content and applications providers will have on growth and innovation. Unfortunately, such competition is not present among wireline broadband providers. Moreover, such robust competition is not present in the wireless market either, and wireless broadband acts more as a complement than a substitute for wireline broadband.

Relying on narrow interpretations that are not robust to changes in assumptions, these commenters also claim that models of competition in

two-sided markets reassure us that price discrimination against third party applications/content providers and exclusive dealing between broadband providers and content/applications providers will not result in higher prices to customers, a reduction in content availability, artificial congestion, or reduced innovation investment. In contrast, I show that careful examination of two-sided markets models offers no such reassurance. Instead, the proposed open broadband rules offer a straightforward and effective means of strengthening market interactions to ensure the openness of the Internet and the resulting growth and innovation that it provides to the U.S. economy.

References

- BECKER, G. & DENNIS, C. (2010): Declaration of Gary S. Becker and Dennis W. Carlton, Attachment A in Verizon Filing, GN Docket No. 09-191, WC Docket No. 07-52.
- BERNHEIM, B. D. & WHINSTON, M. D. (1998): "Incomplete Contracts and Strategic Ambiguity," *American Economic Review*, vol. 88, no. 4, 902-32.
- BOLTON, P. & AGHION, P. (1987): "Contracts as a Barrier to Entry", *American Economic Review*, vol. 77, no. 3, 388-401.
- BRESNAHAN, T. F. (1989): "Empirical Studies of Industries with Market Power," in SCHMALENSEE, R. & WILLIG, R.D. (Eds), *Handbook of Industrial Organization*, Volume II, Elsevier Science Publishers B.V.
- BRESNAHAN, T. F. & REISS, P. C.:
- (1990): "Entry in Monopoly Markets," *The Review of Economic Studies*, vol. 57, 531-553.
 - (1991): "Entry and Competition in Concentrated Markets," *The Journal of Political Economy*, vol. 99, 977-1009.
- CARLTON, D. & PERLOFF, J. (2005); *Modern Industrial Organization*, 4th ed., Pearson Addison Wesley, Boston.
- CHOI, J. P. & KIM, B.-C. (2010): "Net Neutrality and Investment Incentives," *The RAND Journal of Economics*, vol. 41 (3), 446–471
- DOJ (2010): Filing by the United States Department of Justice in response to Notice of Inquiry, in *A National Broadband Plan for Our Future*, 24 F.C.C.R. 4342, 6 (2009). http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-09-31A1.pdf ("FCC Broadband NOI").
- ECONOMIDES, N.
- (1998): "The Incentive for Non-Price Discrimination by an Input Monopolist," *International Journal of Industrial Organization*, vol. 16, no. 3, 271-84. http://www.stern.nyu.edu/networks/The_Incentive_for_Non-Price_Discrimination.pdf.
 - (2008): "Net Neutrality, Non-Discrimination, and Digital Distribution of Content Through the Internet," *I/S: A Journal of Law and Policy for the Information Society*, vol. 4, no. 2, 209-233. www.stern.nyu.edu/networks/Economides_Net_Neutrality.pdf.
 - (2010a): "Why Imposing New Tolls on Third-Party Content and Applications Threatens Innovation and Will Not Improve Broadband Providers' Investment", in Jorge PEREZ MARTINEZ (Ed.), *Net Neutrality: Contributions to the Debate*. http://www.stern.nyu.edu/networks/Economides_Imposing_New_Tolls.pdf.
 - (2010b): "Broadband Openness Rules Are Fully Justified by Economic Research," Working Paper.
- ECONOMIDES, N. & HERMALIN, B. (2011): "The Economics of Network Neutrality," mimeo.

ECONOMIDES, N. & TÅG, J. (2009): "Net Neutrality on the Internet: A Two-sided Market Analysis," NET Institute Working Paper.

ECONOMIDES, N. & WHITE, L. (1995): "Access and Interconnection Pricing: How Efficient is the 'Efficient Component Pricing Rule'?", *Antitrust Bulletin*, vol. 40, 557-579.

ELHAUGE, E. (2009): "Tying, Bundled Discounts, and the Death of the Single Monopoly Profit Theory," *Harvard Law Review*, vol. 123.

FAULHABER, G. R. & FARBER, D. J. (2010): "The Open Internet: A Customer-Centric Framework", Exhibit 1, Comments of AT&T, FCC GN Dkt. 09-191; WC Dkt. 07-52.

FCC:

- (2001): *In the Matter of Access Charge Reform*, Seventh Report and Order and Further Notice of Proposed Rulemaking, 16 FCC Rcd. 9923.

- (2008): "FCC Telecommunications Industry Revenues 2007", report based on FCC Form 499-Q filings. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-293261A2.pdf.

- (2009): September Commission Meeting slides, Sept. 29.

http://www.fcc.gov/Daily_Releases/Daily_Business/2009/db0929/DOC-293742A1.pdf.

- (2010a): "High-Speed Services for Internet Access: Status as of December 31, 2008," Federal Communications Commission, February.

<http://www.fcc.gov/wcb/iatd/comp.html>.

- (2010b): *Connecting America: The National Broadband Plan*, Mar. 16.

HERMALIN, B. & KATZ, M. (2007): "The Economics of Product-Line Restrictions with an application to the Network Neutrality Debate," *Information Economics and Policy*, vol. 19, 215-248.

KATZ, M.:

- (2009): "Investment, Innovation, and Competition in the Provision of Broadband Infrastructure," Declaration of Michael L. Katz, June 8.

- (2010): "Maximizing Consumer Benefits From Broadband," Appendix B, Comments of Verizon, FCC GN Dkt. 09-191; WC Dkt. 07-52.

KRATTENMAKER, T. & SALOP, S.:

- (1986a): "Competition and Cooperation in the Market for Exclusionary Rights," *American Economic Review*, vol. 76, 109-113.

- (1986b): "Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power Over Price," *Yale Law Journal*, vol. 96, 209-293.

KLEMPERER, P. (1987): "The Competitiveness of Markets with Switching Costs," *RAND Journal of Economics*, vol. 18, 138-150.

NCTA - National Cable Television Association (2009): data based on SNL Kagan. <http://www.ncta.com/Statistics.aspx>.

OECD (2009): OECD Broadband Portal.

http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html

PEHA, J. (2007): "The Benefits and Risks of Mandating Network Neutrality, and the Quest for a Balanced Policy," *International Journal of Communication*.

Pew Internet & American Life Project (2009): "Home Broadband Adoption 2009". <http://pewinternet.org/Reports/2009/10-Home-Broadband-Adoption-2009.aspx>.

ROCHET, J.-C. & TIROLE, J. (2006): "Two-Sided Markets: A Progress Report," *RAND Journal of Economics*, vol. 37, no. 3, 645-667.

SALOP, S. & SCHEFFMAN, D. (1983): "Raising Rivals' Costs," *American Economic Review*, vol. 73, 267-271.

SHARPE, S. A. (1997): "The Effect of Consumer Switching Costs on Prices: A Theory and its Application to the Bank Deposit Market," *Review of Industrial Organization*, vol. 12, 79-94.

SCHWARTZ, M. (2010): "Declaration of Marius Schwartz," Attachment to Comments of AT&T, FCC GN Dkt. 09-191; WC Dkt. 07-52.

SEGAL, I. R. & WHINSTON M. D. (2000): "Exclusive Contracts and Protection of Investments," *The RAND Journal of Economics*, vol. 31, no. 4 (Winter), 603-633.

TIROLE, J. (1988): *The Theory of Industrial Organization*, The MIT Press, Cambridge, MA.

TOPPER, M. D. (2010): "Broadband Competition and Network Neutrality Regulation," GN Docket 09-191, WC Docket no. 07-52, Declaration of Michael D. Topper, Jan. 14.

WEYL, G. (2009): A Price Theory of Multi-Sided Platforms, *American Economic Review*.