Consumer Welfare, Capital Formation and Net Neutrality:

Paying for Next Generation Broadband Networks

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The US lags behind several other parts of the world in broadband development and the government is looking for ways to close the gap. The means for doing so are hotly debated with major stakeholders in the Internet value chain urging radically different approaches. The debate has centered around notions of "net neutrality" which has universal support in principle, but fails to find much in the way of consensus on details. A key element of net neutrality put forth by proponents is the proposition that of all the stakeholders in the value chain, only end users may be charged for network access and use. Other beneficiaries of broadband networks, including providers of software, applications and content, would by statute be insulated from paying providers of broadband networks. That notion – end users only pay – has gotten wide support from consumer groups, public interest advocates and from the largest content and applications providers.

This paper considers alternative payment arrangements sufficient to amortize investment in next generation broadband network and estimates their impact on consumer welfare. The paper concludes that requiring end users only to pay for next generation networks:

- *Is inconsistent with practice in other "multisided" markets;*
- *Will increase investor risk, suppress investment and slow construction of next generation broadband networks;*
- *Will increase rates to consumers; and*
- *Will reduce the present value of consumer surplus by more than $8 billion in the top 20 SMSAs -- about $285.00 per telco fiber connected household. Extrapolating to households in other parts of the country and to other, non-telco platforms would very likely bring about at least 3 to 4 times that ($24 billion to $32 billion) in consumer welfare increase on a national basis.*

Broadband markets are consistent with multisided markets in that the platform brings together independent groups that value each other's participation in the market. Imposing rules that prevent voluntarily negotiated multisided prices will never achieve optimal market results, and, as this study shows, can only lead to a reduction in consumer welfare.

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I. INTRODUCTION

The term "network neutrality" (NN) has taken center stage in the debate over reform of the Telecommunications Act of 1996. The outcome of the debate and any legislation emerging will substantially shape the evolution of the Internet and bound future consumer and economic welfare from its use. Given the economic and strategic importance of growing the scale and scope of Internet infrastructures and services, all stakeholders agree that we can ill afford legislative mistakes at this pivotal period in the development of critical national information infrastructures.

The NN debate has taken several forms with different focal points, but tends eventually to gravitate to consideration of the role government regulation should take in determining what kinds of networks are available, what services and content are available from them, how the costs of these networks are recovered and the level and structure of charges for different Internet uses and users.

Various NN advocates express fears that providers of facilities networks will impose conditions counter to the interests of other participants in the value chain -- equipment suppliers, applications providers, owners of content and end users. Derivative legislative proposals address various Internet-related "principles" and "freedoms" with respect to network access; access to content; access to applications and interconnection of terminal equipment.[2] Each insists that facilities based network providers not be allowed to block or restrict the access to core network facilities of downstream, cooperating producers in the Internet value chain. Details vary, but advocates support a significant role for regulation in protecting or advancing these principles and freedoms.

[2] The term "Internet Consumer Freedoms" (also called the "Four Freedoms") describes the four principles laid out by then-FCC Chairman Powell in his speech to the Voice on the Net (VON) Conference in October 19, 2004. These track fairly well with the four "Connectivity Principles" proposed by the High Tech Broadband Coalition. They are also reflected more or less in various legislative proposals –Broadband Internet Transmission Services (BITS), Wyden, etc. Some advocacy papers and draft legislative proposals have addressed other issues – universal service, build out requirements, the wisdom of municipal provision of broadband services and others -- within the net neutrality umbrella.

A. NN Advocates Claim that Consumers' Interest Requires Utility-Type Rate Regulation for Broadband Service Providers.

Generalized concerns about potential loss of these "freedoms" have spilled over and been levered into recommendations that government determine who can be charged for use of the network, how much, and how such charges should be determined. NN advocates urge Congress to prevent facilities providers from segmenting markets and offering different classes of service and different rates depending on classes of use, service, user, and location in the value chain. Specifically, several NN advocates urge that infrastructure providers, local distribution networks in particular, be obliged to charge for service or value rendered only to end users and be forbidden to charge firms (even through voluntary agreements) who provide other links in the value chain – content or applications providers like Google, Amazon, Microsoft, Yahoo, eBay, etc. – notwithstanding their substantial dependency on and enormous value derived from broadband Internet infrastructures and upgrades.

The American Enterprise Institute (AEI) stated the controversy as follows:

> [NN] advocates argue "…that it should be illegal for broadband service providers to charge end-users more for, say, streaming a full-featured movie than for downloading a recipe, or to charge content providers for sending data down the broadband provider's high-speed lines. The companies that supply high-speed Internet connections to consumers, like Verizon, Comcast, and AT&T, see it differently. They argue that other companies should not necessarily be allowed to use their property for free, and that they should be allowed to use flexible pricing mechanisms."[3]

While the debate is couched in general terms, it is a debate about more than just price regulation, but also extends to proposals for specific regulatory forms and processes. Advocates urge that end users alone should pay, and that the structure of rates be determined by government fiat and regulatory processes rather than market means.

- One NN advocated testified: "At a minimum, Congress could simply restrict access-tiering by network providers. That would leave network providers free to offer consumer-tiered service. But

[3] Robert Hahn and Scott Wallsten, The Economics of Net Neutrality**,** AEI-Brookings Joint Center for Regulatory Studies, April 2006, at p.1; Also see, Jean-Charles Rochet and Jean Tirole, Platform Competition in Two-Sided Markets, *IDEI Working Papers* 152, Institut d'Économie Industrielle, Toulouse, France, December 13, 2002.

such tiering should not be allowed to turn upon the particular provider of network content.[4]

- Speaking [at the Winter NARUC Convention] to the issue of innovation, Mark Cooper, director-research at the Consumer Federation of America, said "We need to keep an open space for innovation so that the real innovators can deliver the services that the consumer can and will pay for…*Let the consumer pay - it is the consumer that uses the network*."[5]

- A spokesman for a major corporate beneficiary of the broadband infrastructure testified: "The broadband carriers already are fully compensated by their residential customers for their use of the network. These companies can charge their own customers whatever they want, in order to make back their investments. Trying to extract additional fees from Web-based companies – who are not in any way "customers" of the provider – would constitute a form of "double recovery."[6]

- Finally, a bill introduced by consumer-champion Senator Wyden appears intended to ensure precisely that outcome – end users and for the most part consumers bearing the entire cost of investment in new broadband networks. The Senator's website explains: "Under Wyden's bill, the Internet Nondiscrimination Act of 2006, network operators would be prohibited from charging companies for faster delivery of their content to consumers over the Internet or favoring certain content over others." The context of the discussion on the

[4] Testimony of Lawrence Lessig before the Senate Committee on Commerce, Science and Transportation, Hearing on Network Neutrality, February 7, 2006, p. 10. Moreover, his opposition to tiering is limited to charging other firms in the value chain. At pages 2 and 3 of his testimony, Lessig writes: "To oppose access-tiering, however, is not to oppose all tiering. I believe, for example, that consumer-tiering should be encouraged. Network providers need incentives to build better broadband services. Consumer-tiering would provide those incentives. Consumer-tiering, however, should not discriminate among content or application providers. There's nothing wrong with network owners saying *we'll guarantee fast video service on your broadband account*. There is something wrong with network owners *saying we'll guarantee fast video service from NBC on your broadband account*. And, there is something especially wrong with network owners telling content or service providers that they can't access a meaningful broadband network unless they pay an access tax." We note that it is fair to ask whether a charge to beneficiaries is an access tax if levied on other firms, but a legitimate pricing practice if imposed on end users.

[5] As quoted by Maureen King, "Net Neutrality Principles Debated at NARUC Meeting," *TR Daily Online*, (No page number), February 14, 2006. (Emphasis added.)

[6] Prepared Statement of Vinton G. Cerf, Vice President and Chief Internet Evangelist for Google Inc. presented to the U.S. Senate Committee on Commerce, Science, and Transportation Hearing on "Network Neutrality," February 7, 2006 at p. 6.

> site indicates that the prohibition on charging other companies would extend to any company that is not an end user.[7]

Advocates claiming to represent consumers, the public interest, low-income users, minority users, senior citizens, the education community and others have made similar claims and/or are supporting approaches in, or like those in, the Wyden bill. While maintaining that the Internet not be regulated, these advocates urge that companies providing access to the Internet be regulated on grounds that doing so will advance consumer welfare.

B. This Study Addresses the Consumer Welfare Impact of a Statutory Requirement that only End Users May Be Charged for Broadband Access.

While various representations have been made on behalf of consumers and in the name of advancing consumer welfare, none reflects anything resembling a systematic effort to analyze how consumers would in fact be impacted by the proposed user-only charging schemes. This paper reports a first effort in that direction through simulation of the consumer welfare impact of a statutory requirement that local broadband infrastructure providers recover capital and other common costs entirely from end users.

The model used is a hybrid that draws on parts of several models widely used in other sectors and for other policy purposes. It uses consumer surplus as an estimate of consumer welfare; it uses broadband revenue requirement per household as a proxy for broadband prices; it uses new service diffusion experience to describe household penetration (the take rate) for next generation broadband services; it uses standard discounting tables to derive present value of streams of consumer surplus generated by broadband infrastructure investment; and it considers an investment suppression effect (from price regulation generated risk, earnings and growth effects) derived from the logic of standard capital budgeting models and investment valuation approaches.

The logic of the paper's approach is simple. If only end users can be charged, two interrelated effects follow. First, rates for end user access to the Internet and all services thereon are on average higher than they would be if part of the cost of building network infrastructure were to be recovered from other beneficiaries in the value chain. Higher end user rates reduces aggregate consumer welfare by a) reducing the number of users connected to networks, b) slowing the rate of new service adoption of those who are connected and c) by reducing consumer surplus (the difference between what they pay and what they would be willing to pay) for remaining users. Alternatively, recovering infrastructure investment in part from others who

[7] "Wyden Moves to Ensure Fairness of Internet Usage with New Net Neutrality Bill," News Release, March 2, 2006. Downloaded 6:04 PM, Thursday, May 4, 2006 at http://wyden.senate.gov/media/2006/03022006_net_neutrality_bill.html.

derive value from that infrastructure permits lower end user prices, accelerates the rate of household broadband penetration and increases, through well-known externalities, the total value of the Internet.

Secondly, the higher subscriber prices and lower take rates associated with requiring end users only to bear all costs of constructing new broadband networks a) make investment in network infrastructure more risky, b) reduce expected earnings for risk taking shareholders and c) reduce expected growth of cash flow from broadband network services. These events in turn raise capital costs, lower the optimal rate of rolling out broadband networks, and delay and/or reduce infrastructure investment. These effects feedback negatively on user prices, take rates, and consumer welfare, as well as reduce demand throughout the value-chain, affecting content and applications providers.

The alternative approach, recovering a part of the common costs of constructing infrastructure from cooperating producers of Internet services, who are clearly beneficiaries of growth in the scale and scope of network infrastructure, will lower rates to end users and trigger a sequence of events that are essentially the precise opposite of the foregoing: end user rates down, household penetration and service diffusion rates up, more users, more services added, better investment profile for shareholders and faster network rollout and investment.

It is likely that any potentially offsetting negative consumer impacts of higher costs for these cooperating firms will be modest, but in any event nowhere near large enough to offset the first order consumer welfare gains. So it is as well with any negative impact on investment and innovation by second and third tier providers.

While its logic is simple, several inputs are required to estimate the model. Robust estimates of many of those inputs are not available, in large part because this study models a network that does not exist. That means that prices, quantities, demand elasticities, investment, investment suppression from price changes, take rates, the impact price changes on cooperating producers of Internet services, and other value drivers must be estimated and bounded from limited data.

We conclude that the likely impact of an end user only pay restriction on common cost recovery for Internet access has no basis in promised consumer welfare gains. To the contrary, it is virtually certain that relaxing such a restriction would increase consumer welfare by lowering rates, increasing penetration and increasing prospects for recovering investment.

II. ECONOMICS OF PRICING IN MULTISIDED MARKETS

A. Multisided Markets Exhibit Joint Value Creation by Different Agents in the Value Chain.

Traditional economic analysis has focused on "one-sided" markets. In such markets the producer sits between two one-sided markets as in, for example, traditional economic models of the firm sitting between end users who buy output from the firm and suppliers of inputs used by the firm to make the product. And, while there are interdependencies, the producer internalizes this fact and deals with each side more or less independently.

The analysis of one-sided markets begs important questions arising frequently in the modern world and analysts have turned to such questions under the broad rubric of "two-sided" or "multi-sided" markets analysis. It is notable that many of the most interesting applications and recent analyses have to do with networks and/or with markets related to the Internet – both of which are apt in the NN debate over pricing.

The essence of multisided markets is the explicit and clear-cut interdependency among different groups who derive value from a particular production activity or economic "platform." One analyst defined multisided markets "…as platforms that serve two or more distinct groups of customers who value each other's participation."[8]

Another defines them as "…markets with network externalities [that] are characterized by the presence of two distinct sides whose ultimate benefit stems from interacting through a common platform."[9]

A third observes that: "A market is two-sided if platforms serve two groups of agents, such that the participation of at least one group raises the value of participating for the other group."[10]

There are numerous examples of interdependencies and positive externalities in multisided markets. "Buyers of videogame consoles want games to play on; game developers pick platforms that are or will be popular among gamers. Cardholders value credit or debit cards only to the extent that these are accepted by the merchants they patronize; affiliated merchants benefit from a widespread diffusion of cards among consumers."[11] Similar examples appear in the broad IT space: video streaming, text processing software, browsers, videogames, Internet

[8] Andre Hagui, "Pricing Structures of Two-Sided Platforms," RIETI and Harvard Business School (mimeo). http://www.bettermanagement.com/library/library.aspx?l=14019.
[9] Rochet and Tirole at p. 1.
[10] Roberto Roson, "Two-Sided Markets: A Tentative Survey Review of Network Economics," *Review of Network Economics*, Vol. 4, Issue 2 – June 2005, at p 142.
[11] Rochet and Tirole, at p.1.

backbones, portals and media, and operating systems. These markets would not exist as they do now, but for their unique multi-sided pricing structures.

Platform builders and service suppliers in multisided markets must solve a classic "chicken and egg problem" which is manifest in the business challenge of getting all sides of the market to participate.[12] Because of the externalities among different sides, platform providers cultivate all sides. Thus, newspapers need readers and advertisers; broadcast networks need station affiliates, program producers, viewers, and advertisers; credit card companies need cardholders and participating merchants; Internet search engines providers need searchers, content, and advertisers; and so on.

B. Broadband Network Infrastructure Access is Provided in a Multisided Market.

The Internet has been likened to a "value chain" linking a variety of value adding firms and processes; to a "network of networks" within which various agents cooperate to add value to the stand-alone services of others; and to a collection of vertically disintegrated assets created by interdependent firms joining to create an array of end user services (email, online shopping, research, telephony, e-commerce, etc.) and content of various formats and kinds (voice, data, video, graphics, audio and the like.) However construed, the Internet is comprised of agents that both receive value from and confer value upon other agents.

It is useful for present purposes to think of the Internet as deconstructed into four parts: a**)** providers of telecommunications infrastructure and information paths (backbone and local distribution facilities networks); b) providers of content; c) providers of applications and transactions enablers; and d) end users. Each of the piece-parts is an integral part of a conglomerated network of agents linked by a complex array of contracts and markets, which provide the opportunity for each to confer and take value from the presence of others. Whatever metaphor is employed, the fact is that when end users access the Internet, they avail themselves of several individual services and/or products that combine to produce utility or value for them. There are, in short, reciprocal externalities in the sense that each group contributes value to other groups, while individual agents within groups create value for others within the same group and in other groups.

The illustrations and discussion in the multisided market literature make very clear that broadband network services are provided in multisided markets. Broadband network infrastructure platforms are located among, and create value for, several different economic agents or classes of beneficiaries. End users are one class, but not the only one. Other agents

[12] Ibid., to use their words, "get both sides on board."

and classes of firms, including various applications providers and providers of different kinds of content, draw enormous value from the platform – value which increases with expansion of the scale and scope of the infrastructure platform and the number of users connected to it. The demand for broadband networks from each of these agents or classes of firm is based on the value derived from the services provided through the cooperation of infrastructure providers and other agents and classes of firm in the value chain. All these relationships are well-known but worth emphasizing.

The value to end users of -- and their demand for -- Internet applications and content depends on the scale, scope and quality of underlying broadband network platforms. Similarly, the demand for Internet access is derived from the demand for, and value of, the products, services and relationships available from others connected to the Internet and/or other parts of the value chain. Infrastructure, applications and content are complementary goods/services in much the same way as highways, automobiles, motels and various tourist or travel related business services are. Better roads create value for motorists, but also for these neighboring, complementary businesses. So, too, do broadband network infrastructures create value for neighboring firms in the value chain that provide complementary goods and services, as well as for end users.

Complementary goods in a value chain exhibit externalities. Product improvement by one agent in value chain creates value for both users and for other agents in the chain. So it is with the broadband infrastructure platform. The presence of externalities and complementarities in telecom infrastructure network platforms are sure signs of a multisided market.

A little reflection suggests that multisided markets wherein central economic platforms of various sorts create value for multiple stakeholders are increasingly the rule rather than the exception in the US economy. Similar characteristics can be found in Yellow Pages directories (businesses, readers), publication software like Adobe Acrobat (authors, readers), Internet backbones and search engines (sites, surfers), shopping malls (shops, consumers), credit card platforms (end users and cooperating merchants derive value therefrom); matching and employment agencies, auction houses, service vouchers networks, payment systems, all kinds of communication networks, videogame consoles, scientific journals, Internet search engines (which provide value for searchers, "searchees," and advertisers); broadcast platforms (which create value for end users, production assets, advertisers and content providers); to name a few.[13]

Almost without exception these markets operate according to terms set out in private contracts, freely negotiated among principals, and subject to

[13] See Roson at p. 142. See also, Rochet and Tirole and references there.

general rights of property with only general, but minimal, trade oversight from government. And, they apparently work.

C. Pricing in Multisided Markets Takes Several Forms; Depends on Market Idiosyncrasies.

When multiple agents derive value from construction, provision and operation of an economic platform in a multisided market, questions, conflicts and disputes naturally arise, including: who pays, how much, according to what principles or standards, and what is economically optimal? But, these seem to be pretty successfully, if quite differently, resolved in most instances by negotiations and market processes.

Even a casual survey of multisided markets adjacent to various service/product platforms reveals an array of business models and pricing conventions. These range from "end users pay nothing" through a variety of shared cost recovery among end users and other agents in the network. Free TV is paid for by advertisers. Newspaper costs are recovered from both end users and advertisers. The Yellow Pages are free to end users, but space in them is sold to businesses. Some newspapers are free to users and supported fully by advertisers. Dating services networks charge membership fees for men, but grant membership to women free of charge. Credit card companies charge businesses and cardholders. It is difficult to find examples in which consumers as end users absorb the entire cost of the platform serving and creating value for other agents or sides.[14]

The variation in multi-sided pricing reaches into the IT space as well. For example, operating systems providers -- Apple, Microsoft, Symbian, Palm and others -- support system development, underwrite investment and earn profits from users through licensing fees while encouraging applications developers via grants of inexpensive access to their platforms. In contrast, videogame console manufacturers like Sony (PlayStation) and Microsoft (Xbox) cover costs and earn from royalties assessed to game developers while pricing below cost and incurring losses on sales of consoles to end users. eBay provides markets for both buyers and sellers, but charges only sellers.[15]

[14] In their survey and discussion of pricing practices in multi-sided markets Rochet and Tirole provide numerous illustrations of different platform cost recovery schemes.

[15] See Rochet and Tirole. Variations of multi-sided market pricing schemes are being used by some of the more vocal advocates of NN, rather than an end user only pays pricing regime. Hahn and Walsten point out as much (see at pp. 6-7 for discussion). Google's planned "free" Wi-Fi service in San Francisco might very sensibly be augmented in the future by advertisements charged third parties and delivered to Wi-Fi users. Yahoo recently committed to integrating its services with Blackberry, but, will charge Research in Motion (Blackberry's maker) for the privilege. Amazon recently announced its S3 storage system, which will allow software developers to store data on its servers for a storage fee of $0.15 per gigabyte stored per month and a transfer fee of $0.20 for each gigabyte. There are other examples, no doubt, and we have not searched diligently for them. Providers are

The socially optimal prices for customer groups in multisided industries depend on price elasticities of demand, indirect network effects between customer groups, marginal costs for providing goods or services to each group, inertia borne of custom and history, and other factors.[16] Moreover, for multi-sided markets, the optimal market solutions cannot generally be achieved by charging only consumers.

Most pricing models recognize the interdependence of agents and their character of joint value creation and harvesting among agents and classes of beneficiaries. Pricing practices and strategies are sensitive to the requirements of "getting both sides on board" – a phrase which recurs frequently in the literature. Both the business problem and the focus of recent research are on how to structure prices, not just within a class of agents (like end users or advertisers), but also between classes of agents. One study concluded:

> A key aspect of research centers around price determination in two-sided markets. Under two-sidedness, platforms need not only choose a total price for their services, but must also choose an optimal pricing structure, referring to the division of the total price between the two sides of the market. [17]

There is no single rule, rather both profit maximizing and economic welfare maximizing price structures are highly circumstantial and dependent on price elasticities of demand (ability to pay), the marginal value to different agents of the scale/scope of other agents, the incremental cost to the platform operator of "getting different agents on board" and others.

The choice is not a trivial question, since the very existence of the platform, and certainly its scale and scope, are contingent on getting prices right as between and among agents or classes on different sides of the market.

Notably, in the net neutrality context, one analyst observed:

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themselves discovering the benefits of pricing mechanisms they would deny broadband providers.

[16] See David S. Evans and Richard Schmalensee "The Economics of Interchange Fees and Their Regulation: An Overview," AEI-Brookings Joint Center for Regulatory Studies, May 2005. Also see, Wilko Bolt and Alexander Tieman, "A Note on Social Welfare and Cost Recovery in Two-Sided Markets," DNB Working Paper 24, December, 2004, wherein cost recovery requirements and the welfare impact of alternative pricing schemes are considered in formal economic models. The main takeaway for our purposes is that full cost recovery from one side only is never the economic optimum; that the real issue is how to allocate cost recovery responsibility among the different sides; and, that consumer welfare and demand elasticities are arguments in the solution. http://www.dnb.nl/dnb/bin/doc/working%20paper%20No.%2024-2004_tcm12-49223.pdf

[17] Bolt and Tieman at p. 1.

> …the distribution of prices faced by the two sides influences market participation and the overall volume of demand.[18]

Another was even more pointed:

> …in two-sided industries the product may not exist at all if the business does not get the pricing structure right. The need for both a pricing level and a pricing structure is one of the defining characteristics that distinguish two-sided markets from industries ordinarily studied by economists.[19]

Professor Hagui at Harvard argues:

> The pricing structure—that is, how much to charge to one side relative to others—matters; and in order to determine the optimal pricing structure one needs to carefully analyze the relative interdependencies among the multiple sides as well as their willingness to pay and join the platform.[20]

There appears to be a remarkable consensus among economists who have in the past five years focused on the character of multi-sided markets on issues that have been raised in the context of the Net Neutrality debate over pricing access to Internet platforms. Such markets have several value contributors and beneficiaries. There are significant complementarities and externalities among different agents in the value chain. Platform providers generally choose pricing schemes designed to a) reflect joint value contributions, b) "get on board" as many paying agents as possible, c) distribute revenue generation and cost recovery responsibility across different agents in varied ways, and d) almost never find it optimal to load all costs on consumers or end users as means of minimizing the burden on firms on other sides of the market who also harvest value from the platform.

D. There Are No Precedents, Principles or Guidance for Regulating Prices in Multisided Markets.

As an alternative to an outright statutory prohibition on multisided pricing to recover the costs of constructing Internet infrastructure platforms, it has been suggested that government regulators should be empowered and directed to assure that prices charged by Internet platform providers are "fair", "nondiscriminatory", "neutral" or otherwise in the "public interest." Available economic research on pricing in multi-sided markets provides

[18] Roson, at p. 142.
[19] Evans and Schmalensee, quoted in Bolt and Tieman at p. 1.
[20] Hagui, at p. 6.

no support for believing that such would lead to greater consumer welfare in pricing and use of broadband Internet infrastructure platforms.

First and foremost, there are no established principles for determining the public interest or fairness or neutrality with respect to the prices charged or services rendered to agents on different sides of a multisided market. What we have are subjective, unverifiable and immeasurable metrics for evaluating any change in policy, rules or market performance. It is simple to get a consensus on these nebulous objectives. Who will vouch for bias or unfairness or discrimination? However, it is next to impossible to find agreement on details in a concrete regulatory or market context. There is no certainty about how any statute empowering and directing regulators to regulate charges according to these standards would be enforced.

Secondly, there is little basis in recent telecom regulatory history to suggest that Congress and regulators can create consumer welfare by injecting government action in place of market forces. A spokesman for consumer interests (the Consumer Federation of America, Free Press and Consumers Union) recently reviewed in Senate testimony the current state of telecommunications policy under the Telecommunications Act of 1996. He concluded tersely: "It is not a pretty picture for consumers."[21] He elaborated on that conclusion:

> I believe that we have been brought to this sorry condition because:
> (1) the 1996 Act tried to do the impossible in some markets, aiming to build competition where conditions could not sustain sufficient competition to protect the public from abuse;
> (2) the Federal Communications Commission (FCC) and the antitrust authorities mishandled the introduction of competition in markets where it was sustainable; and
> (3) the FCC misread the 1996 Act in other markets, undermining and threatening competition that actually existed (e.g. Internet access and services).[22]

Given this indictment, it is not at all clear why we should expect different results on behalf of consumers were the FCC given the opportunity to divide and assign common costs among beneficiaries of Internet platforms and fix rates for different agents. A bit of introspection suggests the difficulty of FCC and state rate regulation in a multi-sided market for Internet infrastructure platforms.

[21] Testimony of Mark Cooper, Director of Research Consumer Federation of America on behalf of Consumer Federation of America, Free Press, and Consumers Union before the United States Senate Committee on Commerce, Science and Transportation, March 30, 2006, at p. 2.
[22] Cooper at p.3.

For example, consider the following rhetorical questions. What principles (in the name of net neutrality, fairness, nondiscrimination or the public interest) would the FCC invoke to decide how to apportion the fixed and sunk costs of Internet network infrastructures a) between end users as a class and other agents in the value chain, b) among different classes of users and use and c) among different agents upstream in the Internet value chain? How long would it take the FCC to establish such a set of principles? How long would it take for FCC processes and decisions to clear judicial reviews? If consumers' experience under the 1996 Act (as characterized above) is a reasonable guide, the prospect "…is not a pretty picture for consumers."[23] Nor could risk averse investors be encouraged.

III. BROADBAND SERVICES, DEMAND, INVESTMENT, COST AND CONSUMER WELFARE

Market experience and pricing practices of other platform providers serving multi-sided markets make clear the overriding challenge for broadband infrastructure network service providers: they must devise pricing schemes that maximize the value of the network, optimize its scale, scope and quality while also covering the substantial costs of constructing and operating it. That is a tall order.

It is well established that broadband networks are characterized by substantial sunk and fixed costs that must be provided at the threshold of provision of any services. Such networks also have modest marginal costs for serving the incremental user or providing incremental services. It is also well established that consumer welfare depends critically on how these costs are assigned to and recovered from value harvesting agents on different sides of the marketplace.

This section addresses some important relationships among investment, consumer welfare, prices, different kinds of network costs and cost recovery methods. It also derives some cost estimates that may be used as proxies for prices and as the basis for estimating the consumer welfare impact of pricing/cost recovery approaches now being advocated by different sides in the NN debate.

[23] The adverse consumer impact of regulatory uncertainty, delay and inefficiency would be contributed to and compounded by the reaction of investors to regulation of Internet access charges.

A. Consumer Welfare Depends on High Rates of Capital Expenditure on Broadband Networks; Potential Investors Are Not Enthusiastic

There is broad consensus that the US is "behind" much of the rest of the world in the development and use of broadband networks. Critics from all points on the political spectrum lament the US rank of 17th or 18th worldwide in the level of broadband penetration, which is down from number 4 in 2000. There is also consensus on the importance of broadband systems to the overall economy and the negative implications for economic growth, employment, productivity and global competitiveness as a result of the gap.

The consensus on the seriousness of the problem to be resolved breaks down completely on how best to resolve it. Nobody disputes that building new broadband networks will be costly. But, the magnitude of the investment, its risk, the prospects for recovering it and the cautious, frequently quite negative attitudes of investors who must supply the risk capital are all less apparent in the debate.

The amount of capital investment has been variously estimated (a matter to be addressed more fully below), but the order of magnitude is suggested by a recent study by Bernstein Research, which observed:

> If started in 2005, an FTTP [fiber to the premises] network connecting more than 30 million customers [in the 20 most populous states] would cost the three largest Bells about $45 billion to build…[24]

Since this estimate focuses only on the "three largest Bells" and 30 million households it is only a fraction, and perhaps a relatively small fraction, of the total capital budget required to serve the remaining 80 million or so households and to support one or more additional competitive wireline platforms built by cable companies or power companies; or wireless networks provided by municipalities or others. The total investment "bill" to support construction of broadband choice for most US households is very likely north of $300-$350 billion.[25]

The link between broadband investment, the scope and quality of broadband services and welfare for consumers and the national economy are generally understood. But they are not widely and consistently reflected in the debate about NN and the role of government. Nobody denies the absolute

[24] Bernstein Research, Fiber: Revolutionizing the Bells' Telecom Networks, A Joint Bernstein-Telcordia Technologies Study, New York, May 24, 2004, at p.1. (Hereafter Black Book).

[25] NECA is currently analyzing the cost of constructing broadband facilities in rural areas, but past studies indicate that the cost per household in less dense areas is well above the level in urban areas.

necessity in the first instance of high rates of new investment to enable the provision of the kinds of broadband services from which consumers and the economy will draw value. But, the current debate tends to gloss over the fact that investors must be persuaded to invest, or at a minimum given comfort that they may earn on and recover scarce capital, if the bounty of broadband networks is to be harvested. And, it is critical to bear in mind that that government regulation may well suppress investment.[26]

Since the telecom bubble burst 5 years ago, investors have been skittish about large capital expenditure programs and cautious about rosy forecasts of market demand growth and capital recovery. Thus, all companies, the Bells not excluded, have been subjected by investors to very strict capital budgeting discipline.

Financial analysts' and investors' views about broadband investment by telephone and cable companies vary from lukewarm to negative.[27] None are enthusiastic about the payoff to shareholders and creditors who express concerns about expected earnings, earnings growth and risk from construction of broadband networks.[28] All are implicated from an investor's point of view during consideration of the enormous capital outlays involved in building next generation fiber networks. Most analysts appear to be quite skeptical and some are downright hostile to the idea of massive telco or cable company, high risk capital expenditures. Even the most optimistic are cautious.[29]

- Earnings dilution. Equity analysts uniformly project significant reductions in short and medium term earnings for companies that undertake such investment. The extent and duration of such

[26] For a discussion of the relationship between regulation and incentives for firms to take risks and invest, see: Larry F. Darby and Joseph P. Fuhr Jr., "Investment Incentives and Local Competition at the FCC, *Media Law & Policy*, Vol. IX, No 1, Fall 2000, pp. 1-18 and references there. See also Jerry Ellig, "Costs and Consequences of Federal Telecommunications and Broadband Regulations: A Working Paper in Regulatory Studies", Mercatus Center, George Mason University, February 2005.

[27] See Full Senate Committee Hearing on Net Neutrality, Wall Street's Perspective on Telecommunications", March 14, 2006. http://commerce.senate.gov/hearings/witnesslist.cfm?id=1705 A hearings summary and commentary is available at: Ted Hearn, Analysts Question Bell Investments, *Multichannel News*, March 14, 2006. Online at: **(**http://www.multichannel.com/article/CA6316081.html?display=Breaking+News**).**

[28] "There is a high degree of skepticism that the substantial investment underway at the [phone companies] to deliver broadband networks to the home will deliver a satisfactory return on the incremental investment," said Luke Szymczak, vice president of JPMorgan Asset Management.

[29] Investors dislike policy upheavals in Washington that distract them from focusing on market fundamentals, said Kevin Moore, wireline telecom analyst at Wachovia Securities. "We have enough to worry about in considering the rapidly changing competitive and technological environment. In other words, we want regulatory stability and certainty," Moore said. (Quoted by Hearn at p. 1.)

dilution depends on the type of fiber deployment considered and the specific strategy pursued by different companies. [30]

- Risk. Market risk associated with such investment is significant. While the debate among advocates and policymakers over just how competitive the broadband market will be is not likely to be resolved soon, capital markets and investors are building in significant risk premiums to the cost of capital to reflect their assessment that telco broadband systems will have to vie with cable and satellites, in the near term, for market share and revenue, while considering the long term implications of wireless broadband platforms that are widely anticipated. Competition is a two-edged sword in this context. It impels pro-consumer behavior, but also increases investor risk and limits the ability of firms to amortize the enormous upfront investment.[31]

- Expected Growth. Outside the business community – and especially among public interest and academic advocates -- there appears to be a generalized, if implicit assumption to the effect of: "Build it and they will come." That may be, but investors are not so sure and their uncertainty is a barrier to the networks being built.[32] Investors who must risk their savings and wealth are unsure that the overall broadband market will grow fast enough to warrant investment in telco or cable broadband platforms – especially in the context of the growing likelihood that each will have to compete in the short term with satellite systems for some services; services provided by municipalities; or other systems that may be provided over power company lines; or, most importantly for the future, broadband wireless networks.[33]

[30]This is explained by Bernstein Research, "The Couch Potato Wars: Assessing the Impact of Bell Entry into the Consumer Multichannel Video Market", May 2005, See in particular Exhibit 58 at p. 82 (Hereafter Couch Potato Wars). "Our analysis of the economics of the Bell's fiber optic deployments suggest that earnings dilution can't be avoided in the near term, as the capital outlays for deploying fiber outpace the more gradual penetration of new services and cost savings," at p. 1.

[31] "The challenging economics of fiber will, however, limit the degree to which the Bells can aggressively discount video services in their bundles. For their channel investment, the Bells will capture only about 6-7% of the consumer multichannel market by 2010, or 15-20% share in the markets where they offer video. Couch Potato Wars at p.1. (Emphasis added.) The dilemma here is that price discounting raises penetration and reduces revenue requirement per user (RRPU), but it also reduces average revenue per user (ARPU). It is not clear that the result of reducing both ARPU and (RRPU) will have a positive impact on earnings. It will if, and only if, RRPU falls faster than ARPU.

[32] "The costs of these networks are far beyond what the returns of the new services can provide," said Craig Moffett, VP and senior analyst of U.S. cable and satellite broadcasting at Sanford C. Bernstein & Co. (Quoted by Hearn from Moffatt remarks at Senate Hearing cited above in fn. 27.)

[33] "Over the next five years, the Bells will collectively spend tens of billions of dollars to deploy fiber optic networks in order to add video services to their bundle of voice and data

> While policy advocates look back and at the current market for indicators of competition, investors must look at future time horizons sufficient to recover their investment. Given that a) the bulk of the investment must be made before returns begin to be generated and b) that expected rates of market penetration and new service adoption will delay such returns, investors must be sensitive to what the market will look like in the five to ten year timeframe and beyond.[34]

The importance of investor attitudes about the broadband buildout can scarcely be overemphasized, since, quite obviously, without investment there can be no consumer welfare from next generation broadband networks. But, an equally important consideration in the current debate may be more subtle. Specifically, investors have a big stake in the resolution of NN issues and particularly in the outcome of the debate over who can be charged, by what principles and by whom – that is, in resolution of set of network access pricing issues.[35]

B. Willingness to Pay, Prices, Price Elasticities, and Consumer Welfare.

We now turn from consideration of the supply side of the market – from platform pricing in multisided markets and supply conditions in capital markets to the consumer side of the market. In what follows we will link investment and capital costs to alternative means of recovering such common costs and to consumer welfare.

Direct consumer welfare from consumption is widely regarded by economists as represented by the difference between what consumers pay for a good or service and what they otherwise would have been willing to pay rather than do without. The difference measures "consumer surplus."

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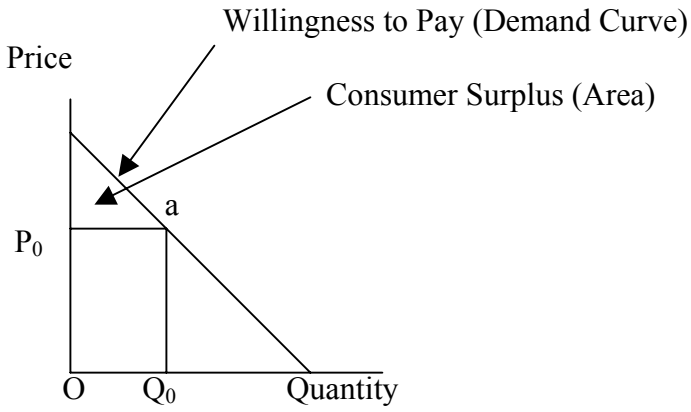
services – putting them in direct competition with cable and satellite operators." Couch Potato Wars at p. 1.

[34] "…as a rule, technological revolutions do not produce results over night – though the costs are incurred practically over night…While the revenue and cost benefits of fiber are long term, the multibillion-dollar capital investments required are very much near term." Couch Potato Wars at p. 83.

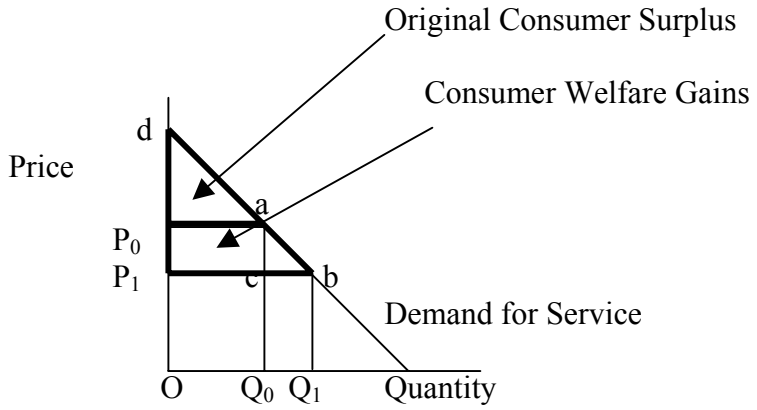
[35] During the Senate Hearing of Wall Street Analysts, Craig Moffett warned that if network owners were barred from creating a "fast lane" on the Internet to generate more revenue to cover capital expenditures, they would have to recover much, if not all, of their cost from subscribers, whose monthly bills would likely rise substantially. "Mandated net neutrality would further sour Wall Street's taste for broadband-infrastructure investments, making it increasingly difficult to sustain necessary capital returns, and it would likely mean that consumers alone would be required to foot the entire bill for whatever network investments do get made," Moffett said. (Quoted by Hearn at p.1.)



The diagram above is a familiar one relating different prices to different quantities that might be purchased. It shows users' "willingness to pay" for different amounts of service. Price P_0 and quantity Q_0 represent one such pairing. The rectangle cornered by OP_oaQ_0 represents the users' outlay for quantity Q_0 at price P_0. The triangle above rectangle OP_oaQ_0 measures the difference between what users were willing to pay for quantity Q_0 (if required to pay according to the willingness to pay schedule) and the market price that was actually paid. This is generally regarded as "consumer surplus." It is widely used as a measure of economic welfare and as the basis for assessing the welfare impact of policy changes.[36]

The diagram below illustrates the change in consumer welfare resulting from a change in prices. When price falls from P_0 to P_1, users increase the amount purchased from Q_0 to Q_1. This enlarges the consumer welfare triangle by the area represented by the triangle defined by *abc* plus the rectangle defined by P_0acP_1. The total increase is bounded by P_0abP_1.

[36] Erik Brynjolfsson, Michael D. Smith, Michael D. and Yu (Jeffrey) Hu, "Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers", MIT Sloan Working Paper No. 4305-03, June 2003. Available at SSRN. (This paper discusses several approaches to measuring consumer welfare/surplus and also addresses both limitations and advantages to various approaches. Jerry Hausman, "Cellular Telephone, New Products and the CPI," *Journal of Business and Economic Statistics,* Vol.17, No.2, April 1999, pp.184-194. Jerry Hausman, "Valuing the Effect of Regulation on New Services in Telecommunications," *Brookings Papers on Economic Activity*; Microeconomics, 1997, pp.1-38. Jerry Hausman, Mobile Telephone*, Handbook of Telecommunications Economics*, Chapter 13,Volume 1, M.E. Cave et al. (eds), 2002, Elsevier Science B.V. Austan Goolsbee, The Value of Broadband and the Deadweight Loss of Taxing New Technology January 2006. (Available online at http://www.nber.org/papers/w11994 and elsewhere in preliminary and free versions.)



Total outlay changes from P_0 times Q_0 to P_1 times Q_1. Consumer surplus increases since users are buying more and at a price less than they would have been willing to pay (as indicated by the demand schedule). The change in consumer welfare (ΔW) from a price change from P_0 to P_1 is estimable by adding the area of the triangle bounded by the change in price (ΔP) and the change in quantity (ΔQ) plus the opportunity to buy the old quantity Q_0 at the lower price . That is:

(Equation 1)
$$\Delta W = \left(\frac{1}{2}\right)\Delta P \Delta Q + \Delta P Q_o$$

Equation 1 can be used to estimate welfare changes from historical data sets containing actual prices and quantities from which changes can be calculated. However, most consumer welfare analysis is future oriented and driven by questions related to expected impacts of current or future policy changes. Analysts have devised and relied on a shorthand measure of the willingness to pay or demand curve, which describes the relationship between prices, quantities and changes in each. This measure – the price elasticity of demand – describes the (percentage) change in quantity resulting from a given percentage change in price. In cases where quantity demanded is quite responsive to changes in prices, demand is said to be relatively *elastic*. Where quantity is less responsive – relatively unresponsive -- to price changes, demand is said to be relatively *inelastic*. The formal relationship measuring price elasticity on terms of relative changes in price and quantity from their original values is defined below.

(Equation 2)
$$\varepsilon = \frac{\Delta Q / Q}{\Delta P / P}$$

Combining the relationship defining changes in welfare, as measured by changes in consumer surplus, with the relationship defining price elasticity of demand can be done by substituting Equation 2 into Equation 1 and rearranging terms. The result is Equation 3 below.

(Equation 3)
$$\Delta W = \frac{1}{2}\left[\frac{\Delta P}{P_o}\right]^2 P_o Q_o \varepsilon + \Delta P_o Q_o$$

The relationship in Equation 3 indicates that a price variation driven change in welfare (ΔW) may be approximated by the size of, and interrelationships among, the following:

- Original Price (P_0)
- New Price (P_1)
- Change in Price ($\Delta P=P_0-P_1$)
- Original Quantity (Q_o)
- New Quantity (Q_1)
- Change in Quantity ($\Delta Q=Q_0-Q_1$)
- Elasticity of Demand (ε)

P_0 times Q_o is total outlay at the original price, $\Delta P/P_0$ is the percent price change in price, P_1 times Q_1 the total consumer outlay, and ΔPQ_o is the consumer surplus or welfare created by the price change which enables consumers to buy the original quantity at a lower price. In effect ΔPQ_o measures "new" consumer surplus resulting from users paying less than previously for quantity Q_o.

C. Broadband Costs and Cost Structures

As indicated above, welfare changes can be estimated using equation 3. In the focus of the analysis, if historical or descriptive in nature, it is possible to use historical data. Thus, we might ask, as others have, what were the changes in consumer welfare from the introduction of a new service, from a tax, from a price change or some other historical event or event sequence. In those cases the welfare equation can be estimated from historical records describing actual prices, price changes, quantities and quantity changes combined with estimates of price elasticities.

However, since we are interested in future impacts, we must define and consider prices and quantities in the context of market circumstances that have yet to materialize. We must resort to hypothetical or illustrative values, since future prices and quantities for different services or uses cannot be known by legislators, regulators, investors, company managers, or us. That fact complicates, but does not prevent, making reasoned

estimates based on available information.[37] We cannot know future broadband prices or quantities specifically, but we have some information about what prices and quantities might reasonably materialize.

There are a variety of assumptions that one might make about future prices, but it is appealing to relate such prices to underlying cost and demand conditions and thereby make use of available data. That said, we acknowledge again that the costs and demand are basically unknowable, but can nonetheless be reasonably bounded for our purposes.

Prices must be related to costs. More specifically, prices along with quantities sold determine revenue and, in the aggregate, revenue must over time be sufficient to cover total cost. In simple forms of production, revenue from a single product (say wheat) must cover all the costs of producing that product. In more complicated cases, like pricing network access services, the total costs of providing the network must in the long run be recovered from revenue generated from prices and quantities of the "bundle" of services availed by the network to different users and beneficiaries. The required relationship in the long run between costs and revenue and cost per user and revenue per user suggests that we can get a sense of what prices will be by starting with a breakdown of costs. [38]

To estimate prices that will recover investment in the case of access to broadband services, we begin with the form and size of costs of the networks necessary to provide such services. Total costs can be viewed and disaggregated in a number of ways. The focus and purpose of this paper (investment, pricing and consumer welfare) are best served by considering them as comprised of capital and operating costs.[39] Thus, we define total costs (TC) as the sum of capital costs (C_{cc}) plus operating costs (C_{oc}).

[37] OMB Circular A-94 as revised observes in that context: "When market prices are distorted or unavailable, other methods of valuing benefits may have to be employed…[even though] measures derived from actual market behavior are preferred when they are available. See Office of Management and Budget, Transmittal Memo No. 64, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, October 29, 1992, section 6.b. (or see, http://www.whitehouse.gov/omb/circulars/a094/a094.html).

[38] The approach is a mirror image of the approach taken by regulators in the monopoly under "rate base, rate of return regulation." Under that regulatory scheme, future capital and operating costs were estimated and summed to constitute a "revenue requirement" that would recover costs and give the monopolist the incentive to invest. The revenue requirement was then effectively assigned to different classes of use and users on the basis of cost of service and value of service considerations in ways designed to recover costs and incent investment. What we are doing here is similar in the sense that we are asking what prices need to be in order to cover costs and incent investment.

[39] The following discussion of costs borrows from both economic conventions and financial accounting conventions, while being inconsistent in significant respects with either or both. Most of the available data are in financial accounting formats, while much of the regulatory analysis of the issues will be done, at least in part, by economic analysis or others using that framework. All costing and cost definition is purposive. Full

$$TC=C_{cc}+C_{oc}$$

Capital Costs. Capital costs associated with broadband networks have three important characteristics: They are typically regarded as a) "upfront" or threshold costs incurred prior to service cutovers and generation of revenues, b) common to a large number of actual and potential users who might be connected, c) largely "fixed" and "sunk."[40] Capital costs (on an annual basis) depend on capital expenditures, the cost of capital, and the rate at which capital expenditures are recovered over time through depreciation charges. Thus, capital costs can be regarded as sum of the return on capital (rate of return) and the return of capital (depreciation charges).

To illustrate, if a) the weighted average cost of equity and debt capital (WACC) is 10% and b) the average annual depreciation expense (D) is 10% applied to the sum of undepreciated capital expenditures (net plant and equipment) from previous years (corresponding to an expected economic life 10 years), then the annual capital cost of the network is reasonably approximated by 20% times the book value of net plant in service (where net plant is the sum of past capital expenditures minus accrued depreciation). Both return and depreciation can be taken as a function of net plant. Continuing the illustration, if the weighted average cost of capital is 10% and the annual depreciation rate is 10%, the annual capital cost of the broadband network is assumed to be:[41]

$$C_{cc} = \text{Return on Capital} + \text{Depreciation} = .20\ (\text{Net Plant})$$

It is critical here to note that these are common costs that must be recovered from some beneficiary of the underlying network(s). But, they are not

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allegiance to neither the economic view nor the financial accounting view of costs supports the purposes of this paper.

[40] Fixed costs refer to those that are generally invariant with respect to changes in output, while sunk costs are those that are recoverable only in the targeted line of business. Assets are effectively sunk and not usable/recoverable in other markets. The costs of broadband networks are effectively sunk.

[41] The depreciation charge reflects the weighted average life of different classes of plant, which we assume here to be 10 years. The depreciation rate depends on conventions followed by managers (tax considerations, estimates of technological change, market circumstances and others), but is in any event a blended rate reflecting lives of different kinds of categories of investment. We use ten years as a reasonable estimate for the kinds of systems being considered. Such is consistent with a recent study of broadband costs in Europe. "In the cost modeling for the project, the capital costs are depreciated over an appropriate period: 3 years for customer premises equipment (CPE); 5 years for line interface cards; 10 years for network systems and backhaul; 25 years for fibre." See, Price Waterhouse with Ovum and Frontier Economics, "Technical Assistance in Bridging the 'Digital Divide': A Cost Benefit Analysis for Broadband Connectivity in Europe", Final Report to the European Space Agency, October 6, 2004 at p. 28.

strictly "caused by" or unambiguously attributable to a specific network user or beneficiary. Common costs must be recovered in the aggregate from beneficiaries of the network platform, but the share of any particular beneficiary is quite variable. As discussed above in the context of multi-sided markets, there is virtually an infinite number of ways to recover common costs from beneficiaries on different sides of the market. Multisided markets allocate such costs retroactively as a result of different price determination processes. In contrast, government regulators divide, assign and allocate costs as a part of the rate regulation process. It is well known that there are countless bases on which regulators have historically allocated such costs, but it is generally recognized that all such bases are in the end arbitrary.[42]

The NN pricing controversy can be construed in large part as one of determining a) what beneficiaries should bear any, all, or part of the burden of recovering these common costs and b) what mechanisms (market processes or regulatory processes) should be relied on to assign those costs.

Operating Costs. Operating costs depend on case specific cost and demand characteristics. For present purposes (asking how best to divide common cost recovery responsibility), we divide operating costs into those that may be described as a) common costs that must be shared among all users and b) direct costs that are directly assignable to particular end users or services. The significance of this formulation is that a part of operating costs – that is the common costs – are like capital costs in the sense that they must be spread over the number of users connected to the network or other beneficiaries of the network platform rather than assigned directly. Operating costs are divisible between those that are common to all users and those directly attributable to (caused by) an individual users.

$$C_{oc} = C_{coc} + C_{doc}$$

Where C_{coc} refers to common operating costs that are attributable to and borne by all users and C_{doc} refers to direct operating costs that are attributable (caused by) to individual users.

Total costs are the sum of capital costs and operating costs ($TC=C_{cc} + C_{oc}$) and can now be rewritten as:

$$\text{Total Cost} = .2\ (\text{Net Plant}) + C_{coc} + C_{doc}$$

We now eliminate direct operating cost that are caused by a user and commenced at the time of connection. This leaves us to consider how to

[42] Indeed, it is widely believed that in the presence of large amounts of common costs that regulators typically revise the sequence implied by "cost based ratemaking" to one of "rate based costmaking."

recover only common costs – capital plus operating costs -- that must be shared by beneficiaries of the network. It also eliminates any possibility that end users connected to the network will have a part of their direct costs paid, or be "cross-subsidized", by another beneficiary who is not an end user. Again, it is well established that consumers who pay all the direct cost that they in fact "cause" are not subsidized by others who also pick up a share of the common costs. We are left now with total common cost as expressed below.

$$\text{Total Common Cost} = .2\ (\text{Net Plant}) + C_{coc}$$

We estimate that common operating costs (C_{coc}) – those not attributable on a causation basis to individual subscribers are 12% of revenue per user.[43] We can now redefine Total Common Cost as:

$$\text{Total Common Cost} = .2\ (\text{Net Plant}) + .12\ (\text{RPU})$$

We now divide that by the number of users connected to derive what is in effect the burden of overhead per user to get common cost per user as written below:

$$\frac{\text{Total Common Cost}}{\text{Users}} = \frac{.2\ (\text{Net Plant}) + .12\ (\text{RPU})}{\text{Users}}$$

It is notable that both capital costs (C_{cc}) and common operating costs (C_{coc}) are in the nature of "upfront", sunk costs associated with the scale and scope of the network. As such they must be borne fully and recovered from users connected to the network and, if consistent with practices in other multisided markets (as discussed above), from other agents in the value chain. This makes clear the importance of high network connection or penetration rates. High penetration rates do two things: a) they provide the opportunity to spread common cost more widely and b) they increase, through network externality effects, value for both end users and other platform beneficiaries. Low connection rates mean lower network value for end users and other beneficiaries, while increasing the share of common costs borne by individual agents or classes of agents in multi-sided markets.[44]

[43] See "Couch Potato Wars", Ex. 44 at p.64 in which Bernstein allocates General and Administrative expenses individually to voice, video and data services, then assigns the unallocated residual costs to "all services." This satisfies the practical definition and magnitude of common operating costs provided in the text.

[44] The value of the network to non-subscribers may be regarded in the nature of an option value. The existence of a particular broadband network platform creates an option to subscribe which may be realized in different ways. For example, the existence of the telco network will provide price leverage against satellite, cable or other providers of similar services. In a similar fashion a given network may provide options and leverage for other agents in the Internet value chain.

Network builds cannot generally be economically tailored to address only those users initially willing to buy service, but rather must "pass" other homes unwilling then or ever to buy. Bernstein made the point as follows:

> The average capital investment per connected customer decreases as the number of connected customers increase, lowering the hurdle for achieving positive returns. This is because the upfront capital spending is dominated by the "infrastructure" build, which is required just to pass homes.[45]

Thus, while the network cost per home passed is of interest as a measure of cost per unit in the "addressable" market, and an indicator of long run cost per unit in a mature market, the key to the economics in the short and medium term is the cost per subscriber or per connected customer. For a given level of cost per addressable home – or homes passed by the network – the cost per connected customer varies directly with the penetration rate. Twice as many customers connected allows costs to be spread in a way that reduces by half the cost borne by each customer. Half the number of connecting customers means twice the cost. There is a positive externality here in the sense that a new subscriber creates value for other current and future subscribers by lowering the average network cost per connected customer.[46]

Moreover, as established above, the new subscriber also creates value for other agents in the value chain, inasmuch as many business models and values for Internet service and product companies are directly related to the number of subscribers, "eyeballs", "hits", minutes of use or other metrics directly related to the number of connections.

D. Estimating Broadband Costs

The foregoing set out a conceptual framework for considering broadband network costs that must be recovered from beneficiaries. It disaggregated costs and recombined them in an effort to define common costs that must be recovered and might reasonably be assigned in a variety of ways to different beneficiaries of the network – end users and other agents in the value chain. We will use available cost data to fill in the framework as a means, eventually, of determining potential prices and the welfare impact of different cost recovery and pricing schemes.

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[45] Couch Potato Wars, at p. 18.

[46] The externality is not inconsequential. Increasing penetration from 5% to 10% of homes passed reduces the average investment per connected home from about $8,000 to about $3,000. As penetration rises, the incremental value of an added subscriber (as measured by the reduction in average cost) declines, but is still of some considerable consequence. The phenomenon in other contexts is known simply as spreading the overhead.

Over the past several years several estimates of the costs of building broad(er)band networks have been made. The estimates vary in several dimensions: type of technology, nature of legacy network being upgraded, network scale and scope, geography, the rate of construction and rollout, the companies' overall broadband strategies and others. These cost estimates are circumstantial, but analysts have learned from previous efforts so that more recent cost studies appear to provide pretty good estimates.

Wall Street analysts have undertaken such studies as means of evaluating investment grades and shareholder values of broadband network construction and rollout. An extensive, detailed and convincing (and recent) cost analysis has been published by Bernstein Research under the title "Couch Potato Wars."[47] Building on work they originally did in 2004[48], Bernstein's analysts a) explain, compare and contrast the fiber deployment strategies and plans of Verizon, BellSouth and SBC, b) examine the cost implications of fiber network build outs to the neighborhood (FTTN), to the curb (FTTC) and to customers' premises (FTTP) and c) examine the relative economics and financial impacts of mass deployment versus success based strategies of different companies. According to Bernstein's analysts:

> If started in 2005, an FTTP network connecting more than 30 million customers would cost the three largest Bells about $45 billion to build...[49]

It is important to emphasize at the outset that the Bernstein cost data which we use as a starting point gives an incomplete picture of the total investment likely to be required to build out broadband networks in all parts of the country and by platform providers other than the Bell Companies covered in the Bernstein work. The Bernstein cost estimates relate a) to only three large telcos (no costs for cable, satellite, municipal, power company or wireless platforms) and b) to only about 30% of the nation's households. *Thus, our results will only be a partial estimate of the impact of different pricing rules*. The results should nonetheless suggest the order of magnitude of a more universal view.

Modeling broadband costs on a national basis is made more difficult by the fact that each company is following a different approach; that these three companies are not planning in the immediate term to buildout all their franchise territories; and, that much of the geographic area of the US is not within these franchise territories. Thus, at best, any cost analysis must be only partial and "averaged" over different networks. That said, we believe

[47] Couch Potato Wars.
[48] Bernstein Research, Fiber: Revolutionizing the Bells' Telecom Networks: A Joint Bernstein Research-Telcordia Technologies Study, New York, May 24, 2004 ("Bernstein Black Book").
[49] Black Book, at p. 1.

that using these data, while recognizing their limitations, to assess the consumer welfare impact of alternative cost recovery schemes will yield valuable insights to policy makers about alternative cost recovery rules.

The Bernstein studies take several different cuts at costing out current plans of the three largest Bell Companies. An indication of the order of capital requirements, Bernstein estimates the average capital cost for fiber to the customers' premises (FTTP) to be $1,424 per subscriber passed and connected. This 100 percent fill assumption is clearly unattainable, but is useful nonetheless as a point of reference.

Bernstein analysts also estimated the costs of a success-based strategy in which homes passed are not necessarily connected.[50] Dubbed the FPTP (Fiber *Past* the Premises) strategy, this approach permits economizing on direct subscriber connection costs. The effect is to reduce immediate investment outlays by $550 – the amount of CapEx required to connect a home, given that it is "passed" by the network. The result is to reduce infrastructure capital expenditures to $974 per home passed.[51]

Comparing these two cost frameworks makes clear, among other things, the importance of the penetration rate, which is the ratio of homes connected (or subscribers) to homes passed. Since much of the capital cost under either strategy is common to all homes passed whether connected or subscribed, the cost per actual subscriber is sensitive to both the network rollout strategy and the penetration rate. Bernstein's analysis assumes that the companies will achieve nearly 20% penetration of homes passed in the first year and that the penetration rate will grow to over 60% of homes passed in seven years.[52]

In order to "populate" the cost categories defined and discussed above, we have modified the Bernstein data in ways that serve present purposes while being faithful to the general investment, cost and penetration picture they depict. We have taken capital outlays estimated by Bernstein as necessary to upgrade existing networks to fiber and spread them over a five-year period. For subsequent years we reduced those expenditures to a level commensurate with "maintaining, adapting and incrementally upgrading" the essentially completed network. Thus, the capital carrying costs described above are based on $10 billion investment annually for the first 5 years and $3 billion in years 6-10.

We used the Bernstein telco penetration rates, even though they, and we, regard them as very aggressive (>60% telco share of homes passed in 6-7 years). We also use the Bernstein data to estimate common operating costs

[50] Couch Potato Wars, Ex. 46.
[51] Ibid., Ex. 47.
[52] Ibid., Ex. 61.

that are not caused directly by a given subscriber and are reasonably treated as overhead to be spread among all beneficiaries. As discussed above, we assume 10% weighted average cost of capital and a blended, composite 10-year life for plant and equipment.

E. Future Broadband Prices and Broadband Costs Recovery

Different pricing rules might be utilized to satisfy the requirement that revenues cover costs. Countless pricing patterns and regimes are observed in different network industries, among firms in the same industry and in different multi-sided markets. In one-sided markets, price structures reflect market segmentation, services bundling, discounting and promotions, price differentiation among classes of use and users, and others. In multi-sided markets costs are recovered in different proportions from end users and from other firms or agents in the value chain.

If only end users may be charged for network services, as NN proponent advocate, then all capital and operating costs will be borne by them. An alternative is to recover a share of common costs and all direct costs from end users, while recovering the remaining share of common costs from other beneficiaries who are also agents in the value chain.

Sharing common costs among end users and other beneficiaries would have several direct benefits to end users. To summarize: doing so would mean lower rates on average to end users, more rapid take rates of network services, and an increase in the value (via externalities) of the network to all beneficiaries. Further, it would improve investors' views of the merits of broadband investment and boost capital market support for more rapid broadband rollout, which would in turn reduce perceptions of risk and the capital cost of the network buildout.

Is there an offset to these consumer benefits? Advocates of end users only being charged will be quick to point out the increase in their costs as a result of having to pay for value that otherwise was free. The question is whether consumers are made worse off by the transfer of cost responsibility. We think not, for the following reasons.

First, standard microeconomic analysis of cost increases indicates that, except for the case in which demand is completely inelastic, a cost increase will be shared by shareholders and customers in accordance with the price elasticity of demand for the firm's services. Looking first at shareholders, their loss of short term earnings from the cost increase is at least in part offset by a) the fact that they may address more users than before and b) that the prospect for long term growth is increased by the growth of users enabled by lower end user access rates. The impact of the cost shift from networks access services to the products and services provided by NN

advocates will vary from firm to firm and is far too complex to address here, but we hazard some impressions as to why they may well be minor. First, many of the "customers" of NN firms are in fact businesses and institutions, not consumers. To the extent they bear any burden, they will apportion that between their owners (or taxpayers) and end users. For costs that might be passed directly to their consumers, the consumer impact is likely, since a) a given NN firms' share of the added cost burden is likely to be small, owing to the fact that the added costs are likely to be widely spread among firms and b) the cost passed forward to end users will be even smaller, given the dependence of the pass through on demand elasticities. In brief, our very tentative and incomplete analysis does identify tangible, identifiable and substantial harm to consumers of services and products of other network beneficiaries who are agents in the value chain.

It has been suggested that allowing Internet platform providers to charge firms other than end users would dampen investment and innovation by those firms. We have seen no supporting analysis, but frankly doubt the assertion and in large part for reasons implied above.

Any direct effect on cash flow to these firms of a cost increase for access Internet platforms would be offset fully, or in substantial part, by future growth in cash flow inspired by the more rapid diffusion and higher quality broadband networks from which their core businesses derive value. As mentioned briefly above, the value of many business models for other agents in the Internet value chain is driven by derivatives of the number of households connected to the Internet and of the bandwidth available to users. Advertising driven business models value "eyeballs"; others derive value by the size and complexity of content (which is function of bandwidth); others from "hits" or "minutes of use" or "times connected" or direct function of the number of households connected.

Given the considerable price elasticity of demand for broadband connections, it is not unreasonable to ask whether there is a reasonable business case for some firms with quantity sensitive revenue models to invest in broadband infrastructure. The marginal returns might in some cases be positive.

IV. CONSUMER IMPACTS OF ALTERNATIVE COST RECOVERY RULES

We conclude from the discussions above on multi-sided markets, Internet infrastructure cost characteristics, and common cost recovery from various network beneficiaries that it is quite common for network platform providers in multi-sided markets to spread costs beyond end users and that, in the general case, doing so creates incremental value for consumers. The intuitive case, that reducing prices for end users of Internet access services

and diffusing such costs recovering them from a wider set of beneficiaries, seems to hold up pretty well. The economic welfare created for beneficiaries of the change – end users of broadband Internet access services – are substantial, and owing to externalities, are shared by others in the value chain.

A. Quantifying Changes in Consumer Welfare from Cost Recovery Rules.

That leaves the question of how much consumer welfare is created. Fully aware of the challenges (posed in large part by the lack of a complete and fully satisfying set of data) of quantifying changes in welfare from changing methods of recovering common costs of constructing and operating broadband networks, we offer a first cut at such an analysis in what follows. We have attempted on the basis of available data to derive estimates of the welfare change equation derived above and estimated below.

(Equation 3) $$\Delta W = \frac{1}{2}\left[\frac{\Delta P}{P_o}\right]^2 P_o Q_o \varepsilon + \Delta P_o Q_o$$

Inspection of Equation 3 (reproduced from above) indicates that the drivers of welfare change on the right hand side are, most importantly, baseline price and quantity (P_o and Q_o); that is the expenditure by households if they were obliged to pay direct costs of network provision and bear the full burden of all the common investment and operating costs that create value for them as well as for others in the value chain. That set of prices and quantities will set the benchmark for estimating the amount of consumer surplus generated by construction of networks and their adoption over time by households responding to prices that reflect all common costs.

The second driver is the change in price, which enters the welfare change equation in two places, most importantly as the increase in consumer welfare from users being able to buy services at lower prices, but also as a result of market stimulation and growth in the number of users who now decide that the service is affordable and within the bounds of their willingness to pay. The second is as a percent of the base price squared – that is, $(\Delta P/P_0)^2$. The percentage change in price to end users is determined by the share of common costs that may be recovered from other beneficiaries in absence of an end user only pay requirement – the cost shares that will emerge from market driven multisided pricing of the network platform.

Both the price change effect and the baseline expenditures are magnified according to the responsiveness of broadband demand to a price change, as represented by the price elasticity estimate (ε). This term captures the added consumer welfare from new subscribers who respond to the price change. It is worth emphasizing again that these welfare changes are direct

and do not reflect any externalities, that is, benefits to a particular beneficiary from expansion of networks or an increase in the number of connections.

B. Price Elasticity of Demand for Access to Broadband Networks.

Several estimates of broadband price elasticity are available and there are substantial differences among them. The differences stem from different definitions of "broadband", different models and data sources, different assumptions about important, complementary conditions in the market for broadband services and different time periods. Despite differences in detail and magnitudes, there is a consensus that prices are significant determinants of broadband demand and that price changes will materially change the number of users and the kinds of services they demand --

> We find evidence that broadband price is indeed a statistically significant driver of broadband demand...the coefficient is high enough to indicate a not-inconsequential practical impact.[53]

Consumer groups agree that broadband rates are too high and that consumers are disadvantaged. Indeed, the most frequent explanation for the gap between broadband service adoption in the US and in the rest of the world is simply that "prices are too high" and that if they were to come down in response to one or another government policy initiative or regulation, penetration would increase markedly. These representations do not indicate a specific elasticity measure, but they do suggest significant consumer sensitivity to broadband prices and a relatively high price elasticity of demand.

Consumers reflect this sentiment in response to surveys, where they consistently indicate that broadband rates are too high and that they would subscribe if only rates were lower. Representative of such sentiments, the Yankee Group report found:

> …U.S. consumers are struggling to distinguish between high-speed Internet options. While interest in high-speed services is still growing, dial-up consumers remain highly price-sensitive. Only 17 percent of consumers say they are likely to subscribe to broadband at $45 per month. According to Patrick Mahoney, a Yankee Group consumer technologies and services analyst:

[53] Kenneth Flamm and Anindya Chaudhuri, "An Analysis of the Determinants of Broadband Access," Working Paper, October 2005. Available at http://web.si.umich.edu/tprc/papers/2005/485/broadband.pdf.

> "Seventy-one percent of Internet customers claim they would switch to broadband if it were available at a lower price. [54]

Robert Crandall of the Brookings Institute concluded:

> …evidence from the US suggests that the price elasticity of demand for broadband connections is fairly high. Rappoport and his colleagues found the price elasticity of demand for DSL is –1.46. Using more recent data for households with access to both cable modem and DSL service in the US, J. Gregg Sidak and I estimated the price elasticities of demand for both are equal to –1.2 and that the cross elasticities are positive.[55]

Professor Hal Varian reported that demand for Internet speed is sensitive to price and that price elasticities are in the range of –2.0 to –3.1 for the higher speeds and rather less for lower speeds."[56] Faulhaber and Hogendorn modeled broadband service markets and used –1.533 as the best estimate available for their purposes.[57]

Stephen Pociask reviewed the available evidence and summarized it as follows:

> Empirical evidence suggests that high-speed services are indeed price elastic. One study estimated that a 30% reduction in price would yield a 130% increase in subscribers. This study agrees closely with the observations of noted futurist George Gilder, who predicted that a one-unit decrease in bandwidth price would produce a five-unit increase in demand. Kridel, Rappoport and Taylor developed a demand equation using a large set of data and concluded that cable modem demand was price elastic. Their study concluded that a 1% increase in price would yield between a 1.1% to 1.8% decrease in subscription. A study of Internet subscribing households estimated that a 1% increase in high-speed installation charges would produce a 141% decrease in installations, which explains why high-speed providers frequently discount their installation charges. Another study

[54] See, "Yankee Group Says Broadband Prices Still Too High for Many U.S. Dial-up Consumers," April 2004. (http://www.itaa.org/isec/pubs/e20044-03.pdf).
[55] Robert W. Crandall, *Competition and Chaos*, Brookings Institution Press, Washington, D.C., 2005, at p. 120.
[56] Hal Varian, "The Demand for Bandwidth: Evidence from the INDEX Project," Chapter 4, at pp. 57-83 in Crandall and Alleman.
[57] Gerald R. Faulhaber and Christian Hogendorn, "The Market Structure of Broadband Telecommunications," *Journal of Industrial Economics*, Vol. XLVII, Sept. 2000, No. 3, p. 326, or see http://www.assets.wharton.upenn.edu/~faulhabe/Broadband.pdf, downloaded May 23, 2006.

> found both cable and DSL services to be elastic as well. Later work by Kridel, Rappoport, Taylor and Duff-Demo concluded that the price elasticity for broadband services was econometrically measured to be –1.5…[58]

In a recent paper, Austan Goolsbee estimated price elasticities of demand in the top 50 Metro Areas of the U.S.[59] The estimates were based on Forrester's Technographic Surveys of adoption rates suggested by consumer responses to a question in the form: "How much would you be willing to pay for broadband access at speeds up to 100X what is available on conventional modems?"[60] The elasticity estimates vary substantially across metro areas. The range in the top twenty cities (Miami is number 20.) is from –2.44 (Atlanta) to –3.07 (Seattle), with a simple, unweighted mean of –2.71. Metro areas from number 21 through 50 have a broader range and a higher mean price elasticity of demand for broadband services.

There is in short a range of estimates of price elasticity of broadband demand and no clear consensus. Based on our review and assessment of the underlying methods and data, we conclude that reasonable range for our purposes is in the –1.5 to –2.5 with the weight of the evidence, especially from the Goolsbee work, lifting it toward the top of the range.

C. Changing Broadband Network Access Prices from Abandoning "End User Only Pays"

In the absence of a statutory prohibition on doing so, or a rule from the FCC or other regulation, prices for non-end users would be determined as they are now for end users – that is, by market forces. Platform providers and other agents in the value chain would be required to negotiate and agree contractually on rates and terms for service, just as they do in other multiplatform markets. That means that rates would come to reflect the values they each confer on the other and their relative bargaining power. It is clear that there are substantial reciprocal externalities among platform providers and other agents in the Internet value chain. It is equally clear that there will be some market power on both sides of the negotiating table. It is also clear that market power of platform providers is diminishing and will continue to do so as a result of both economic and technological change. The results of these negotiations cannot be known a priori, but they will of course be subject to review in any event under the antitrust laws.

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[58] For the quote and supporting references, see, Steve Pociask, "Taxing High-Speed Services: A Quantification of the Effects on the DSL Industry and Universal Service,' New Millennium Research Council, April 2004, downloaded on May 23, 2006 http://www.thefuturefaster.com/pdf/042604report.pdf.

[59] Goolsbee, at p.8.

[60] Ibid.

There are mixed signals from equilibrium prices struck among participants in other multisided markets. As discussed earlier, there are instances of almost every conceivable pricing structure, ranging from end user pays nothing (say broadcast television and Yellow Pages directories) to end users sharing platform costs with other platform beneficiaries in varying proportions (newspapers, magazines, online retail and business services, search services and others).

There is some guidance from one important multisided market – Internet backbone connections. There are about 14,000 facilities-based backbone operators and ISPs, about half of whom are located in the US. They interconnect with each other under privately negotiated terms and conditions reflected in Internet peering and transit agreements. Such agreements and negotiations are "unregulated", renegotiated frequently and appear to generate minimal, if any, complaints to government.[61]

We modeled a modest range of shifts of 5%, 10%, 15% and 20% of the common costs per connected household calculated from the Bernstein data. We express no preference for, nor forecast, any one of them, but believe them to be a conservative reflection of cost sharing among beneficiaries and pricing in other multi-sided markets.

D. Broadband Revenue

The welfare equation requires estimates of price and total revenue from networks with unknown technologies that are not yet built and with unknown service qualities and take up rates by end users. In keeping with our analysis of costs and the requirements that revenues eventually recover them, we will base our price estimates on the total common costs per connected household. The estimates are incremental, and forward-looking, in the sense that they do not reflect currently booked costs incurred in the construction and operation of current networks. These, along with penetration rates, are estimated in Bernstein and we shall use these estimates. Specifically, we assume investment of $10 billion for each of the next five years; $3 billion for years 6-10; blended depreciation of 10% per year and a WACC of 10%. We note again that the Bernstein estimates are only for the three large Bell companies who are projected to build out networks in the top twenty SMSAs.

[61] Personal conversations with William Woodcock, Director of Research at the Packet Clearing House. He estimates that there are in place between 20,000 and 25,000 commerical agreements governing internet traffic exchange. He indicated that they are typically updated or renegotiated every 12-36 months depending on their size, relative growth of the parties to the agreement, expected changes in the costs of network capacity and other valuation factors that come to bear in negotiating negotiated rates and terms for exchanging Internet traffic. (Conveyed in a personal conversation.)

E. Time Horizon and Discount Rates

Consumer welfare changes from broadband investment and from network platform access price changes will not be harvested fully in a single time period. The simulation we use provides for a 10-year time horizon, which corresponds roughly to the assumed weighted average life of the new plant. Investment initially is "new" and incrementally supports enhancements and additions to current networks to support fiber to the home, then tails off in the last five years to reflect replacement, maintenance and assorted improvements and adaptations.

Since the benefits of investment and price changes are harvested in different time periods over the ten-year span, we discount those to reflect their different time values. The cost-benefit literature is mixed on the appropriate discount rate to use to adjust for the future and we use (without apology and on the basis of insufficient reason to do otherwise) 8%, which is in the neighborhood of currently effective home mortgage rates.

F. Some Preliminary Results

The way the model is constructed, the results are for households connected in each year by the three Bell companies in the top 20 SMSAs using the Bernstein households penetration rates which range from less than 20% in the first year to over 60% of homes passed (28.3 million subscribers) in year 10.

We estimate slightly in excess of $8 billion dollars as the present value of increased direct consumer welfare (no externalities) for subscribers to the Bell offerings (only) in their addressable market in the top 20 SMSAs (only) for a final subscriber count in year ten of 28.3 million subscribers. That is about $285.00 per household connected.

This particular simulation assumes:

1. 10% of the common costs (based on our configuration of Bernstein estimates) are recovered from (shifted to) beneficiaries other than end users;
2. Broadband price elasticity of demand of (minus) 2.0;
3. An initial price of $50.00 per subscriber per month; and
4. A discount rate of 8%.

Other assumed simulation inputs yield other results. Larger cost shifts (price changes), larger elasticities, lower discount rates, and higher initial prices yield larger present values for consumers from platform providers being able to negotiate prices with other beneficiaries. Of these drivers, the results are most sensitive to the share of costs recovered from other

beneficiaries. Doubling those shares (within limits) roughly doubles the consumer welfare increases.

As indicated above the results are only a partial measure of the increased consumer welfare that might materialize from adoption of traditional multi-sided pricing approaches, if Congress does not prevent it by commanding end-user only pricing schemes for providers of broadband network platforms. A more complete measure of the increase in economic welfare would have to include gains:

- Similar to those noted here for the other (roughly) 80 million households not covered in the Bernstein cost study nor in our estimates;
- Similar to those noted here for non-telco broadband platform providers (cable, satellites, power companies, municipalities, and wireless companies); and,
- That are not captured by "direct" increases in consumer welfare, that is, the enormous and varied set of externalities reasonably expected to be generated by more rapid and broader diffusion of broadband Internet networks and technologies.

Estimating these gains is properly the subject of another paper, but our sense is that their incorporation would increase the change in consumer welfare to a measure in the range of three to four times our partial estimate – to $24 billion to $32 billion in increased consumer welfare in present value terms. It is also worth noting that these gains will accrue in substantial measure to households that thus far have lagged the national average in adoption of broadband Internet services: lower income families, rural households, minorities and senior citizens.

V. Some Conclusions and Reflections on Consumer Welfare and Net Neutrality

There is not in the record of debate over net neutrality – not a scintilla of hard evidence – indicating that consumers are made better off by a federal rule requiring them directly to pay the entire cost of building out the next generation of broadband networks. There are categorical declarations, but no economic or financial analysis of any material consequence.

Given the importance of the question of who pays for the next generation of broadband networks to consumers, our collective economic welfare, and future growth prospects, this analytical void is astounding. Our analysis is meant as a first step toward focusing the debate more specifically on the interests of consumers and away from unsubstantiated conclusions of non-consumer beneficiaries of a "free" Internet.

Stripped of all pretension, rhetoric and the *sturm und drang* of net neutrality, the basic message from some of the nation's most successful, fastest growing, and best managed companies to consumers is straightforward and unmistakable: "We want you to pay the entire bill for the basic Internet infrastructure, which we will then use to sell our products and services to you."

The market for Internet connections, like all other multisided markets, is driven by fundamental principles of reciprocal value creation. All firms in the value chain cooperate to create end value for consumers. Consumers, in turn, create value for all firms in the value chain – platform providers and businesses that use the platform as a core input into its business. The lesson from multisided markets in the rest of the economy is that reciprocal value creation requires symmetric pricing discretion.

Market driven, negotiated contract arrangements are the rule in business to business transactions in multisided markets throughout the economy. Firms agree on terms that reflect their options; their estimates of relative values added and derived; and negotiating skills. None of these multi-sided markets are "perfect" and many, if not most of the business participants, are likely to have some market power. It is not clear from the record how markets for access to Internet infrastructures will diverge from that norm.

End users only paying for telecom networks is an artifact of circuit switched voice message-only technology. As local networks evolved into full service, high capacity digital platforms, the companies that provide them have, in parallel, migrated from one-sided to multisided businesses. In the interest of consumers and our national economy, public policies must allow multi-sided markets to adapt to market pricing models like those successfully in play throughout the new (and old) world economy.

The practice of "end users only paying" evolved in, and was suitable for, the world of circuit switched, voice message only technology. But, Congress should not lock that business model into a market for which it is ill-suited – and certainly not do so on grounds that consumer welfare is thereby enhanced.

About Larry F. Darby

Dr. Larry F. Darby is an economic and financial consultant based in Washington, DC. He earned a doctorate in economics from Indiana University in 1971, specializing in industrial organization and international economics. He subsequently joined the faculty of the Graduate School of Business at Temple University, where he taught managerial and industrial economics and regulation of business.

In 1975, he became Senior Economist in the White House Office of Telecommunications Policy. He then served as Chief Economist and Chief of the FCC's Common Carrier Bureau, where he was the architect of Commission orders directing reorganization and reregulation of the telephone, satellite, and communications equipment industries -- from lowering entry barriers to prescribing market-competitive ratemaking and accounting practices. After leaving the FCC, he spent two years on Capitol Hill directing a joint Congressional investigation of application of the antitrust laws to the motor carrier industry.

He went to Wall Street in 1983, joining Lehman Brothers as Vice-President in the Telecommunications Investment Banking group. At Lehman he concentrated on asset valuations; in particular, assessment of the impacts on financial values of technological, regulatory and market developments affecting cable television, broadcasting, and wireline/wireless telecommunications services and equipment.

In 1988 Dr. Darby founded Darby Associates, where he has consulted on various issues, including broadcasting, cable television, domestic and foreign telephony, trade and technology, and domestic common carrier regulation. Recent consulting assignments required assessments of: the financial and investment impacts of alternative regulatory schemes in cable and telephony; quantitative relations between telecom and cable television regulation and national macroeconomic performance (income, growth, productivity and jobs); several matters related to costs and tariffs for access to local telephone networks; numerous IT business and strategic planning reviews; measuring market effects of competition; pricing principles for Internet services and software services; valuation of licenses and assets used to provide new digital services; impact of spectrum auctions on satellite costs and license values; implications of ecommerce development on firm strategies; Internet taxation; and, impacts of the Telecommunications Act of 1996 on telecom investment.

From 1989 to 2005 he served as Professorial Lecturer in Telecommunications Finance at the George Washington University Graduate School in Washington, D.C. and is currently Adjunct Professor of Law at the New York Law School. He has written over 125 biweekly articles for the trade biweekly "Communications Business and Finance." Dr. Darby has testified before the Senate Commerce Committee on spectrum valuation and auctions; on resale of airline passenger services; before the House Telecommunications Subcommittee on deregulation of telecom markets, then on telecom trade agreements; and, before the Postal Rate Commission on experimental rate structures. He is Senior Economic Advisor to CompassRose International, Inc. He is working on the second draft of a book on the impact of regulation on investment in telecom and information technology markets since 1996.