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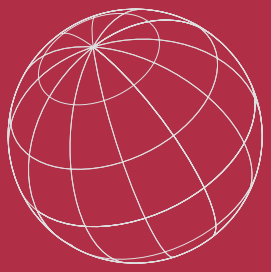

Broadband Competition in the Internet Ecosystem

Jeffrey A. Eisenach

October 2012

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Acknowledgments

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Foreword

In this paper, Jeff Eisenach tackles the important and timely debate surrounding the regulation of Internet-based communications. Broadband service providers are currently treated differently from other information technology industries in that they are subject to increasing levels of ex ante regulation by the Federal Communications Commission (FCC). Other Internet sectors are subject to ex post treatment under standard antitrust laws. The discrepancy is justified by claims that broadband is somehow crucially different from the remainder of the Internet ecosystem and as a result requires special regulatory practices.

The FCC outlined its rationale in the December 2010 Open Internet Order; however, its authority to implement the order is currently being challenged in court. Verizon Wireless appealed FCC's "data roaming" rules, which would impose new open-access regulations on broadband service providers, and last month the FCC presented oral arguments defending its rules.

In a similar case, the DC Court of Appeals will pass judgment next year on the "net neutrality" rules, which would prohibit broadband providers from engaging in business practices that are both common and legal in other industries. The outcomes of these cases will help answer the question at the heart of the issue: will more regulation improve broadband networks?

The case for heavier government regulation is often justified on the grounds that competition in broadband markets operates differently from competition in other Internet markets. Many believe that broadband is a monopoly, but in this paper, Eisenach argues the other side and makes a convincing case that this assumption is simply not true. He analyzes the core characteristics of broadband networks—dynamism, modularity, network effects, and multisidedness—which are remarkably similar to other information technology industries. His analysis effectively dismantles the claim that broadband deserves asymmetric regulatory treatment and suggests that modern antitrust principles should be applied instead.

Applying the proper regulatory framework is crucial since a failure to do so can stifle the incentives to innovate with broad implications for the entire economy. It is my hope that this paper will help identify the appropriate policies that will encourage competition among broadband service providers.

—Aparna Mathur, AEI Economic Studies Editor

Executive Summary

Like the other information technology (IT) markets that comprise the Internet ecosystem, broadband communications services are characterized by rapid innovation, declining costs, product differentiation, competitive price discrimination, network effects, and "multisidedness." Broadband Internet service providers (ISPs) make large sunk cost investments and seek to differentiate their products so that they can earn economic returns on those investments. They seek to assemble or participate in systems that create value for consumers and do so by choosing both the platforms they join and the products with which they interconnect. They experience both supply-side economies of scale and scope and demand-side externalities that create powerful incentives to increase volumes by maximizing system openness, but as with other IT firms, these incentives do not always outweigh the costs of interoperability. In short, like other IT markets, broadband (1) is characterized by rapid innovation, high sunk costs, and declining average costs (*dynamism*); (2) functions as a complementary component in modular platforms (*modularity*); and (3) is subject to demand-side economies of scope and scale (*network effects*).

Despite these similarities, broadband is treated differently from other IT industries when it comes to competition policy: competition in the rest of the IT sector is subject to scrutiny under antitrust laws, while broadband is regulated by the Federal Communications Commission (FCC). Indeed, the FCC is currently in court defending its authority to impose "net neutrality" regulations prohibiting broadband ISPs from engaging in business practices that are both presumptively legal and commonplace in other industries. In the wireless arena, the FCC asserts its authority over the electromagnetic spectrum to impose economic regulation on wireless ISPs. And the commission's recent decision to extend the $9 billion "universal service" program (heretofore limited to telephone services) to broadband promises to impose de facto price controls on broadband ISPs that participate. In short, while other elements of the "Internet ecosystem"—applications, content and devices—receive ex post treatment under the antitrust laws, broadband ISPs are subject to ex ante regulation.

Broadband is regulated differently from other IT markets in part because it is analyzed differently. Although important unsettled questions remain about how best to police competition in such markets, it is generally agreed that analysis of such markets should deemphasize the traditional "structure-conduct-performance" paradigm and assess the consequences of potentially harmful conduct on a case-by-case basis. Thus, high levels of concentration in IT markets such as handsets, operating systems, search engines, and social networks are not regarded as signals of market power (or at least not market power sufficient to justify ex ante regulation), but the FCC often still utilizes anachronistic measures of concentration to justify regulation of broadband markets.

One asserted rationale for asymmetric treatment is the notion that broadband networks are uniquely at the "core" of the Internet while content, applications and devices are at the "edge." This metaphor is at best misleading, and in any case does not justify differential policy treatment. To the contrary, for purposes of competition analysis, it is no longer possible to distinguish meaningfully between the competitive characteristics of broadband markets and other IT markets, and accordingly, there is no basis for asymmetric regulatory treatment. Accordingly, ex ante oversight of competition by the FCC should be replaced by the same ex post enforcement framework that applies to the rest of the Internet ecosystem.

1

Introduction

It is increasingly apparent that markets for broadband communications services share many of the "high-tech" characteristics found in other information technology (IT) markets, including rapid innovation, declining costs, product differentiation and competitive price discrimination, network effects, and "multisidedness."[1] These characteristics have important implications for competition analysis, including the need for increased focus on market dynamism and vertical relationships among market participants, a reduced emphasis on traditional structural presumptions, and increased reliance on case-by-case analysis.

Some scholars suggest competition in IT markets is so naturally intense, or that the risks of policy error are sufficiently high, that enforcers should apply a reduced level of antitrust scrutiny.[2] Others argue that IT markets are in some respects more prone to market failure than more traditional markets and hence deserve enhanced scrutiny.[3] The Federal Communications Commission's (FCC's) December 2010 Open Internet Order seems to endorse an extreme form of the latter view.[4] While the FCC presented a cursory "structural" assessment of the broadband market,[5] it ultimately concluded that the conduct it sought to deter does "not depend upon broadband providers having market power with respect to end users"[6] and, in fact, that the "broad purposes of this rule . . . cannot be achieved by preventing only those practices that are demonstrably anticompetitive or harmful to consumers."[7] Instead, the FCC determined that ex ante regulation of broadband providers' conduct in the "Internet ecosystem"[8] was justified based on arguments associated with network effects and multisidedness—theories that, it concluded, suggest that broadband Internet service providers (ISPs) might "set inefficiently high fees to edge providers"[9] or "withhold or decline to expand capacity."[10]

The FCC's acknowledgement that broadband markets have become integrated with the overall Internet ecosystem is reflective of a rapidly emerging consensus.[11] However, its decision to impose price controls and preemptively ban certain conduct, and to do so without finding that the conduct at issue was harmful to consumers, is not easily squared with mainstream academic opinion, which widely agrees that competition oversight of IT markets should be case-specific, narrowly tailored, and grounded in a concern for consumer welfare.[12]

As this is written, the FCC's authority to implement the Open Internet Order is being challenged in litigation before the US Court of Appeals for the DC Circuit.[13] Even if the challenge is successful, however, the FCC might assert its authority to impose ex ante rules on broadband services through a variety of means. For example, the agency imposes various regulations on wireless ISPs, based at least in part on its authority over the electromagnetic spectrum,[14] and, its recent expansion of the Federal Universal Service Fund—heretofore limited to supporting voice communications services—would subject broadband ISPs receiving support from the new Connect America Fund to de facto price regulation.[15] Moreover, even if the Open Internet Order is overturned, the FCC might well attempt to revisit its prior decisions declaring that broadband is not a telecommunications service and hence not subject to the FCC's core authority over common carriers. As recently as 2010, the FCC's general counsel issued a memorandum stating that it could declare broadband a Title II "communications service," subject to the full array of common carrier rules designed for monopoly providers of traditional telephone service.[16]

The central thesis here is that the expansion of ex ante FCC regulation over broadband markets is

inconsistent with both academic consensus and market reality. To the contrary, the convergence of broadband with other IT markets argues for a convergence at the policy level as well: if it is no longer possible to distinguish meaningfully between the competitive characteristics of broadband markets and other IT markets, the basis for asymmetric regulatory treatment—for ex ante regulation of broadband services and ex post antitrust scrutiny of other IT markets—is impossible to sustain. Further, if the choice is between applying modern competition principles to broadband and subjecting the rest of the Internet ecosystem to FCC-style regulation, the former course is far superior to the latter.

In this context, this paper examines the market for broadband services through the lens of the literature on competition in IT markets. I conclude that the competitive dynamics[17] of broadband markets are now substantially similar to those in other sectors of the Internet ecosystem and that competition oversight of broadband markets should therefore be brought into conformity with the ex post, case-specific approach applied to other IT markets. This discussion is organized around three sets of characteristics that distinguish competition in IT markets from competition in more traditional ones: dynamism, modularity, and network effects.

By *dynamism*, I refer to what is sometimes called "innovation competition" or "Schumpeterian competition." It is the idea that firms compete primarily by creating new and better products, as opposed to "static competition," in which firms compete to charge the lowest price for a homogenous and unchanging commodity. Markets characterized by rapid innovation are often associated with high rates of capital spending (for R&D and capital expenditures), economies of scale and scope, "competitive price discrimination," and product differentiation.

Modularity refers to what some have called "mix and match" competition: the ability to assemble bundles of complementary products from different suppliers, and the interoperability (for example, the existence of standards or of a technology "platform") that makes it possible to do so. Providers of complementary products in such markets must cooperate to make their products work together, but they also compete for the economic rents generated by a successful platform, including by seeking to become "customer facing."

Third, *network effects* are present in markets where the value of a product or service to each customer is affected by the number of other customers who use it, as with telephones and fax machines, for example. Multisided markets represent a particular form of network effects, in which some types of consumers attach value to the presence of other customer types, such as when stock exchanges compete for both listings and investors or newspapers compete for both readers and advertisers. Both phenomena represent what can also be referred to as demand-side complementarities or, to be more specific, demand-side economies of scale (network effects) and demand-side economies of scope (multisidedness).

Taken together, these characteristics cause the competitive dynamics of IT markets to differ from the competitive dynamics of more traditional ones. They help to explain, for example, why IT markets are often relatively concentrated yet typically exhibit high levels of rivalry and strong performance. All three sets of characteristics are present in broadband markets, which despite being relatively concentrated, evidence falling prices, rising output, rapid innovation, and few apparent instances of anticompetitive conduct.

The remainder of this paper is organized as follows. Section 2 briefly discusses the "structure-performance paradox," finding that, like many other IT markets, the broadband market exhibits both (a) relatively high levels of concentration by traditional metrics, and (b) strong performance in terms of output expansion, innovation, and other metrics. Section 3 describes the broadband market from the perspective of the three themes I described—dynamism, modularity, and network effects—and shows how the economic phenomena associated with these concepts affect the competitive dynamics of broadband markets, causing them to behave like IT markets. Section 4 outlines some specific implications of this analysis for competition oversight of broadband markets,

concluding overall that the dynamism and complexity of broadband markets, and their interrelatedness with other elements of the Internet ecosystem, argue strongly against the sort of industrial policy–oriented, ex ante regulation practiced by the FCC. Section 5 provides a brief conclusion.

2

Broadband Competition: The Structure-Performance Paradox

In a 1999 article on competition in the computer industry, Tim Bresnahan took note of an interesting paradox arising out of Andy Grove's description of the computer industry.[18] In *Only the Paranoid Survive* (1995), Grove had argued that the industry had shifted from a "vertical" to a "horizontal" structure comprised of independent competitors at each of several layers (for example, Dell and Hewlett-Packard selling computers and Microsoft and Apple selling operating systems).[19] Moreover, Grove said, competition in this new "mix and match" model, was more intense than in the old vertically integrated structure in which firms like IBM and DEC competed to sell the entire "stack" of complementary products and services. Bresnahan noted that Grove's assessment was widely shared: "Almost all market participants characterize the 'Silicon Valley' style of industry organization as more competitive than the 'IBM style.'"[20]

For economists, Bresnahan pointed out, Grove's conclusions presented something of a puzzle:

> The puzzle arises when one looks at [the new horizontal structure] with an industrial organization economist's eyes, especially with an antitrust economist's eyes. Several of these 'competitive' horizontal layers have very concentrated structures, typically suggesting a dominant firm and fringe model. . . . [A]n elementary structural analysis shows a puzzle. How can this be so competitive?[21]

As Bresnahan said in 1999, "Resolving the puzzle is the key to understanding computer industry competition."[22] The same is true for broadband markets today.

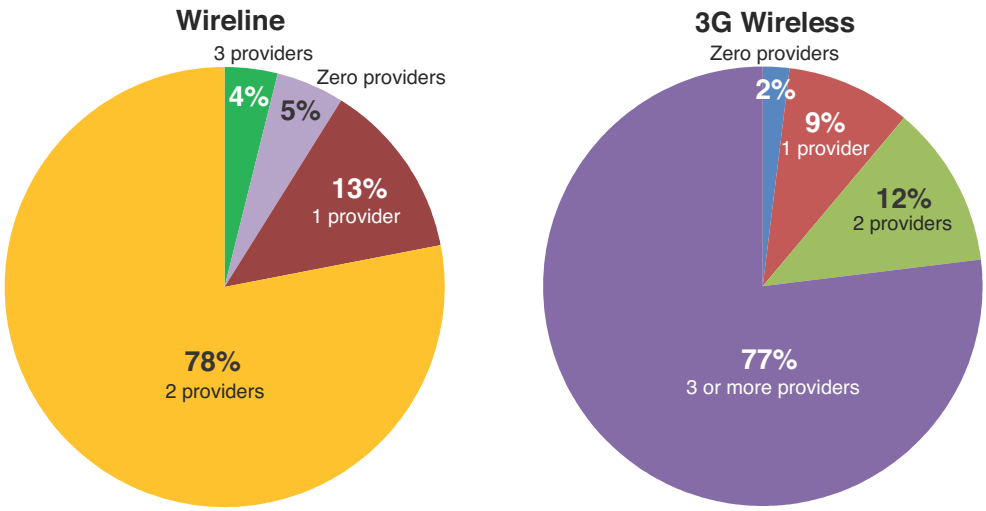
The Structural Presumption

Although recent developments have begun to shift the focus of competition analysis away from structural presumptions,[23] both the antitrust agencies and the telecommunications regulatory agencies—the FCC and state public utility commissions—continue in many cases to base their analyses largely on traditional concepts of market definition and concentration. While rebuttable, the "structural presumption" is that, other things equal, highly concentrated markets are more likely than unconcentrated ones to be subject to the exercise of market power.[24]

Market power takes two basic forms. First, firms may possess traditional market power: the ability to raise price above the competitive level, reduce quality, or otherwise deprive consumers of the benefits of competition (for example, by slowing innovation). Traditional market power is manifested through either coordinated effects (explicit or tacit collusion)[25] or unilateral effects; the latter is typically associated with some form of locational market power[26] resulting from geography or product differentiation, which allows a firm to raise prices (or lower quality) to a subset of consumers without having to fear that they will switch to competitors in sufficient numbers to make the price increase unprofitable.[27] Second, firms may possess exclusionary market power: the ability to deprive competitors or potential competitors of inputs or access to markets or to raise their costs, reducing competition in the long run.

Traditional analysis invariably concludes that markets for broadband service are relatively concentrated: as illustrated in figure 1, there typically are two wireline suppliers and three wireless providers serving each community. Moreover, although many think that the next generation of 4G wireless services

FIGURE 1
US RESIDENTIAL BROADBAND AVAILABILITY BY MODALITY, 2009



SOURCE: Federal Communications Commission, Office of Broadband Initiatives, *Connecting America: The National Broadband Plan* (March 2010).

(based on LTE or WiMAX technology) will serve as an economic substitute for wireline broadband, there is not yet a consensus that that moment has arrived; hence, the wireline and wireless markets are often considered separately.[28] Finally, it would seem that entry barriers in wireline service are high enough to make new entry unlikely, and even in wireless, some argue that the costs of acquiring spectrum and building out a network limit the likelihood of entry.[29]

In its Open Internet Order, the FCC summed up the structural evidence as follows:

> (1) The wireline broadband market is highly concentrated, with most consumers served by at most two providers; (2) the prospects for additional wireline competition are dim due to the high fixed and sunk costs required to provide wireline broadband service; and (3) the extent to which mobile wireless offerings will compete with wireline offerings is unknown.[30]

As noted above, the FCC ultimately refused to base its net neutrality rules on a finding that broadband ISPs had traditional market power.[31] In other contexts, however, it has not hesitated to rely on structural evidence as a basis for findings of market power. In its 2010 Qwest Forbearance Order, for example, the FCC conducted a "traditional market power analysis,"[32] determined that "the retail mass market for wireline services in Phoenix remains highly concentrated with two dominant providers, Qwest and Cox,"[33] and was "unable to find that Qwest is subject to effective competition in the Phoenix MSA."[34]

Similar findings frequently play important roles in the FCC's analyses of wireless competition. In its recent Data Roaming Order, it justified the new rules in part on grounds that they would "promot[e] competitive choice in broadband services."[35] Similarly, the FCC cited the desire to increase the number of wireless broadband providers in its decision granting a wireless license transfer from Skyterra Communications to Harbinger Capital Partners Funds.[36] In 2010, for the first time in many years, the FCC failed to find the wireless market "effectively competitive," at least in part as a result of concerns about "continued industry concentration."[37] In 2011, the Department

of Justice sued to block the acquisition of AT&T by T-Mobile in part because "the proposed merger would result in an HHI [Herfindahl-Hirschman Index] of more than 3,100 for mobile wireless telecommunications services, an increase of nearly 700 points. These numbers substantially exceed the thresholds at which mergers are presumed to be likely to enhance market power."[38]

More broadly, the structuralist approach has been a touchstone of groups advocating increased regulation, which have frequently characterized the wireline broadband market as a "cozy duopoly"[39] and argued that even the wireless market has an insufficient number of competitors to achieve a competitive result.[40] According to Cooper,

> Most communications markets have a small number of competitors. In the high speed Internet market, there are now two main competitors and the one with the dominant market share has a substantially superior technology. When or whether there will be a third, and how well it will be able to compete, is unclear. This situation is simply not sufficient to sustain a competitive outcome.[41]

For structural purists, a market with even six competitors would not be sufficiently unconcentrated to produce competitive results.[42]

The predicted consequences of high concentration, according to the structuralists, include high prices; reduced output; retarded innovation; and frequent, successful exclusionary conduct. In a joint 2007 filing at the FCC, for example, the Consumer Federation of America, Consumers Union, and Free Press argued that, as a result of high concentration and insufficient regulation, US broadband connections were "slow, expensive, and not universally available."[43] Pointing to inadequate competition in the wireless market and the failure of the FCC to impose network neutrality regulation, the groups complained that wireless broadband networks "actively block the use of unapproved equipment," that "certain applications and services are prohibited (e.g., VoIP)," and that network operators were seeking to turn wireless services into "a proprietary network of 'walled garden' content and services."[44]

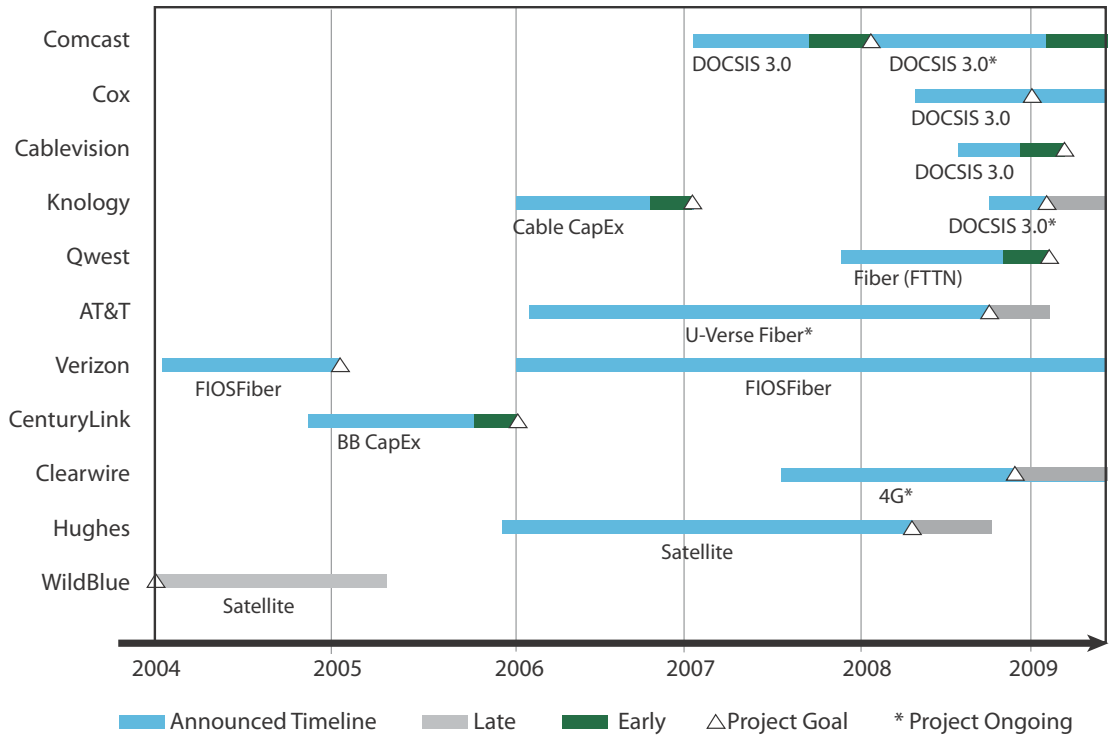
The Performance Paradox

The broadband industry has consistently confounded structuralist predictions of poor performance, thus presenting precisely the same type of paradox Bresnahan identified in Grove's analysis of the "new" computer industry. Despite (or perhaps because of) high concentration, broadband output is rising, prices are falling, quality is increasing, firms are making large investments in new technologies and infrastructures, rivalry is intense, and there are few significant instances (some would say none) of demonstrated anticompetitive conduct.

While a complete discussion of the performance of US broadband markets is beyond the scope of this paper, a lengthy treatment is hardly necessary to reject the "cozy duopoly" hypothesis. Indeed, the evidence that broadband markets are performing well can be found in the FCC's own reports, beginning with the 2010 *National Broadband Plan* (NBP) report, which concluded, "Due in large part to private investment and market-driven innovation, broadband in America has improved considerably in the last decade. More Americans are online at faster speeds than ever before."[45] Research performed for the FCC in conjunction with the NBP report found that real wireline broadband prices fell at a 5 percent annual rate between 2004 and 2009,[46] while evidence reported by the FCC in its regular *CMRS Competition Reports* shows rapid declines in prices for both mobile voice and data.[47]

Quality-adjusted broadband prices have declined primarily as a result of higher speeds, which in turn reflect the deployment of more capable infrastructure. The NBP report surveyed deployment plans of new broadband infrastructures by major broadband providers. As shown in figure 2, it found that both telephone companies (deploying either fiber-to-the-premises [FTTP] or advanced DSL infrastructures)

FIGURE 2
SELECTED FIXED BROADBAND INFRASTRUCTURE UPGRADES



SOURCE: Federal Communications Commission, Omnibus Broadband Initiative, *Connecting America: The National Broadband Plan* (March 2010), 39.

and cable companies (rolling out third-generation DOCSIS 3.0 infrastructure) were in the process of completing upgrades to their networks and that Clearwire had begun rolling out a nationwide 4G network based on WiMAX technology. Separately, the report noted that several wireless carriers had announced plans to roll out 4G wireless networks based on LTE technology, including Verizon, which had committed to upgrading its entire 3G infrastructure to 4G by 2013.[48]

In another report prepared in conjunction with the NBP, Atkinson and Schulz surveyed the capital expenditures of major US communications companies, estimating investments for 2008 through 2015 based on actual spending and announced plans, concluding that cumulative private-sector investment in broadband infrastructure over the eight-year period would total $244 billion.[49] The NBP report specifically concludes that high levels of investment are the result of competition among network operators.[50]

Declining prices, improving quality, and increasing availability have led to increased adoption and output. In a report released in February 2011, the National Telecommunications and Information Administration found that broadband penetration increased to 68.2 percent in October 2010 from 63.5 percent a year earlier and just 19.9 percent in 2003. Broadband is the fastest-propagating technology in history, and mobile broadband is propagating even more rapidly than wireline.[51]

There is no evidence that countries that have taken a more regulatory approach have achieved superior performance as a result. Despite entreaties from advocates of increased regulation to conclude that the United States was "falling behind" other nations,[52] the NBP report refused to weigh in, concluding only that

"each country's experiences and challenges have critical differences."[53] In fact, US markets appear to be performing well on a variety of metrics, including the deployment of fiber-to-the-premises and of 4G wireless, where the United States has a clear lead.[54] A recent Nielsen report found that among nine Western nations, America was second only to Switzerland in broadband connection speeds.[55]

In addition to strong performance, other metrics are also inconsistent with the structuralist hypothesis. First, no credible evidence exists that broadband ISPs earn above-market returns. For example, Hazlett and Weisman analyze financial market valuations of telephone and cable companies and find no evidence of market power,[56] while Darby presents evidence that broadband providers earn lower returns than the Standard and Poor's average and significantly lower returns than many high-tech firms.[57]

Second, it is worth noting that despite the sunk costs associated with entry, new broadband providers have entered the market, and further entry is likely. In the mobile arena, Clearwire represents a recent case of new entry, and Dish is seeking government permission to acquire the spectrum necessary to enter. Moreover, in an important sense, *all* wireless broadband providers are recent entrants into the market for 3G services, and either new or aspiring entrants into the market for 4G.[58] On the wireline side, infrastructure upgrades undertaken by wireline carriers have allowed them to enter and compete in new product markets (for example, cable companies in telephony, telephone companies in video).[59] Such behavior is not consistent with the structuralist prediction that "cozy duopolists" would refuse to enter one another's markets.

Third, structuralist predictions of exclusionary conduct and stifled innovation have not been borne out by experience. To the contrary, whereas the structuralists predicted that wireline providers would seek to emulate the "walled garden" of the early wireless marketplace—in which carriers chose equipment, limited access to outside content and applications, and so forth—the opposite has occurred: the advent of 3G wireless led to the opening up of the "wireless ecosystem," with content, application, device, and companies like Apple, Google, Microsoft, and Samsung taking the lead in defining the wireless value proposition.[60] Rather than limiting the devices and applications on their networks, mobile providers are now competing on the basis of the types and number of third-party applications available through their phones and devices.[61] Nor is innovation limited to the wireless sphere. "Over-the-top" video services such as Netflix now account for the bulk of Internet traffic, and broadband ISPs are responding by offering such services such as TV Everywhere and applications that allow customers to watch live television programming on their iPads using home Wi-Fi connections.[62] On the other hand, the FCC's Open Internet Order could cite only two adjudicated instances of anticompetitive conduct (one of which, Comcast's alleged discrimination against BitTorrent, has since been overturned in the courts) and none since 2007.[63]

The fact that the broadband market outperforms structuralist predictions is not surprising in the context of modern competition analysis, which recognizes that large numbers of competitors are not necessary to achieve competitive results. As the NBP report noted,

> The lack of a large number of wireline, facilities-based providers does not necessarily mean competition among broadband providers is inadequate. While older economic models of competition emphasized the danger of tacit collusion with a small number of rivals, economists today recognize that coordination is possible but not inevitable under such circumstances. Moreover, modern analyses find that markets with a small number of participants can perform competitively.[64]

"The critical question," the report continued (quoting from the Department of Justice's ex parte comments), "is not 'some abstract notion of whether or not broadband markets are 'competitive' but rather 'whether there are policy levers that can be used to

produce superior outcomes.'"[65] Before turning to that question, we first seek a better understanding of the competitive dynamics of the Internet ecosystem generally and modern broadband markets in particular.

3

The Competitive Dynamics of Broadband

Bresnahan began his 1999 article on the computer industry by explaining that, for an industry economist, "the first task is to understand how competition works in the industry, and how structure influences and is influenced by competition. Only when that task is done can we reasonably hope to say what kinds of industry structures public policy should favor and how."[66] In the same spirit, this section describes how competition works in the modern broadband industry. The conclusion, to summarize, is that competition in the broadband industry is shaped by the same forces as in the rest of the Internet ecosystem, like the markets for computers, content, applications, software, and so forth. As I have explained, those characteristics can be thought of as falling into three broad categories: dynamism, modularity, and network effects.

First, because broadband markets are dynamic, the primary focal points of competition are innovation and product differentiation. Broadband ISPs, like other Internet firms, seek to outpace their rivals, and earn economic rents, by developing superior products and services. To do so, they make large, nonrecoverable investments in R&D, equipment, and other fixed assets. To recover these costs (which must be recovered, at least in expectation, or the investments would not be made), ISPs must charge at least some customers prices in excess of marginal cost, which is to say they must price discriminate or, as some prefer to say, engage in "differential pricing."[67] To price discriminate, they must differentiate their products. This causal chain (or, more accurately, causal circle)—invest, innovate, differentiate, price discriminate, invest, and so forth—is central to the competitive dynamics of all IT markets, including broadband. (See figure 3.)

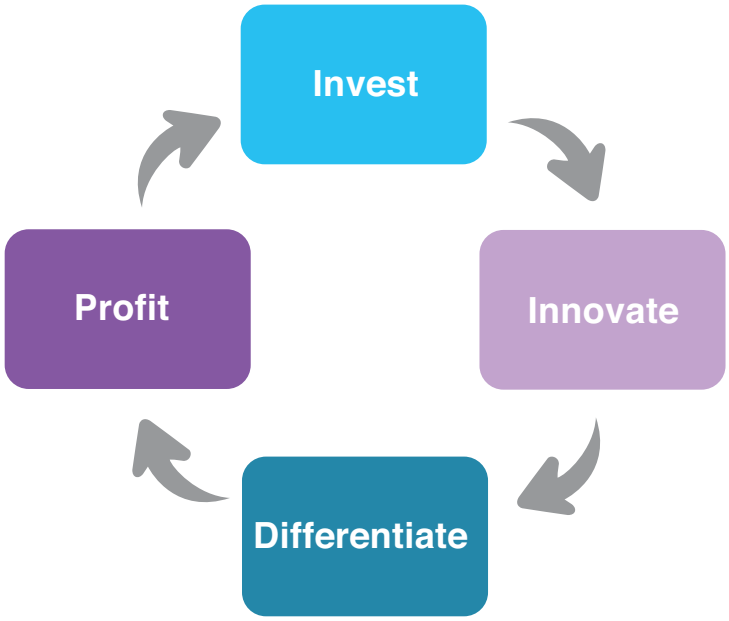
Second, broadband products serve as complementary inputs in larger systems. The ability to assemble different types of inputs into value-producing systems is referred to as modularity, which is made possible, in turn, by the existence of standards or "platforms." Competition may occur both within platforms (intraplatform competition) and between them (interplatform competition). As I will discuss, broadband services are one of four types of modules (along with applications, content, and devices) that comprise Internet platforms. (See figure 4.)

Third, broadband markets are, like other IT markets, subject to both demand-side economies of scale (network effects) and demand-side economies of scope (multisidedness). Markets are said to be subject to network effects if the value attached to a product or service by each consumer is a function of how many other consumers use it. In multisided markets, some types of consumers (for example, content and application providers) value the presence of other types of consumers (for example, subscribers). (See figure 5.)

Network effects and multi-sidedness typically go hand in hand. For example, a vertically integrated content and application aggregator and device manufacturer (for example, Apple) may place a higher value on distributing its products through a broadband ISP with many customers than one with fewer customers, not only because it will sell more iPhones, but also because doing so increases its own value to the content and applications providers (the other participants in its platform) on which it depends for complements.

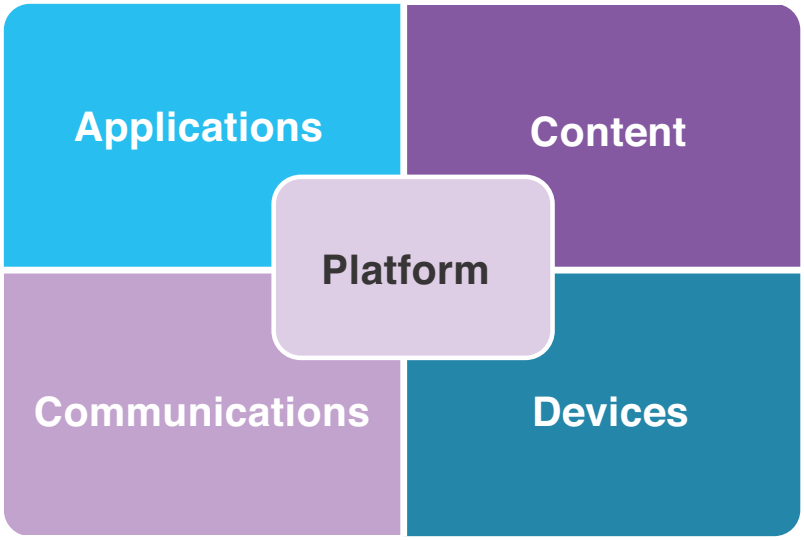
It is worth noting that the term *platform* is used to describe both modularity (referring to institutions that facilitate the exploitation of complementarities between products) and multisidedness (institutions that facilitate complementarities between economic actors). Thus, both the Windows/Intel ("Wintel") computer environment (facilitating interaction between complementary

FIGURE 3
CYCLE OF DYNAMIC INNOVATION



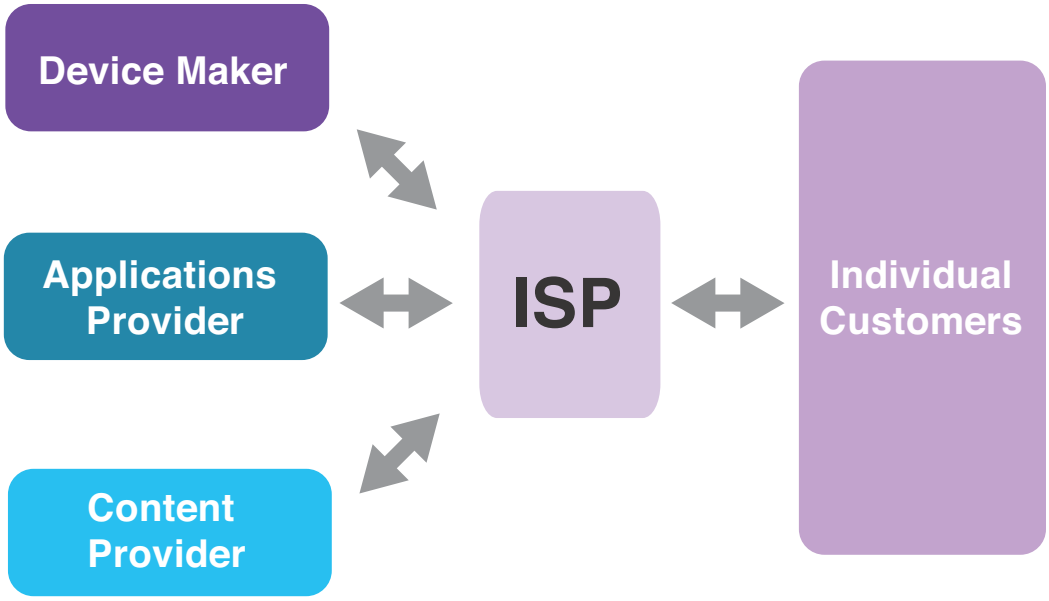
SOURCE: Author.

FIGURE 4
ELEMENTS OF AN INTERNET ECOSYSTEM PLATFORM



SOURCE: Author.

FIGURE 5
THE ROLE OF ISPS IN A TWO-SIDED MARKET



SOURCE: Author.

computer products) and the local newspaper (facilitating interactions between advertisers and readers) are referred to as "platforms."[68]

We now turn to a more extensive examination of how these characteristics manifest themselves in broadband markets.

Dynamism

Markets characterized by rapid technological change are often referred to as "dynamic." Market structures may change rapidly, and firms must innovate and adapt just to keep up; today's dominant firm may be seeking bankruptcy protection tomorrow. But technological change does not happen of its own accord: innovation demands investment, not only to invent new products (R&D), but also to bring them to market (capital expenditures). Such investments tend to be both sunk (unrecoverable) and fixed (insensitive to output). As a result, industries characterized by rapid technological change are generally subject to economies of scale and engage in efficient price discrimination, enabled by product differentiation, to earn back past investments and attract the capital needed to make new ones.[69]

In innovation markets, firms compete not only by seeking to offer the best products at the lowest prices, but also—and primarily—by making investments intended to create entire new categories of products or substantially reduce the costs of making existing ones. According to Baumol, "Innovation has replaced price as the name of the game in a number of important industries. The computer industry is only the most obvious example, whose new and improved models appear constantly, each manufacturer battling to stay ahead of its rivals."[70] Innovation competition plays a central role in economic progress[71] and likely contributes far more to long-run economic prosperity than the static efficiency gains associated with achieving the competitive result in traditional models.[72]

Telecommunications markets were not traditionally thought of as "innovative" in this sense, but the convergence of telecommunications with digital computing has accelerated the pace of change. Mobile wireless markets are the most obvious example, with new technologies now being introduced roughly every five years as the market progresses from 3G to 4G wireless standards (WiMAX and LTE).[73] However, wireline networks are also evolving rapidly: current fiberoptic networks deliver speeds four times as fast as those initially introduced in the early 2000s[74]; techniques developed in just the past few years (known as vectoring and pair bonding) now allow even legacy copper networks to deliver broadband speeds up to 100 Mbps.[75]

One important characteristic of innovation competition is its riskiness: innovation markets have a win-or-lose aspect, where the firms that innovate successfully are rewarded with high margins, while those that do not die off.[76] The leading exponent of dynamic competition, Joseph Schumpeter, famously coined the phrase "creative destruction" to describe it. As Schumpeter put it, innovation competition "strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives."[77]

Again, telecommunications markets were not traditionally thought of in such terms; for decades, AT&T was the prototypical safe investment, and telephone companies enjoyed the steady returns associated with rate-of-return regulation until the mid-1990s.[78] But investors in firms such as Clearwire, with its bet-the-firm commitment to WiMAX technology—or for that matter, in Verizon, with its arguably even more audacious bet on fiber-to-the-home—can have little doubt that everything is at risk. Firms that bet wrong do, in fact, cease to exist: AT&T, which made losing bets on everything from cell phones (it sold, then bought) to cable companies (it bought, then sold), survives today in name only.

Dynamism has several important implications for competition analysis. First, and perhaps most obviously, rapid technological change places a burden on antitrust enforcers to take a forward-looking approach to the assessment of market power. Katz and Shapiro, for example, note that "under the Schumpeterian view that competition consists of repeated waves of innovation that sweep aside 'dominant' incumbents, current product-market shares may indicate very little about the future of the industry or about whether any given firm will possess significant market power."[79] Similarly, Posner, writing in 2001, concluded, "Because of the extraordinary pace of innovation, not only in computers but in communications technology . . . the networks that have emerged in the new economy do not seem particularly secure against competition."[80] The US Department of Justice made essentially the same point in a 2010 filing before the FCC:

> In any industry subject to significant technological change, it is important that the evaluation of competition be forward-looking rather than based on static definitions of products and services. Insight can best be gained by looking at product life cycles, the replacement of older technologies by newer ones, and the barriers facing suppliers that offer those newer technologies. In the case of broadband services, it is clear that the market is shifting generally in the direction of faster speeds and additional mobility.[81]

In one respect, at least, the FCC seems to have taken this advice to heart: Looking at potential future technological developments in the broadband market, the NBP report concluded today's telephone companies—dominant firms, in the eyes of many—are at risk of obsolescence if they are not able to find a way effectively to compete with cable's cost-effective DOCSIS 3.0 technology.[82]

The extent to which dynamism erodes market power, and perhaps reduces the need for antitrust enforcement in general, is a matter of contention.[83] However, many agree on a narrower point: that the traditional presumption against market concentration does not carry over to innovation markets. As Katz and Shelanski explain:

> A proper understanding of innovation-based competition means that, in some markets, antitrust enforcement cannot rely on its long-established presumptions that increased concentration or market power will reduce innovation or harm consumer welfare. A merger from four to three firms, or even from three to two, while raising a presumption of increased short-run power over price and output, does not so easily raise a presumption of reduced development and deployment of new technology.[84]

In other words, to the extent market performance is measured by the pace of innovation, there is simply no basis for presuming an inverse relationship between concentration and performance.

Another important implication of dynamism in IT markets is the importance of economies of scale, which lead ultimately to competitive price discrimination. As Baumol notes, innovative industries spend substantial proportions of their revenues on fixed costs such as research and development. He observes, "These outlays [on R&D and other innovative activities] are substantial, amounting to more than 10 percent of total annual revenue in industries such as communications and pharmaceuticals. In the computer software industry they may well be higher."[85] Such costs can be recouped only through high margins. As Shapiro explains:

> Since R&D costs often do not vary with the scale of output, such fixed costs are common in innovative industries. In my experience it is common in the technology sector for firms to follow a rule of thumb that involves investing some percentage of revenues into R&D; hence, long-term viability requires sufficient margins to fund ongoing R&D efforts. Fixed costs also are very common in industries that create informational content. Indeed, in some of these markets, such as those for movies or music, that involves (*sic*) "hits" and "duds," it is well understood that the large margins earned on the "hits" are necessary to compensate for the larger number of "duds" that are inevitable.
>
> For all of these reasons, competitive prices are often above marginal cost in innovative industries, and sometimes far above marginal cost.[86]

The problem of defraying fixed costs in industries with economies of scale is a familiar one, especially to students of regulated industries (like traditional telecommunications), who recognize it as the central challenge posed by natural monopoly. Economic efficiency requires that prices be set equal to marginal cost, but marginal cost is always below average cost in industries with downward-sloping average cost curves over the relevant range of output; thus, setting price equal to marginal cost ensures the firm earns negative returns and, having anticipated the problem, never enters the market in the first place. As Varian explains:

> Many important industries involve technologies that exhibit increasing returns to scale, large fixed and sunk costs, and significant economies of scope. Two important examples of such industries are telecommunications services and information services. In each of these cases the relevant technologies involve high fixed costs, significant joint costs and low, or even zero, marginal costs. Setting prices equal to marginal cost will generally not recoup sufficient revenue to cover the fixed costs and the standard economic recommendation of "price at marginal cost" is not economically viable. Some other mechanism for achieving efficient allocation of resources must be found.[87]

The efficient solution is price discrimination. As Wallsten explains in the context of broadband, "Because [broadband] carriers must recover the high fixed costs of investment, average prices must exceed marginal costs if providers are to continue investing in their networks. The most efficient way to recover those fixed costs is to charge different types of consumers different prices."[88] Such price discrimination

is efficient to the extent that it reflects Ramsey pricing principles: when price-cost margins are set in inverse proportion to the elasticities of demand of different customer groups so that the least price-sensitive customers shoulder the fixed costs by paying prices above average cost, while the most price-sensitive are offered prices at or near marginal cost (below average cost).

For many years, economists believed that price discrimination was impossible in competitive markets, since competitors would always have an incentive to undercut ("cream skim") above-cost prices. Indeed, the expectation that competition would make price discrimination impossible led economists for many years to suppose that the presence of price discrimination was a certain indicator of market power. As it turns out, neither proposition is true: competition does not preclude price discrimination, and price discrimination does not imply market power.[89]

Indeed, recent work by Baumol and others has led to a growing recognition of the ubiquity and significance of the practice, especially in IT markets.[90] As Baumol and Swanson explain in an important 2003 article, competitive price discrimination is not just *desirable* in markets with high fixed costs and heterogeneous consumers, but also *necessary* and *inevitable*. Moreover, the prices charged are generally efficient (reflecting Ramsey pricing), and so long as the market is sufficiently competitive, the price-discriminating firms earn only competitive returns.[91]

The economic imperative to differentiate products has a profound impact on competition in the Internet ecosystem: it means that individual firms compete to create new products and new product attributes that serve as effective differentiators—attributes that create sufficient added value to cause some cohort of consumers to be willing to pay a price greater than marginal cost.[92] Thus, broadband service providers seek to differentiate both their wireline (FiOS vs. U-Verse vs. DOCSIS 3.0) and wireless (LTE vs. HSPA+ vs. WiMAX) communications offerings.[93] At least equally important, they also compete by seeking to assemble the most compelling combinations of products for consumers (those that generate the most value for at least some subsets of consumers).[94] Thus, at the same time that they are innovating internally, broadband ISPs are also collaborating with suppliers of complementary inputs (mobile wireless devices, high-capacity DVRs, video applications for iPads, TV Everywhere services, and so forth) to generate compelling bundles of products and services that differentiate them from their competitors.

To reiterate, what I have described is a causal chain with direct implications for both the competitive dynamics of broadband markets and the challenges faced by competition authorities in evaluating them. High rates of innovation (dynamism) imply large sunk costs, which must be recouped through price discrimination, but price discrimination is possible only if products can be sufficiently differentiated to allow for higher margins on at least some sales.[95] Thus, firms are constantly engaged in a search for product-differentiating attributes in their own products; in markets characterized by modularity, in the complementary products produced by others; or, in multisided markets, in the types of customers to whom they cater.

Modularity

In its FCC filing on the *National Broadband Plan*, the Department of Justice concluded that "Broadband services are one part of a wider information technology ecosystem that ultimately delivers value to consumers."[96] The statement rings true, but an economist cannot help but ask: precisely what does it mean to be "part of an ecosystem"?

The answer lies in the related concepts of modularity (an engineering term) and complementarity (an economic one). Modularity refers to standards (or "platforms") that allow different products (or "modules") to interoperate, while complementarity refers to the fact that the products generate greater benefits if used together than if used independently.[97] In IT markets, it is commonplace for modules to be perfect complements, meaning that they

generate no value at all unless used in conjunction with other modules as part of a platform (a personal computer, an operating system, and one or more types of applications software).[98] Thus, to say that a product or service is part of the Internet ecosystem is to say that it is one of the complementary modules operating together on one of the many platforms that comprise the "platform of platforms"[99] called the Internet.

It is conventional to classify the modules that make up Internet platforms into four categories: applications, communications (broadband), content, and devices.[100] Further, an Internet platform can be defined as a system that contains at least one of each type of module, without which it would be unable to function; that is, the term "Internet platform" can sensibly be defined such that the four types of modules are perfect complements.

The recognition that broadband comprises just one of four equally necessary components of all Internet platforms has important implications for how we think about the competitive dynamics of the Internet ecosystem. In particular, it becomes clear from this perspective that one of the central metaphors in the policy discussion about broadband regulation—the notion that broadband networks are at the "core" of the Internet while content, applications, and devices are at the "edge"[101]—is fundamentally misleading and economically incorrect. Although it is certainly understandable that the modern telecommunications intelligentsia would see broadband as the center of the Internet ecosystem (just as pre-Copernican astronomers, seeing the universe from their earthbound perspective, mistakenly believed the Earth was the center of the universe), it is not. For purposes of competition analysis, at least, broadband is a complement among complements, a module among modules.

This realization does not end the debate about appropriate competition policy for broadband and other Internet services, but it does reframe it. First, it explains why it is incorrect to argue, as the FCC does in the Open Internet Order, that broadband ISPs differ from "edge" providers because they "control access to the Internet for their subscribers and for anyone wishing to reach those subscribers" and, on this basis alone, to "find broadband providers distinguishable from other participants in the Internet marketplace."[102] The same could be said for the providers (collectively) of any essential input to Internet platforms, including operating systems, browsers, Internet access devices, and so forth. (For example, it is equally true that operating system providers "control access to the Internet for their subscribers and for anyone wishing to reach those subscribers.") Going further, the ability to cut off access to the entire Internet is hardly necessary to raise competition issues: it may be sufficient, in theory, for a device manufacturer to restrict interoperability with a software program, or for a search engine operator to decline to show results from a competitor's sites. Nothing is unique, in other words, about the ability of broadband ISPs to affect—for competitive reasons or otherwise—how various modules interoperate, or fail to interoperate, on Internet platforms.[103]

To understand the competitive dynamics of broadband markets, it is necessary to dispense altogether with the edge versus core metaphor and focus instead on the roles played by broadband ISPs in two types of competition: competition between producers of modules within platforms (intraplatform competition) and competition between platforms (interplatform competition).[104] I will discuss both types of competition in this section and the following one.

To begin, the central economic function of a platform is to strike the optimal balance between the benefits and costs of modularity (in this context, interoperability) on one hand and the benefits and costs of integration on the other.[105] The primary benefit of modularity is that it allows firms (and the platform or platforms in which they participate) to capture both the benefits of specialization (of specializing in the production of one or a few modules) while still benefiting from the economies of scale and scope made possible by participation in a widely distributed platform.[106] But modularity also imposes costs. Most obviously, the design and engineering costs of achieving interoperability across different products (porting costs) may outweigh the benefits.[107]

Modularity can also interfere with the ability of entrepreneurs to appropriate returns on investment,[108] or (in cases of complementary monopoly products) inhibit efforts to avoid "double marginalization" through vertical integration.[109] Successful platforms achieve a mix of interoperability and integration that maximizes overall value, given the technical and economic context of the market in question and are capable, over time, of adjusting to change.

Given the obvious complexity of this balancing exercise, it might seem that the challenge of creating and maintaining a stable interface would best be solved through centralized decision making. That is, regardless of whether the platform operator opts for relative modularity (like Android) or a more integrated approach (like Apple), intuition suggests that there will generally be a single "platform czar" calling the shots. This intuition, however, turns out to be wrong—or, to be more precise, true only as a special case.[110] In general, platform participants compete to control the direction of a platform and, by doing so, to affect how current and future economic rents are divided. Indeed, intraplatform competition is commonplace in the computer sector and in the broadband ISP sector as well.[111]

In a 1999 article, Bresnahan and Greenstein coined the term "divided technical leadership" to describe "a structure in which a number of firms possess the capability to supply key platform components."[112] As Bresnahan explains:

> Under divided technical leadership, there is no single vertically integrated firm with control over direction of a platform. Instead, a number of firms supply, in the short run, and invent, in the long run, platform components. Frequently, different firms will have positions of dominance in different layers. These firms must cooperate in the short run to serve their customers. They find themselves, however, in competition when it comes to invention.[113]

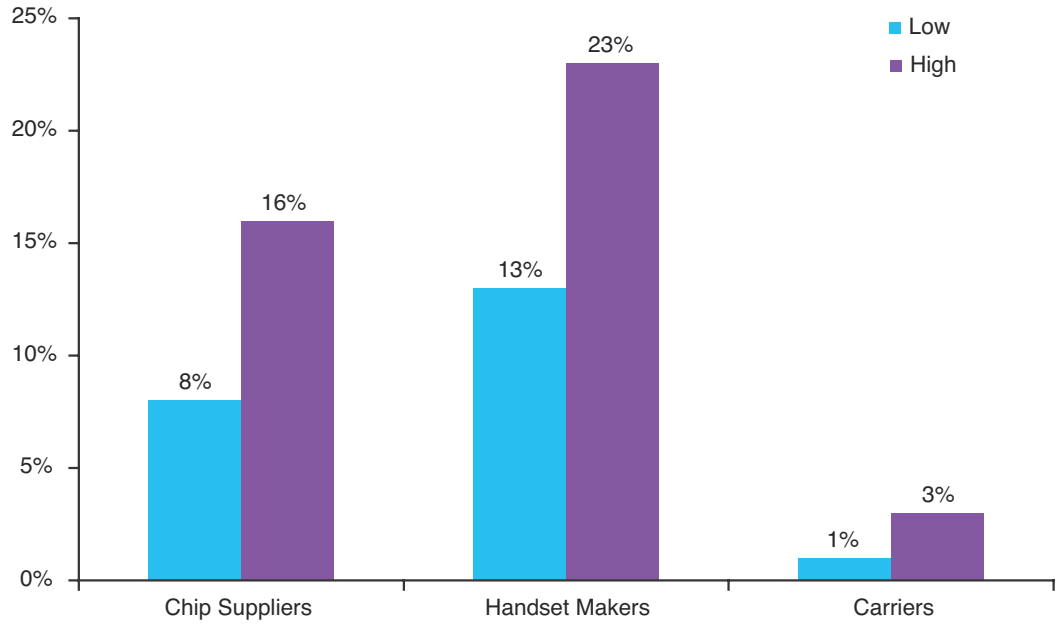
According to Bresnahan and Greenstein, divided technical leadership was the "inevitable" consequence of the emergence of client/server architectures, which "necessarily have divided technical leadership because they re-use components from other platforms," requiring an "aspiring client/server platform steerer" to "make progress on each component at or near the technical level of the leader of that component," an "extraordinarily difficult feat."[114]

Modularization has had the same effect in the Internet ecosystem, permitting the reuse of components across platforms, making it difficult or impossible for a single firm to steer the technological development of every module or component, and leading to divided technical leadership (intraplatform competition).[115] As Bresnahan puts it, intraplatform competition results in part from the fact that "a firm in one layer [of the platform] has every incentive to grab the rents of a firm in another layer."[116] Consider the following example, offered by Sallet:

> A consumer who buys a book from Amazon on her iPad using the AT&T wireless network engages in three separate transactions with three separate revenue streams, three price points, and three consumer relationships. But, and this is the critical point, the transactions are interdependent, and this interdependence—the shared value arising from the use of a package of complementary products—is what firms can bargain over. The bargaining may involve specific terms of a contractual relationship, such as exclusivity rights. It may involve payment from one firm to another for the ability to gain access to the package. It may be the purchase or subsidization of another firm's product for the ability to engage in joint marketing.[117]

Firms in the Internet ecosystem compete over rents by seeking to develop better products or superior brand images, or by leveraging control of some key input or attribute like intellectual property. For example, a recent study by Dedrick, Kraemer, and Linden analyzes the intraplatform competition for the rents generated by smartphones:

FIGURE 6
RETURN ON ASSETS FROM "ICONIC" SMARTPHONES



SOURCE: Table 4 in Jason Dedrick, Kenneth L. Kraemer, and Greg Linden, "The Distribution of Value in the Mobile Phone Supply Chain," *Telecommunications Policy* 35 (2011): 505–21.

> In the smartphone market, carriers and handset makers each try to increase their leverage. Handset makers can accomplish this in part by building brand image with consumers. An excellent recent example of this is Apple's iPhone. Well regarded by consumers based on its hit line of iPod music players, Apple was reportedly able to negotiate a share of monthly iPhone subscriber revenue from AT&T.[118]

As shown in figure 6, Dedrick, Kraemer, and Linden examined the division of profits between chipset suppliers, handset makers, and wireless carriers and found that both chipset suppliers and handset makers earned far higher returns on assets than the carriers, who earned just 1–3 percent, largely as a result of the high capital costs incurred in creating and maintaining their networks.[119]

Based on their findings, Dedrick and colleagues conclude that "value-adding complementary goods and services" are "shifting the key level of competition toward platforms based on operating systems, including those provided by software makers such as Google and Microsoft or by the handset makers such as Apple."[120]

The FCC has acknowledged the growing role of complementary goods in broadband competition, at least in the wireless market. For example, in its 2011 report on competition in the commercial mobile radio services market, it concluded:

> In addition to network quality and advertising, a third component of non-price rivalry among mobile wireless service providers is the differentiation of the downstream products that they offer or that rely on their networks, including handsets/devices, operating systems, and mobile applications. . . . As mobile operating systems, and the functionalities and application stores they enable, play a more

> prominent role in a consumer's mobile wireless experience, consumers are showing an increasing loyalty to particular operating systems or device platforms.[121]

Although this acknowledgement is certainly a step in the right direction, it remains—in the spirit of the FCC's continuing adherence to the core-edge metaphor—carrier-centric. That is, differentiation is portrayed not as competition among platforms, but rather as "rivalry among mobile wireless service providers." Indeed, the discussion is contained in a section of the report labeled "Provider Conduct," implicitly suggesting that applications, content, and device providers are passive players in the competitive dynamics of wireless communications markets, rather than active participants in the competition within and among ecosystems.

In fact, platform competition takes place along virtually every dimension of product differentiation and involves all types of platform participants.[122] Broadband platforms compete to offer the most compelling content (like music and apps in wireless and access to video-on-demand or compelling sports programming in wireline), to provide the most compelling devices and applications software,[123] and to build and protect the most valuable intellectual property portfolios.[124] They also compete for brand recognition and the ability to be "customer facing."[125] Although broadband providers are often portrayed as customer facing, Sallet notes this is not always the case.[126] For example, a broadband ISP may play a visible but secondary role, as when a satellite TV company (for example, DirecTV) sells a triple-play package in which the wireline broadband service is provided by a phone company. In still other instances, the broadband provider may be completely "upstream" from the customer, such as when a consumer purchases a Kindle packaged with connectivity from a provider (originally Sprint, now AT&T) whose identity the consumer may not even know.

The role of modularity in modern broadband markets is perhaps best illustrated by the recent travails of formerly dominant cell phone supplier Nokia. As Sallet points out, in February 2011, Nokia's CEO sent a memorandum to employees describing the firm's strategic challenge and "telling the tale of value creation"[127] in the Internet ecosystem:

> The battle of devices has now become a war of ecosystems, where ecosystems include not only the hardware and software of the device, but developers, applications, ecommerce, advertising, search, social applications, location-based services, unified communications and many other things. Our competitors aren't taking our market share with devices; they are taking our market share with an entire ecosystem. This means we're going to have to decide how we either build, catalyze or join an ecosystem.[128]

Three days later, Nokia announced its decision to enter a strategic alliance with Microsoft, in the hope of creating a new ecosystem capable of competing successfully with the likes of Apple; Android; and another formerly dominant but now fading provider, Research in Motion. The first major result of that collaboration—the Nokia Lumia 900, a 4G smartphone using the Windows operating system—rolled out in Spring 2012.[129] It was available exclusively on the AT&T network.[130]

Network Effects and Multisidedness

The third set of characteristics that distinguish IT markets from traditional ones is the presence of network effects and multisidedness. Network effects are demand-side economies of scale, meaning that the value of a product or service to consumers is a function of how many other consumers use it.[131] Multisided markets, by contrast, involve demand-side economies of scope: that is, participants in multisided markets are assumed to be heterogeneous and to value diversity rather than numbers.[132] A telephone network with identical subscribers evidences network effects, as its value is an increasing function of the number of subscribers. A telephone network

to which businesses as well as consumers subscribe is also multisided, assuming both groups value the presence of the other type of subscriber.[133]

The competition literature on network effects has two main themes. One theme focuses on "tipping" and "lock-in" effects. Tipping means that if the value of a network increases with the number of subscribers, then (a) in equilibrium, there will only be one network, and (b) once one network establishes a lead, the balance of competition must "tip" in its favor, perhaps even if it is in other respects inferior.[134] Moreover, subscribers, recognizing that they will to some extent be "locked in" to their choices by the investments they make to join a network (in software, hardware, or learning), will tend to join the networks they expect to prevail, even if those networks would not otherwise be their first choice. Tipping and lock-in, in other words, suggest not only that network effects create a tendency toward monopolies, but that the resulting monopolies may be as much the result of chance as of merit.[135]

The second theme relates to the nature of competition in markets where tipping has not occurred. In this case, network effects tend to intensify competition, since the effects of changes in product characteristics (price, quality, availability of complements) are magnified by demand-side complementarities.[136]

Importantly, the tendency of network effects to result in monopoly is often counterbalanced by offsetting factors, including declining returns to scale and the presence of heterogeneous consumer tastes. As Weiser explains:

> The claim that network markets will invariably tip to a single standard . . . overlooks important reasons why network competition can occur. Significantly, the tipping prediction does not take account of the likely scenario where a network effect (the value of additional customers) declines at some point in time because the network size has reached critical mass or where a rival network is able to overcome the first mover's initial advantage. In markets where the critical mass is small enough to accommodate multiple providers of a particular product or service, multiple firms will compete at the platform level, as they currently do in the market for video game consoles and cell phones. Moreover, it is quite clear that consumers' demand for variety can compensate for a lack of a strong network effect.[137]

Moreover, tipping is an issue only in the case of incompatible standards—Betamax versus VHS, QWERTY versus Dvorak, Apple versus Wintel, and so forth. If platforms are interoperable or, to use Rohlf's term, interlinked, then network effects are tied to total industry output—that is, to the size of all interlinked platforms, rather than to the size of any one platform.

It is noteworthy that broadband communications networks have been characterized by voluntary peering and transit arrangements (voluntary interconnection). For example, Economides notes that "dire predictions" that network effects would lead to the emergence of a dominant Internet backbone provider which would "degrade interconnection with a targeted rival" have not been borne out by experience; instead, "on the Internet we have observed a trend in the opposite direction (toward interconnection and full compatibility)."[138]

Despite universal interconnection of their communications functions, broadband networks experience indirect network effects by virtue of their participation in both "upstream" platforms associated with competing network architectures (for example, DOCSIS 3.0, FTTP/GPON, LTE, WiMAX) and "downstream" platforms associated with competing consumer platforms (for example, Android, iOS, Windows Phone).[139] In each case, ISPs benefit from belonging to larger platforms—and suffer, as seems to be the case with Sprint-Nextel's choice of WiMAX for its 4G standard, from choosing smaller ones. The value of a broadband ISP to an Internet platform can also be a function of indirect network effects. A device maker (like Nokia) may value distributing its devices through a larger broadband ISP not because its devices will be able to communicate

with more customers (which, because of interlinking, is not the case), but because the larger ISP may have a larger customer base or more sales outlets and thus contribute to more sales of the device, in turn contributing to the value of the Nokia platform (for example, to suppliers of applications and content).

The presence of network effects, combined with the multisided nature of the market, provides an important constraint on downstream pricing power. For example, a broadband ISP that raises prices to downstream consumers has to take into account not just the lost revenues from consumers who switch to other providers, but also the resulting reduction in its value to producers of complements. And the feedback loop does not stop there: as customers flee to competitors, the competitors' value grows. As Rysman explains:

> If there are multiple competing market intermediaries, the effect of participation of one side on the other has even more bite. Consider two competing platforms pricing to consumers and sellers. As without competition, the consumer price depends on consumer demand, consumer cost, and the mark-up to sellers. But now, lowering the consumer price attracts consumers from the competing platform, which degrades the value of the competitor to buyers, and hence leads to a larger increase in buyer interest in the original platform. Hence, the "two-sidedness" of pricing can be more pronounced in competitive markets.[140]

Network effects intensify interplatform competition in nonprice dimensions as well. As Weiser notes, "standards competitions" create strong incentives for innovation:

> Standards competitions often will enable consumers to benefit from a more dynamic product market that includes more choices, enhanced products, and lower prices. To be sure, a head start or an installed base from a related technology is important to influencing the ultimate outcome of such a battle, but, regardless of the outcome, it seems clear that competition to control the standard will push companies to develop superior technology in the hope of establishing their preferred standard.[141]

Thus, network effects intensify both intra- and interplatform competition, while creating strong incentives for interoperability.[142] As Weiser explains, "where a firm sponsoring a platform standard faces competition, it is likely to provide open access to its platform in order to attract complementary products even without regulatory requirements that it do so,"[143] promoting competition within platforms and facilitating the entry of "independent" modules.[144]

Efforts to promote development of complements can also have more direct effects on competition in other layers. For example, Intel's decision to invest billions of dollars in wireless broadband ISP Clearwire was driven by its desire to catalyze growth in the WiMAX platform, of which Intel is the lead sponsor,[145] and Google's desire to foster development of a platform around its Android operating system was a driving force behind its decision to enter the device business.[146]

Multisidedness can intensify competition in the same way as network effects. Indeed, the two often go hand in hand: as explained above, for example, the downstream pricing power of a broadband ISP is attenuated by the combination of network effects and multisidedness, which together tie its value to upstream complementers to the volume of downstream customers. In addition, three other consequences of multisidedness have important consequences for broadband competition.

First, efficiency in two-sided markets demands price discrimination, in the sense that the very purpose of a two-sided platform is to set relative prices so as to achieve the optimal mix between the two types of participants (or, more broadly, the optimal mix between multiple participant groups).[147] Thus, in general, advertisers will be charged one price and readers a different one, and so forth. Moreover, to the extent customers on one or both sides of the market

are heterogeneous, the case for price discrimination within customer groups is strengthened—since efficient price discrimination can lower prices to marginal consumers, bringing more of them to the platform and creating "external" benefits for customers on the other side.[148]

Second, multisided markets are also associated with the notion of "terminating monopoly": the notion that a platform operator (for example, a broadband ISP) might be able to exercise upstream market power by virtue of the fact that its downstream consumers "single home," or subscribe to only one broadband ISP.[149] As Rysman explains, the question of "multi-homing" vs. "single-homing" matters because

> The intermediary can be viewed as a monopolist over access to members that do not use other intermediaries. Hence, firms compete aggressively on the side that uses a single network in order to charge monopoly prices to the other side that is trying to reach them. As a result, competition between platforms can have large price effects on the side of the market that uses a single platform and little or no effect on the side that uses multiple platforms.[150]

As intuition suggests, however, the terminating monopoly problem is premised on the assumption that downstream consumers do not value the ability to access multiple upstream providers (they do not value diversity), so that the platform operator can threaten to exclude upstream providers without lowering the value of its platform to consumers.[151] This assumption is not valid in the market for broadband access, where consumers place a high value on the diversity of available applications, content, and devices.

Third, it is worth emphasizing that the literature on two-sided markets is in an early phase of development. The theoretical models are highly stylized (they fail to capture salient attributes of actual markets), and to the extent that they have been used to predict either the efficiency consequences or distributional implications of various policy proposals (for example, net neutrality), the predictions typically depend on strong assumptions both about the structure of the models and the values of various parameters.[152]

How Broadband Competition Works

To summarize, broadband markets are now characterized, like markets in the rest of the IT sector, by dynamism, modularity, network effects, and multisidedness. The competitive dynamics of such markets are shaped by complex interactions between market-specific factors on both the demand and supply sides, but the central tendencies are straightforward. Dynamism is shorthand for a causal circle in which firms compete by investing to create new products and, by succeeding, differentiate themselves sufficiently to earn an economic return on their investments, which attracts the capital needed to repeat the cycle. Modularity allows this process of innovation and differentiation to exploit the specialized capabilities of multiple firms to generate complementary products; it places producers of complementary goods in competition with one another over the current rents and future directions of the platforms in which they participate; and it creates a new type of competitor, competitive platforms, composed of loose and fluid alliances of complementers that may themselves belong to multiple platforms. Network effects and multisidedness function in many respects as competition "superchargers"—they magnify the effects of competitive choices through demand-side complementarities of scale and scope.

For purposes of competition analysis, broadband markets share all the key characteristics of other IT markets, including, specifically, the markets for Internet applications, content, and devices. Like other IT firms, broadband ISPs make large sunk cost investments. For many IT firms, such investments primarily take the form of intellectual property; for broadband ISPs, they are primarily telecommunications infrastructures. From an economic perspective, however, the effect is the same: in each case, firms invest to create products that are sufficiently unique

and highly valued (by at least some consumers) to command prices that generate returns sufficient to compensate for not only the capital invested but also the risk of failure. Put simply, there is no economic difference between the risky investments made by companies like Sprint Nextel (in WiMAX) and Verizon (in FiOS) and the similarly risky investments made by companies like Facebook (in Instagram) or Intel (in WiMAX). In other words, broadband markets, like other IT markets, are characterized by dynamic competition.

Similarly, broadband ISPs, like other IT-sector firms, seek to assemble or participate in systems that create new value for at least some types of consumers, and they do so by choosing both the platforms they interoperate with and, when they function as platform leaders, the complementors they admit. Their decisions regarding interoperability are affected by both supply-side and demand-side economies of scale and scope, which create powerful incentives to increase volumes by maximizing system openness and capturing the benefits of modularity, but these incentives do not always overcome the costs of interoperability.[153]

Because of both supply- and demand-side economies of scale, broadband markets, like other IT-sector markets, are relatively concentrated. Moreover, as in other IT markets, firm-level entry may involve sector-specific costs (for example, patents and copyrights, access to content and distribution networks, a new semiconductor fabrication plant, the need to procure spectrum licenses). Yet the rapid pace of innovation associated with all of these markets forces incumbents to constantly reinvest, whether in intellectual property or in new network equipment, diluting the advantages of incumbency.[154]

4

Implications for Regulation and Competition Policy

The emergence of the Internet ecosystem has accelerated innovation, enhanced economic growth, and increased consumer welfare. The challenge for public policy is to develop and maintain a legal and regulatory framework that facilitates its continued development, including a framework for preventing anticompetitive conduct that harms consumers without stifling rivalry and entrepreneurship. in this section, I will begin by explaining why ex post antitrust oversight would be superior to ex ante regulation for broadband markets and close by discussing some of the broader implications for competition analysis and regulatory policy of the theory of broadband competition I have presented.

Replacing Regulation with Antitrust

Competition policy seeks to preserve competition and enhance consumer welfare while avoiding the temptation to protect or promote particular competitors, industries, or technologies. In a world of imperfect information, this must necessarily involve weighing benefits and costs, including the benefits and costs of waiting to intervene (weighing "Type I" against "Type II" error).[155] In general, the balancing of benefits and costs places a high value on the recognition that, absent clear evidence of market failure, competition provides powerful incentives for the efficient allocation of resources to their highest valued uses,[156] and it recognizes that the exercise of government authority is itself not without costs, including the incentives it creates for "rent seeking" or "taxation by regulation."

With these principles in mind, competition policy in the United States has generally relied upon ex post antitrust enforcement over ex ante regulation. The exceptions have included, and to some extent still include, markets thought to be subject to natural monopoly (for example, electricity, pipelines, railroads, and telecommunications), as well as markets where, correctly or not, policymakers perceived a unique, compelling need for government intervention (for example, airlines and broadcasting).

The legacy of traditional communications regulation—in the form of the FCC and the fifty-state public utility commissions—remains in place. Until fairly recently, it had appeared that these legacy regulators would limit themselves primarily to traditional communications services—primarily to voice telephony (Title II of the Communications Act for landline service; Title III for mobile wireless) and to traditional broadcast (Title III) and cable (Title VI) video platforms—and not extend ex ante regulation to the Internet. As these traditional services were gradually subsumed into the Internet ecosystem, many believed, legacy regulatory structures would become less relevant.[157]

Two factors now suggest otherwise. First, the FCC's foray into "net neutrality" regulation—beginning in 2005 with its decision to adopt four "Open Internet Principles" (which it later sought to enforce in the Comcast-BitTorrent Order), and most recently with its issuance of the Open Internet Order—indicates the agency believes it is "compel[led] to protect and promote the Internet" and has "broad authority to promote competition, investment, transparency, and an open Internet."[158] Second, as noted above, both the FCC and state regulators continue to intensively regulate traditional communications services, promulgating and enforcing various forms of prescriptive regulations, including price controls, universal service programs, interconnection mandates, and open-access policies, the effects of which increasingly are

spilling over onto the Internet.[159] At the same time, of course, most of the Internet ecosystem remains subject to traditional antitrust enforcement,[160] which is quite different both in operation (ex post vs. ex ante) and substance (antitrust being far less prescriptive and, because it develops over time through precedent, more evolutionary, than regulation).

The most obvious risk of this duplicative approach to competition regulation is the potential for confusion and inconsistency, and the obvious remedy is for policymakers to facilitate development of coherent, integrated approach to the regulation of all IT-sector markets, broadband included. This conclusion is not new and should not be controversial. As Farrell and Weiser put it in 2003,

> As the Internet, computer software, and telecommunications ("New Economy") industries converge, affected firms will increasingly seek clear and consistent legal rules. Moreover, courts reviewing the FCC's decisions in this area are increasingly pressuring the Commission to devise a regulatory regime more compatible with economic theory and antitrust policy.[161]

The factors that led Farrell and Weiser to this conclusion have only intensified in the intervening years, yet there is little apparent progress towards the integration they urged. Indeed, the incompatibilities between FCC regulatory policies on the one hand and economic theory and antitrust policy on the other continue to be significant.

Second, arguably the most fundamental distinction between antitrust and regulation is that the former is inherently reactive while the latter seeks to be proactive. As the Antitrust Modernization Commission explained:

> Antitrust law in the United States is not industrial policy; the law does not authorize the government (or any private party) to seek to "improve" competition. Instead, antitrust enforcement seeks to deter or eliminate anticompetitive restraints. Rather than create a regulatory scheme, antitrust laws establish a law enforcement framework that prohibits private (and, sometimes, governmental) restraints that frustrate the operation of free-market competition.[162]

The same cannot be said for communications regulation: while the question of the FCC's authority over broadband is yet to be fully litigated, its role in traditional communications markets goes beyond simply protecting competition to shaping the industry's form and structure in "the public interest."[163] In short, the FCC is charged—at least, with respect to its regulation of traditional telecommunication services—with executing the very sort of "industrial policy" the antitrust laws reject.[164] The potential costs of such an approach are especially high in environments, like the Internet ecosystem, where technologies and industry structures are rapidly evolving. That is, in an environment with a technologically stable telecommunications industry, policies that bias the level of investment away from the efficient optimum are presumably less harmful than they might be in a more fluid environment where policy biases risk tipping the competitive outcome in favor of a less efficient technology or structure.[165] As Renda notes,

> Asymmetries in the regulatory treatment of players located at different layers of the value chain may result in distortions of platform competition, and should thus be avoided unless they are justified by the need to remove sources of egregious, irreversible market power, or refusals to supply truly indispensable assets.[166]

A third, and related, principle is that a less concentrated industry structure, in and of itself, should not be an objective of competition policy when it comes to broadband. More broadly, policymakers should dispense with the structural presumption in favor of the far more nuanced approach embodied in modern antitrust doctrine. For all the reasons I have described, relatively high levels of concentration are

to be expected in IT sector markets, including broadband, and do not signal market dysfunction or indicate policy opportunities to improve competitive outcomes. Concentration, when it occurs, is usually efficient, often transitory, seldom if ever leads to collusion, and does not imply the ability to earn monopoly rents; to the contrary, even "monopolists" in platform industries are subject to market forces that often dictate welfare-maximizing outcomes.

Ultimately, it is not sufficient simply to deemphasize the role of structuralism in as a policy objective (for example, in formulating spectrum policy); rather, policymakers should recognize that the role of competition policy, in broadband as in other industries, should be to *protect* competition, not *promote* it. In today's converged broadband market, there is no more basis for proactive policies designed to increase the number of broadband ISPs, per se, than for policies designed to increase the number of search engines, operating systems, or social networks.[167]

Fourth, prescriptive regulation should be avoided in favor of ex post enforcement of more broadly defined tenets. This principle emerges, first, from the rapidly changing nature of Internet markets and technologies—dynamism in the narrow sense, that is, of fluidity.[168] As the *National Broadband Plan* concludes, "Technologies, costs and consumer preferences are changing too quickly in this dynamic part of the economy to make accurate predictions."[169] While some worry that ex post enforcement is by nature "too slow" to keep up with rapidly changing markets,[170] markets are often self-correcting (the purported anticompetitive outcome is remedied—for example, by entry—before government action of any kind can take effect).[171] As Shapiro and Varian conclude,

> We believe a cautious approach toward antitrust policy and enforcement is called for in high-technology industries, in part because technological change does tend to erode monopoly power and in part because much of the conduct at issue has at least some claim on increasing consumer welfare.[172]

Even when government action is required, it is far from clear that ex ante regulation is a more expeditious remedy: in this context, the main difference between prescriptive rules and ex post enforcement is the time required to write the rules, and resolve the inevitable litigation that follows, before enforcement can even begin. Moreover, experience has shown that, once a rule is in place, it can take at least as long to modify or repeal it as it took to pass it in the first place, creating the possibility that rules designed to address an ephemeral problem persist long after the problem is resolved—and so are transformed from cure to disease.[173]

Another rationale for avoiding prescriptive rules is that, in an economic environment in which similar conduct (even the very same conduct) can have both positive and negative consequences, banning entire classes of conduct risks throwing "the welfare-enhancing baby out with the anticompetitive bathwater."[174] Broad rules are more likely to do harm than good when the competitive effects of particular types of conduct are fact-dependent and when, as is certainly the case with Internet platforms, economic science has not yet arrived at the kinds of established, broad findings that underlie, for example, the per se rule against horizontal collusion.[175]

Finally, the presumption against prescriptive regulation is further strengthened by the tendency of regulatory agencies to engage in cross-subsidization and, in so doing, create a marketplace for rent seeking. As Shapiro and Varian point out, "We also must note that regulation brings its own dangers: a regulatory structure created to control monopoly power can easily be used to serve other purposes, in particular, to support a system of cross-subsidization."[176] It is noteworthy, in this regard, that one of the rationales proffered for net neutrality rules is the desirability of subsidizing "edge" providers, even at the cost of disadvantaging infrastructure providers.[177]

Thus, to summarize, we have at least four reasons to replace ex ante regulation of broadband with ex post antitrust enforcement. First, doing so is necessary to harmonize competition policy across the various sectors of the Internet ecosystem. Second, ex ante

regulation invites counterproductive "industrial policy" efforts to shape the evolution of a highly dynamic marketplace. Third, there is no basis for efforts to "increase competition" by increasing the number of competitors (and thus reducing measures of industry concentration), and thus no need for ex ante regulation to pursue this objective. Fourth, by its nature, ex ante regulation is inferior to ex post enforcement because it is less accurate in discriminating between welfare-enhancing and welfare-reducing conduct, is cumbersome to implement, and often leads to rent seeking and politicization.

Toward a Pro-Competition Policy for Broadband

The task of replacing today's legacy regulatory framework with a pro-competition, antitrust-based approach to broadband competition is complex and will not happen overnight. Moreover, our understanding of how to apply ex post antitrust principles to high-tech markets is far from perfect and still evolving. Thus, the objective is to replace an imperfect regulatory model with a *less imperfect* enforcement approach. Even so, the analysis I have presented has some clear and immediate implications for how we should regulate, or not regulate, broadband markets.

First, blanket bans on vertical restraints and discriminatory pricing should be avoided in broadband markets as they are in other IT markets.[178] Although such conduct can pose difficult issues for competition analysis in IT markets as elsewhere (because it often generates both benefits and costs), broad consensus exists that ex ante prohibitions on vertical restraints are not justified. For example, Carl Shapiro, who has written that exclusive dealing arrangements are more likely to be problematic in network industries than in traditional ones, nevertheless opposes blanket bans:

> Of course, exclusive dealing and exclusive membership rules need not be anticompetitive, even in network industries. These contractual forms can serve to differentiate products and networks, to encourage investment in these networks, and to overcome free riding. I am certainly not proposing a *per se* rule against exclusivity in a network context.[179]

Similarly, Jonathan Baker, who opposes blanket approval of price discrimination, also opposes a blanket ban:

> So long as entry is easy, and the practices facilitating price discrimination do not harm competition, as by raising entry barriers or otherwise reducing competition by excluding actual or potential rivals, price discrimination is competitive, and not a harmful practice.[180]

As Renda emphasizes, the arguments in favor of vertical restraints and differential pricing are at least as powerful in broadband markets as in other parts of the Internet ecosystem.

> When looking at the economics of complex and interconnected system goods, there seems to be very little room to differentiate between ISPs and gateway players located at higher layers. In both cases, players have an incentive to secure a share of the value created by the system by engaging in some form of differential pricing or price discrimination from their supply side, and in preferential agreements on the demand side.[181]

Renda also notes that the case against ex ante regulation of vertical restraints is further strengthened by the fact that the optimal balance between integration and interoperability often shifts over time, with closed systems often being more efficient (or even necessary) for the development of new platforms, which later evolve towards more open models.

> As often happened in the past few years, the need to create successful business models and to ensure security will initially call for some degree

> of proprietary-ness (as in the case of the App store), and later give leeway to a significant degree of commoditization of lower platform layers. In other words, market forces, rather than a regulator, are likely to solve the problem by pushing for interoperability once the market becomes more mature.[182]

Because exclusivity is often more beneficial to new business models than old ones, blanket bans are likely to have the perverse effect of discriminating against innovation and, by extension, against entry.

A pro-competitive presumption for vertical restraints in broadband markets would have profound implications for regulation. First, and most obviously, the proscription of entire classes of vertical restraints imposed by the Open Internet Order represents precisely the sort of blanket ban rejected by Baker and Shapiro in the context of other high-tech markets. Net neutrality would thus be the first and most obvious regulation to fall.[183] But the effects extend much further, to virtually all forms of vertical "open-access" regulation, existing and proposed, including those governing Internet access devices (the CableCARD and AllVid rules)[184] and wireless handsets,[185] as well as legacy rules governing wireline consumer premises equipment and wireless service (which require wireless service to be offered separately from devices on a nondiscriminatory basis).[186]

Acknowledging the convergence of broadband with the Internet ecosystem also has important implications for horizontal issues, including interconnection and "unbundling." As discussed above, the competitive dynamics of the IT sector, where incentives for innovation are of paramount importance and network effects provide strong incentives (short of tipping) for voluntary interconnection, mitigate strongly against horizontal open-access mandates.

Much of the economic analysis of these issues in the IT sector has been in the context of intellectual property law, where a patent or copyright can give a platform operator de facto exclusive control. The policy questions are when, if ever, the government should impose a compulsory license (the equivalent of unbundling in the telecommunications environment) or mandate "open interfaces" with competing platforms (the equivalent of mandatory interconnection). As Weiser explains, the balance tips in favor of encouraging competition between platforms rather than mandating interconnection:

> A central tenet of the competitive platforms model is that, even if the industry structure will ultimately rely on a single standard, competition policy should still err on the proprietary side of the line, allowing rival standards to battle it out in the marketplace.[187]

The rationale is straightforward: platform competition promotes increased output, product enhancement, and new product innovation.

> By encouraging competition between rival platforms, intellectual property law can advance three critical goals: forcing companies to compete to build a valuable customer base, requiring all companies to continue to enhance their products and bring new ones to market more quickly for fear of being displaced by a new killer application, and driving companies to innovate and develop superior technologies. By contrast, providing open access to a single standard that would otherwise face viable platform competition undermines the achievement of each of these benefits.[188]

For these reasons, content, applications, and device manufacturers are seldom forced to engage in compulsory licensing, except in the context of targeted, typically time-limited, remedies in cases of merger or monopolization.[189] In telecommunications, by contrast, mandated interconnection requirements are commonplace—resulting, as Hovenkamp notes, in reduced incentives for investment:

> Antitrust together with intellectual property is often a better vehicle for addressing such problems as 'interconnection' and the lack of

> neutrality in networked communications. Regulatory solutions have tended to go too far, requiring interconnection and sharing even when doing so inefficiently diminishes investment incentives.[190]

Ultimately, as Renda explains, the effect of open-access regulation is to systematically disadvantage broadband ISPs relative to other Internet ecosystem competitors:

> Being a dominant network operator and internet service provider today means being clearly handicapped in the race to become a dominant IP-based platform, since it entails being subject to a series of open access obligations that other players in the value chain do not have.[191]

Heretofore, regulators have mostly limited horizontal unbundling and interconnection regulations to traditional telecommunications platforms and services, but both national and international regulators are now considering extending such rules to broadband.[192] The convergence of broadband into the Internet ecosystem argues against both unbundling (for example, data-roaming requirements on wireless carriers) and mandatory interconnection regimes.[193]

Lastly, the characteristics of IT markets, including broadband markets, have important implications for merger analysis. For reasons explained above, measures of market concentration have little or no saliency in such markets, yet antitrust authorities in general, and the FCC in particular, continue to focus on such metrics, at least as triggers for further review. More recently, antitrust authorities have begun to rely on "upward pricing pressure" models designed to estimate the unilateral effects of mergers in differentiated product markets.[194] The ability of these models accurately to predict the consumer welfare effects of mergers is directly limited in the presence of multisidedness and other IT market characteristics.[195]

5

Conclusions

The notion that broadband services have been "converging" with other aspects of the IT sector is neither new nor controversial. Indeed, convergence seems to be universally recognized, including by telecommunications regulators, who routinely refer to broadband services as part of the "Internet ecosystem." Yet, despite the fact that broadband markets are now essentially indistinguishable from other IT markets from the perspective of competition analysis, they remain subject to a starkly different and increasingly anachronistic regulatory regime.

The application of modern antitrust principles to the Internet ecosystem is and will remain as much art as science, and both doctrinal and episodic errors will no doubt be made. Such errors are likely to be far smaller, however, than the consequences of continuing to apply nineteenth century regulatory policies and principles to a twenty-first century marketplace.

Notes

1. The idea that telecommunications has converged with other "new economy" sectors such as the Internet and computer software is, of course, not new. See, for example, Joseph Farrell and Philip J. Weiser, "Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age," *Harvard Journal of Law & Technology* 17, no. 1 (Fall 2003): 85–134, at 87: "As the Internet, computer software, and telecommunications ('New Economy') industries converge, affected firms will increasingly seek clear and consistent legal rules"; Michael K. Powell, "The Great Digital Broadband Migration," in *Communications Deregulation and FCC Reform: Finishing the Job*, ed. J. A. Eisenach and R. J. May (Kluwer Academic Publishers, 2001), 11–21, at 15–16: "Computer systems working in parity with communications have spawned the Internet and the advanced networks we see today that fully integrate satellites, telephones, wireless devices, broadcasting and cable over fiberoptic, broadband, and wireless networks. The result is what we now call convergence"; and Richard A. Posner, "Antitrust in the New Economy," *Antitrust Law Journal* 68 (2001): 925–43, at 925: "I shall use the term the 'new economy' to denote three distinct though related industries. The first is the manufacture of computer software. The second consists of the Internet-based businesses (Internet access providers, Internet service providers, Internet content providers), such as AOL and Amazon. And the third consists of communications services and equipment designed to support the first two markets."

2. See, e.g., Geoffrey A. Manne and Joshua D. Wright, "Innovation and the Limits of Antitrust," *Journal of Competition Law & Economics* 6, no. 1 (2010): 153–202; Robert W. Crandall and Clifford Winston, "Does Antitrust Policy Improve Consumer Welfare? Assessing the Evidence," *Journal of Economic Perspectives* 17, no. 4 (Fall 2003): 3–26; and Daniel F. Spulber, "Unlocking Technology: Antitrust and Innovation," *Journal of Competition Law & Economics* 4, no. 4 (2008): 915–66. For a brief summary of the debate, see David Evans, "The Middle Way on Applying Antitrust to Information Technology Industries," *Competition Policy International* (November 2009), www.techpolicyinstitute.org/files/evansnov-09.pdf (accessed October 9, 2012).

3. See, e.g., Carl Shapiro, "Exclusivity in Network Industries," *George Mason Law Review* 7 (Spring 1999): 673–82; F. M. Scherer, *Technological Innovation and Monopolization* (John F. Kennedy School of Government, October 2007), http://ssrn.com/abstract=1019023 (accessed September 27, 2012); and Mark Cooper, "The Importance of Open Networks in Sustaining the Digital Revolution," in *Net Neutrality or Net Neutering: Should Broadband Internet Service Be Regulated?*, ed. T. M. Lenard and R. J. May (Progress & Freedom Foundation, 2006), 107–61, especially 126–32.

4. See Federal Communications Commission, *In the Matter of Preserving the Open Internet and Broadband Industry Practices, Report and Order,* GN Docket No. 09-191, WC Docket No. 07-52 (December 23, 2010) (hereafter, Open Internet Order). See also Federal Communications Commission, *In the Matter of Preserving the Open Internet and Broadband Industry Practices, Notice of Proposed Rulemaking,* GN Docket No. 09-191, WC Docket No. 07-52 (October 22, 2009).

5. FCC, Open Internet Order, ¶32–34.

6. Ibid., ¶32.

7. Ibid., ¶78.

8. Ibid., ¶53: "Promoting competition throughout the Internet ecosystem is a central purpose of these rules."

9. Ibid., at ¶25; see generally ¶¶24–28.

10. Ibid., ¶29; see generally ¶¶29–30. While rejecting a traditional market power analysis, the FCC did embrace a theory of exclusionary market power based on based on raising rivals' costs. See ¶¶21–23.

11. For example, the *National Broadband Plan* specifically concludes that broadband markets are part of a "broadband

ecosystem." See Federal Communications Commission, Omnibus Broadband Initiative, *Connecting America: The National Broadband Plan* (March 2010; hereafter, NBP Report), www.broadband.gov/download-plan/ (accessed September 28, 2012), xi: "Policymakers, including the FCC, have a broad set of tools to protect and encourage competition in the markets that make up the broadband ecosystem: network services, devices, applications and content."); see also 15.

12. See, e.g., Jerry Brito et al., *Net Neutrality Regulation: The Economic Evidence* (April 12, 2010), http://ssrn.com/abstract=1587058 (accessed September 28, 2012).

13. *Verizon v. FCC, Notice of Appeal,* US Court of Appeals, DC Circuit, Case No. 11-1355 (October 2, 2011), www.fhhlaw.com/VerizonNoticeofAppeal.netneutrality.2011.09.30.PDF (accessed September 28, 2012).

14. For a recent statement of the FCC's view of its authority to regulate wireless broadband providers, see its brief in Verizon's challenge of data roaming order: *Cellco Partnership d/b/a Verizon Wireless, v. Federal Communications Commission, Brief for Respondents,* US Court of Appeals, DC Circuit, Case No. 11-1135 (January 9, 2012), www.fcc.gov/document/cellco-partnership-v-fcc-usa-no-11-1135-and-1136-dc-cir (accessed September 28, 2012).

15. See Federal Communications Commission, *In the Matter of Connect America Fund, Report and Order and Further Notice of Proposed Rulemaking*, WT Docket 10-90 (November 18, 2011), ¶¶113–4.

16. See Federal Communications Commission, *In the Matter of Framework for Broadband Internet Services, Notice of Inquiry,* GN Docket No. 10-127 (June 17, 2010).

17. I use the term "competitive dynamics" to refer broadly to how competition works—to the ways in which technology, institutions, demand conditions, and other salient market characteristics are related to industry structure, competitive outcomes, and market performance.

18. See Timothy F. Bresnahan, "New Modes of Competition: Implications for the Future Structure of the Computer Industry," in *Competition, Innovation and the Microsoft Monopoly: Antitrust in the Digital Marketplace* ed. J. Eisenach and T. Lenard (Kluwer Academic Press, 1999), 155–208.

19. For a refresher in graphic form, see www.refresher.com/!paranoid.html.

20. Ibid., 157.

21. Ibid., 157.

22. Ibid., 159.

23. See e.g., Antitrust Modernization Commission, *Report and Recommendations* (April 2007), 2–3: "To be competitive, markets need not conform to the economic ideal in which many firms compete and no firm has control over price. In fact, the real world contains very few such markets. Rather, competition generally 'refers to a state of affairs in which prices are sufficient to cover a firm's costs, but not excessively higher, and firms are given the correct set of incentives to innovate.' Experience has shown that intense competition can take place in a wide variety of market circumstances. Some factors—such as many sellers and buyers, small market shares, homogeneous products, and easy entry into a market—may suggest competitive behavior is likely. The absence of those factors, however, 'does not necessarily prevent a market from behaving competitively.'" [Internal quotations from H. Hovenkamp, *The Antitrust Enterprise* (2005), 13, and E. Gellhorn, *Antitrust Law and Economics* (2004), 72; other internal citations omitted.]

24. See, e.g., US Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines* (August 19, 2010), at 3: "Mergers that cause a significant increase in concentration and result in highly concentrated markets are presumed to be likely to enhance market power, but this presumption can be rebutted by persuasive evidence showing that the merger is unlikely to enhance market power." (hereafter, 2010 Merger Guidelines). The courts continue to embrace the structural presumption in one form or another. See, e.g., *FTC v. H.J. Heinz* 246 F.R. 3d 708 (2001) and *US v. H&R Block* 789 F.Sup. 2d.74 (2011), both of which reiterate the Supreme Court's embrace of market share as an indicator of market power in *United States v. Philadelphia Nat'l Bank*, 374 U.S. 321.

25. See 2010 Merger Guidelines, 24–27.

26. I use the term "locational pricing power" to refer to the ability of firms in differentiated product markets to price above marginal cost even in the presence of free entry.

27. See 2010 Merger Guidelines, 20–24.

28. Interestingly, Timothy Wu, a leading proponent of net neutrality regulation, testified before Congress in early 2012 that "it is clear that 4G to the home is a cable *replacement*, not a complement," apparently contradicting a decade or more of argument by regulation proponents that

wireless is a complement, not a substitute, for wireline and should not be considered as part of the relevant product market. See page 5 of Tim Wu, "Creeping Duopoly?," Testimony before the Senate Judiciary Committee, Subcommittee on Antitrust, Competition Policy, and Consumer Rights, March 21, 2012, www.judiciary.senate.gov/pdf/12-3-21WuTestimony.pdf (accessed October 9, 2012).

29. See Federal Communications Commission, *Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services*, WT Docket 10-33 (June 27, 2011), ¶¶55–66 (hereafter, Fifteenth Report).

30. FCC, Open Internet Order, n. 143, summarizing Department of Justice submission. The apparent implication is that broadband may evolve into two separate antitrust markets, a wireline market and a wireless market, each relatively concentrated, and each exercising little or no competitive discipline upon the other.

31. Ibid., n. 87: "Because broadband providers have the ability to act as gatekeepers even in the absence of market power with respect to end users, we need not conduct a market power analysis." The FCC did conclude, however, that market power, if it did exist, would exacerbate its concerns, and averred that "the risk of market power is highest in markets with few competitors, and most residential end users today have only one or two choices for wireline broadband Internet access service." See Open Internet Order, ¶32.

32. See *Petition of Qwest Corporation for Forbearance Pursuant to 47 U.S.C. § 160(c) in the Phoenix, Arizona Metropolitan Statistical Area*, WC Docket No. 09-135, *Memorandum Opinion and Order* (June 22, 2010), ¶82.

33. Ibid., ¶80.

34. Ibid., ¶86. The FCC also examined potential competition and the likelihood of entry. See generally ¶¶80–86.

35. See *Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers and Other Providers of Mobile Data Services*, WT Docket No. 05-265, *Second Report and Order* (April 7, 2011), ¶16.

36. See *SkyTerra Communications, Inc., Transferor, and Harbinger Capital Partners Funds, Transferee*, IB Docket No. 08-184, *Memorandum Opinion and Order and Declaratory Ruling*, 25 FCC Rcd 3059 (March 26, 2010) at ¶60–61: "Large portions of the country are served by three or fewer providers of mobile broadband service. . . . Harbinger could have a beneficial impact on competition."

37. See Federal Communications Commission, *Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Fourteenth Report*, WT Docket No. 09-66 (May 20, 2010), Section III.C (hereafter, Fourteenth Report), a finding repeated in the Fifteenth Report (see, e.g., ¶2).

38. US Department of Justice, Complaint, *United States of America vs. AT&T Inc.* (August 31, 2011), ¶25. For a full explication of the FCC's assessment of the proposed merger, see also Federal Communications Commission, *Staff Analysis and Findings* (WT Docket No. 11-65), especially ¶¶12–122.

39. See, e.g., *Comments of the Consumer Federation of America, Consumers Union and Free Press, In the Matter of Broadband Industry Practices,* WC Docket No. 07-52, Federal Communications Commission (June 15, 2007), 11, http://apps.fcc.gov/ecfs/document/view?id=6519529519 (accessed October 9, 2012; hereafter, 2007 Consumer Group Comments).

40. See, e.g., Ad Hoc Public Interest Spectrum Coalition, *Comments in Skype Communications S.A.R.L., Petition to Confirm a Consumer's Right to Use Internet Communications Software and Attach Devices to Wireless Networks*, RM-11361, Federal Communications Commission (April 30, 2007).

41. Mark Cooper, "The Public Interest in Open Communications Networks," Consumer Federation of America (July 2004), 47, http://fjallfoss.fcc.gov/ecfs/document/view?id=6516283898 (accessed September 28, 2012).

42. See, e.g., Texas Office of Public Utility Counsel, Consumer Federation of America, Consumers Union, *Comments in Inquiry Concerning High Speed Access to the Internet Over Cable and Other Facilities,* GN Docket No. 00-185 (January 11, 2001), 44: "While six [competitors] is a clear danger sign, theoretical and empirical evidence indicates that many more than six firms are necessary for competition—perhaps as many as fifty firms are necessary."

43. 2007 Consumer Group Comments, 74.

44. Ibid., 25. Consumer groups are not alone in pressing concerns based on structuralist models. For example, in 2009, Senator Herb Kohl wrote to Assistant Attorney General Varney and FCC Chairman Genachowski warning that "four [wireless]carriers control over 90% of the cell phone

market" and expressing concern that "the concentrated state of the cell phone marketplace could lead to future price increases." Letter from Senator Herb Kohl (July 6, 2009), 1.

45. NBP Report, 3.

46. Shane Greenstein and Ryan McDevitt, "Evidence of a Modest Price Decline in US Broadband Services," *Information Economics and Policy* 23, no. 2 (2011): 200–11. (The authors emphasize that prices have declined even more rapidly for products like computers and integrated circuits.)

47. See e.g., Fifteenth Report, ¶191 and ¶194: "AT&T's estimated price per MB for data traffic . . . has declined from $1.21 in 2008 to $0.35 in 2009 to $0.17 in 2010." See also Everett Ehrlich, Jeffrey A. Eisenach, and Wayne A. Leighton, "The Impact of Regulation on Innovation and Choice in Wireless Communications," *Review of Network Economics* 9, no. 1 (2010): 1–49 (especially 17); and Gerald R. Faulhaber, Robert W. Hahn, and Hal J. Singer, "Assessing Competition in US Wireless Markets: Review of the FCC's Competition Reports," *Federal Communications Law Journal* 64, no. 2 (March 2012): 319–69.

48. See NBP Report, 77; see also Fifteenth Report, ¶¶108–15.

49. Robert C. Atkinson and Ivy E. Schultz, *Broadband in America: Where It Is and Where It Is Going* (Columbia Institute of Tele-Information, November 2009).

50. See NBP Report, 38: "Indeed, competition appears to have induced broadband providers to invest in network upgrades."

51. See Mary Meeker (Morgan Stanley), *Internet Trends* (Presented at the CM Summit, New York City, June 7, 2010), slide 4, http://bbh-labs.com/internet-trends-2010-by-morgan-stanleys-mary-meeker (accessed September 28, 2012).

52. See Berkman Center for Internet and Society, Harvard University, *Next Generation Connectivity: A Review of Broadband Internet Transitions and Policy from Around the World* (2010), http://cyber.law.harvard.edu/publications/2010/Next_Generation_Connectivity (accessed September 28, 2012). For a rebuttal, see Robert W. Crandall, Jeffrey A. Eisenach, and Allan T. Ingraham, *The Long-Run Effects of Copper Unbundling and the Implications for Fiber* (March 2012), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2018929 (accessed September 28, 2012); and Jeffrey A. Eisenach, "Broadband in the U.S.—Myths and Facts," in *Australia's Broadband Future: Four Doors to Greater Competition* (Melbourne: Committee for Economic Development of Australia, 2008), 48–59.

53. NBP Report, 4. In May 2011, the commission's International Bureau issued a report which found that "data sources on international broadband are incomplete and generally challenging to compare. . . . As a result, we are limited in the conclusions we can draw from the data." See Federal Communications Commission, *In the Matter of International Comparison Requirements Pursuant to the Broadband Data Improvement Act International Broadband Data Report,* IB Docket No. 10-171, *Second Report* (May 20, 2011), ¶1.

54. See, e.g., Meeker, *Internet Trends*, slide 19: "U.S. is the global leader in mobile users and innovation."

55. See "Swiss Lead in Speed: Comparing Global Internet Connections," Nielsen Wire, April 1, 2011, http://blog.nielsen.com/nielsenwire/global/swiss-lead-in-speed-comparing-global-internet-connections (accessed September 28, 2012). Historically, US broadband speeds have doubled approximately every 18–24 months (at approximately the same pace as dictated by Moore's Law). See J. Eisenach, C. Eldering, and M. Sylla, "Is There a Moore's Law for Bandwidth?" *IEEE Communications Magazine* (October 1999): 117–21; and, for an update, Michael Turk, "Broadband Speed and Moore's Law," CableTechTalk, August 14, 2008, www.cabletechtalk.com/tech-discussions/2008/08/14/broadband-speed-and-moores-law-a-response-to-robb-topolski/ (accessed September 28, 2012).

56. See Thomas W. Hazlett and Dennis L. Weisman, "Market Power in U.S. Broadband Services," *Review of Industrial Organization* 38, no. 2 (March 2011): 151–71.

57. See Larry F. Darby, "The Informed Policy Maker's Guide to Regulatory Impacts on Broadband Network Investment" (American Consumer Institute, November 2009), 10: "Using two of the most common indicators of profitability—net profit margin reflecting deduction of all costs from revenue and return on total capital—the data indicate that broadband access providers are earning less than the S&P average and substantially less than Google."

58. As discussed in note 85, Baumol points out that in industries characterized by rapid innovation, incumbents are required to make continuing investments to remain

competitive. When incumbents and entrants alike face large capital costs, they are not properly considered barriers to entry. See George J. Stigler, *The Organization of Industry* (Chicago: University of Chicago Press, 1968), 67–70.

59. Wireline entry has also occurred in geographic markets where competition is perceived as producing insufficient results, including dozens of instances of municipal entry as well as Google's recent announcement that it will deploy a gigabit fiber network in Kansas City, Kansas.

60. See generally Ehrlich et al., "The Impact of Regulation"; and NBP Report, 75: "Mobile broadband represents the convergence of the last two great disruptive technologies—Internet computing and mobile communications—and may be more transformative than either of these previous breakthroughs. Mobile broadband is scaling faster and presents a bigger opportunity. This revolution is being led not only by domestic wireless carriers, who are investing billions in network upgrades, but also by American companies such as Amazon, Apple, Intel, Google, Qualcomm and numerous entrepreneurial enterprises that export innovation globally."

61. See, e.g., Fifteenth Report, ¶¶151–4.

62. For a more complete treatment of innovation in both wireline and wireless telecommunications networks, see Larry F. Darby and Joseph P. Fuhr, *Innovation and National Broadband Policies* (American Consumer Institute, March 2010); and Jonathan Sallet, *The Creation of Value: The Broadband Value Circle and Evolving Market Structures* (April 4, 2011), www.annenberglab.com/adminfiles/files/BroadbandValueCircle_Sallet.pdf (accessed September 28, 2012).

63. Open Internet Order, ¶35.

64. NBP Report, 37 (citations omitted). See also Fifteenth Report, ¶10: "Market performance metrics provide more direct evidence of competitive outcomes and the strength of competitive rivalry than market structure factors, such as concentration measures.")

65. NBP Report, 37, quoting *Ex Parte Submission of the United States Department of Justice, In the Matter of Economic Issues in Broadband Competition, A National Broadband Plan for Our Future*, GN Docket No. 09.51 (January 4, 2010), 11.

66. See Bresnahan, "New Modes of Competition," 155.

67. For a useful discussion of the economic distinctions between price discrimination and price differentiation, see Denis L. Weisman and Robert B. Kulick, "Price Discrimination, Two-Sided Markets and Net Neutrality Regulation," *Tulane Journal of Technology and Intellectual Property* 13 (Fall 2010): 81–102.

68. See, e.g., Bresnahan, "New Modes of Competition," 159: "A platform is a shared, stable set of hardware, software and networking technologies on which users build and run computer applications."; and Mark Rysman, "The Economics of Two-Sided Markets," *Journal of Economic Perspectives* 23, no. 3 (Summer 2009): 125–43, at 128: "Newspapers are a canonical two-sided market, where the newspaper provides a platform for communication from advertisers to consumers" and 129: "Many papers that study operating systems identify themselves with network effects rather than two-sided markets so perhaps this example is less canonical, but . . . the two literatures have a lot in common." Rysman (132–3) presents the distinction between supply-side and demand-side complementarity slightly differently from the distinction used here. He characterizes interoperability as a strategic decision made by the ("monopolist") operator of a multisided platform. My focus on modularity as a distinct concept facilitates a richer exploration of the interaction between platform participants.

69. For an overview of various approaches to innovation in antitrust doctrine, see Robert D. Atkinson and David B. Audretsch, "Economic Doctrines and Approaches to Antitrust" (Information Technology & Innovation Foundation, January 2011), distinguishing an "innovation economics" approach to antitrust that focuses on the importance of innovation and productivity growth as policy objectives.

70. William J. Baumol, *The Free Market Innovation Machine: Analyzing the Growth Miracle of Capitalism* (Princeton, NJ: Princeton University Press, 2002), 4.

71. The seminal work is Robert Solow, "Technical Change and the Aggregate Production Function," *Review of Economic Studies* 39 (August 1957): 312–20, finding that 87.5 percent of the increase in nonfarm output in the United States between 1909 and 1949 was due to technological progress. See also Atkinson and Audretsch, "Economic Doctrines," 13–14.

72. See e.g., David B. Audretsch, William J. Baumol, and Andrew E. Burke, "Competition Policy in Dynamic Markets," *International Journal of Industrial Organization* 19, no. 5 (2001): 613–34.

73. See Federal Communications Commission, Omnibus Broadband Initiative, *Technical Paper No. 6: Mobile Broadband* (October 2010), 15. See also Robert Hahn and Hal J. Singer, "Why the iPhone Won't Last Forever and What the Government Should Do to Promote Its Successor," *Journal on Telecommunications and High Technology Law* 8, no. 2 (2010): 313–50, especially 317–30.

74. See "GPON FTTH Market and Technology Overview," PMC, April 2006, www.pmc-sierra.com/ftth-pon/ftth_overview.html (accessed October 3, 2012).

75. Analysys Mason, "'Up to a Point Copper': Quantifying the Reach of Accelerated DSL," January 26, 2012, www.analysysmason.com/About-Us/News/Insight/Insight_Accelerated_DSL_Jan2012/ (accessed September 28, 2012).

76. Evans, "The Middle Way," 2: "Dynamic competition is important in many parts of the information technology sector. Some firms compete to create a new market—or a new category. We forget about the many, many firms that competed to create social networks, video sharing sites, computer operating systems, and so forth—and then died off."

77. Joseph Schumpeter, *Capitalism, Socialism and Democracy* (New York: Harper & Brothers, 1942), 84.

78. See Jean-Jacques Laffont and Jean Tirole, *Competition in Telecommunications* (Cambridge, MA: MIT Press, 2000), 4. Some rural companies are still subject to rate-of-return regulation.

79. Michael L. Katz and Howard A. Shelanski, "'Schumpeterian' Competition and Antitrust Policy in High-Tech Markets," *Competition* 14 (2005), 10, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=925707 (accessed September 28, 2012).

80. See Posner, "Antitrust in the New Economy," 930.

81. *Ex Parte Submission of the US Department of Justice*, 4; see also Carl Shapiro, *Antitrust, Innovation, and Intellectual Property* (Testimony before the Antitrust Modernization Commission, November 8, 2005), 2: "In such 'innovative industries,' antitrust must pay careful attention to the incentives and obstacles facing firms seeking to develop and commercialize new technologies, and antitrust must very explicitly recognize that market conditions, business strategies, and industry structure can be highly dynamic."

82. NBP Report, 42: "Thus, in areas that include 75% of the population, consumers will likely have only one service provider (cable companies with DOCSIS 3.0-enabled infrastructure) that can offer very high peak download speeds." Such predictions have often proved inaccurate or even embarrassing. The US Federal Trade Commission, for example, justified imposing significant conditions on the merger of American Online and Time Warner Inc. with its finding that "AOL is the leading provider of narrowband internet access, with a share of approximately 50 percent of narrowband subscribers. AOL is positioned and likely to become the leading provider of broadband internet access as well." See US Federal Trade Commission, *In the Matter of America Online, Inc. and Time Warner Inc.*, Docket No. C-2989, Complaint (December 14, 2000), 3.

83. For arguments against this proposition, see Jonathan B. Baker, "Beyond Schumpeter vs. Arrow: How Antitrust Fosters Innovation," *Antitrust Law Journal* 74 (2007) 575–602 (arguing that antitrust enforcement promotes innovation); Cooper, "The Public Interest," 47–48: "The theory supporting Schumpeterian rents appears to be particularly ill-suited to several layers of the digital communications platform. It breaks down if a monopoly is not transitory, a likely outcome in the physical layer. In the physical layer, with its high capital costs and other barriers to entry, monopoly is more likely to quickly lead to anticompetitive practices that leverage the monopoly power over bottleneck facilities into other layers of the platform"; and J. Gregory Sidak and David J. Teece, "Dynamic Competition in Antitrust Law," *Journal of Competition Law & Economics* 5, no. 4 (2009) 581–631, at 618: "The evolutionary and behavioral economics approaches outlined here would not abandon antitrust enforcement or even necessarily restrict it."

84. Katz and Shelanski, 19. See also Shapiro, *Antitrust, Innovation, and Intellectual Property*, 11–12: "However, there is no consensus among industrial organization economists about the general relationship between concentration and innovation competition." See also Sidak and Teece, "Dynamic Competition in Antitrust Law," 588: "Despite 50 years of research, economists do not appear to have found much evidence that market concentration has a statistically significant impact on innovation."

85. William J. Baumol, *The Free Market Innovation Machine: Analyzing the Growth Miracle of Capitalism* (Princeton, NJ: Princeton University Press, 2002), 165 (citation

omitted). Importantly, as Baumol explains elsewhere, such costs do not constitute barriers to entry. See William J. Baumol, "Regulation Misled by Misread Theory" (AEI-Brookings Joint Center for Regulatory Studies, 2006), 23: "The sunk costs that traditional theory says do not matter for an incumbent firm's decisions are the once-and-for-all expenditures made in the past and not repeated thereafter. They are the ancient history that no current decision can change, whereas the sunk outlays that the firm must be expected to recoup are those that are incurred currently and will continue into the foreseeable future. These expectable and recurring sunk outlays most directly drive the firm to discriminatory pricing. And it is crucial to recognize that they are not barriers to entry in Stigler's (1968) pertinent sense because they are equal burdens for the entrants and the incumbents—that is, they offer no substantial competitive advantage and, hence, no monopoly power to an incumbent firm."

86. Shapiro, *Antitrust, Innovation, and Intellectual Property,* 7.

87. Hal R. Varian, "Differential Pricing and Efficiency," *First Monday* 1, no. 2 (August 1996): 2.

88. See page 3 of Scott Wallsten and Colleen Mallahan, "Residential Broadband Competition in the United States" (March 2010), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1684236 (accessed October 1, 2012).

89. Arguably, the seminal article on competitive price discrimination is Robert H. Frank, "When Are Price Differentials Discriminatory?" *Journal of Policy Analysis and Management* 2, no. 2 (1983): 238–55. For other early contributions, see Michael E. Levine, "Price Discrimination without Market Power," *Yale Journal on Regulation* 19 (Winter 2002): 1–35, at 25–26: "In the same way, high speed Internet access subscribers are charged on a monthly basis by the data transfer rate they wish to purchase, even though the 'cost' (other than the modem) of serving them is the same. The result of all this segmentation is the ability to support large networks with relatively ubiquitous service, offering some very low prices and some very high prices and many prices in between"; and Mark Armstrong and John Vickers, "Competitive Price Discrimination," *Rand Journal of Economics* 32, no. 4 (Winter 2001): 579–605.

90. See, e.g., Jonathan B. Baker, "Competitive Price Discrimination: The Exercise of Market Power without Anticompetitive Effects (Comment on Klein and Wiley)," *Antitrust Law Journal* 70, no. 3 (2003): 643–54, at 645: "Competitive price discrimination is probably found most commonly in high-technology markets and other industries with low marginal cost, high fixed costs, and some product differentiation. In such markets, it may be necessary for sellers to charge at least some customers prices in excess of marginal cost in order to make it profitable for firms to enter the market (by covering fixed costs) or stay there (to the extent the fixed costs are not sunk). Marginal cost pricing, the usual competitive bench-mark, may thus be infeasible."

91. William J. Baumol and Daniel G. Swanson, "The New Economy and Ubiquitous Competitive Price Discrimination: Identifying Defensible Criteria of Market Power," *Antitrust Law Journal* 70, no. 3 (2003): 661–85, at 665. See also Baumol, "Regulation Misled," 3: "[I]n equilibrium, these discriminatory prices are not haphazard in their welfare properties but will generally constitute a Ramsey optimum—satisfying the second-best welfare attributes of revenue-constrained economic welfare." See also Einer Elhauge, "Why Above-Cost Price Cuts to Drive Out Entrants are Not Predatory—and the Implications for Defining Costs and Market Power," *Yale Law Journal* 112 (January 2003): 681–827, at 687: "Competition or low entry barriers will ensure that overall revenue from this output-maximizing price-discrimination schedule does not exceed economic costs."

92. See, e.g., Carl Shapiro and Hal R. Varian, *Information Rules* (Cambridge, MA: Harvard Business School Press, 1999), 26–27.

93. See Wallsten and Mallahan, "Residential Broadband Competition," 3: "In principle, [price discrimination] means charging high prices to consumers willing to pay a lot for broadband and low prices to consumers who are not willing to pay much for it. In reality, it is generally not possible to identify a particular consumer's preferences, so instead providers create different products that appeal to different groups, even though the marginal cost of serving each group may be similar."

94. See Fifteenth Report, ¶138: "In addition to network quality and advertising, a third component of non-price rivalry among mobile wireless service providers is the differentiation of the downstream products that they offer or

that rely on their networks, including handsets/devices, operating systems, and mobile applications."

95. This assumes, of course, that consumers' varying elasticities of demand cannot be observed directly.

96. *Ex Parte Submission of the United States Department of Justice,* 4. Emphasis added.

97. See e.g., Bresnahan, "New Modes of Competition," 159: "A platform is a shared, stable set of hardware, software, and networking technologies on which users build and run computer applications." See also Farrell and Weiser, "Modularity, Vertical Integration, and Open Access Policies," 95: "Modularity means organizing complements (products that work with one another) to interoperate through public, nondiscriminatory, and well-understood interfaces"; and Jeffrey Church and Neil Gandal, "Platform Competition in Telecommunications," in *Handbook of Telecommunications Economics,* Vol. 2, ed. S. K. Majumdar, I. Vogelsang and M. E. Cave (Amsterdam: Elsevier, 2005), 117–53, at 120: "The defining feature of network industries is that products consumed are systems of components: the ultimate 'good' demanded is comprised of a group of complementary products that provide value when they are consumed together. . . . For the complements to work together requires standards to insure compatibility. In this context, a 'standard' refers to a set of technical specifications that enable compatibility between products." For more detailed discussion, see Carliss Y. Baldwin and C. Jason Woodard, "The Architecture of Platforms: A Unified View" (working paper, 2009), www.people.hbs.edu/cbaldwin/DR2/BWPlatformArchitectureWorkingPaper.pdf (accessed October 1, 2012). Subsequent version was published in Annabelle Gawer (ed.), *Platforms, Markets and Innovation* (Cheltenham, UK: Edward Elgar, 2009), 19–44.

98. The number and diversity of modules and platforms in the Internet ecosystem is perhaps best evoked by simply naming a small subset of the firms that provide them, such as Adobe, Amazon, Apple, Clearwire, Comcast/NBC, Disney, eBay, Electronic Arts, Facebook, Google, Hewlett-Packard, Microsoft, Motorola Mobility, Netflix, Nintendo, Nokia, Pandora, RIM, Rovio, Sony, Twitter, and Verizon. Other platform participants, such as Akamai, Alcatel-Lucent, Broadcom, Cisco, Global Crossing, IBM, Intel, Level3, Micron, Oracle, Qualcomm, Rambus, and Symantec, may be less visible, but no less important.

99. See page 28 of Timothy F. Bresnahan and Shane Greenstein, "Technological Competition and the Structure of the Computer Industry," *Journal of Industrial Economics* 47, no. 1 (March 1999): 1–40.

100. See, e.g., Open Internet Order, ¶3.

101. Ibid., ¶1.

102. Ibid., ¶50 and n. 160.

103. This analysis also implicates the FCC's description of wireless markets in the Fifteenth Report. While the commission acknowledges the existence of a "mobile wireless ecosystem" and finds that "each of the segments in the mobile wireless ecosystem has the potential to affect competitive and consumer outcomes in the mobile wireless services segment," it embraces a traditional value chain model that portrays "mobile wireless services" as occupying a "middle part" of the mobile wireless ecosystem between "input/upstream segments" such as spectrum and network equipment and "edge/downstream" segments such as apps, content, and mobile commerce. See Fifteenth Report, ¶5–6 and figure 1. See also Fourteenth Report, ¶9–10 and figure 1.

104. See Bresnahan and Greenstein, "Technological Competition," 23. A great deal of academic attention has focused on the special case of a platform monopolist—a platform operator that faces neither intra- nor interplatform competition, and on the question of whether such a firm will make efficient choices regarding interoperability. See, e.g., Farrell and Weiser ("Modularity, Vertical Integration, and Open Access Policies"), who conclude that under limited circumstances a platform monopolist might inefficiently foreclose interconnection. For a concise critique (arguing inefficient foreclosure is highly unlikely), see Thomas M. Lenard and David T. Scheffman, "Distribution, Vertical Integration and the Net Neutrality Debate," in *Net Neutrality or Net Neutering,* ed. Lenard and May, 20–23.

105. See, e.g., Rysman, "The Economics of Two-Sided Markets," 32–33, as discussed in note 68. See also Kevin Boudreau, "Open Platform Strategies and Innovation: Granting Access vs. Devolving Control," *Management Science* 56, no. 10 (October 2010): 1849–72.

106. See Carliss Y. Baldwin, "Where Do Transactions Come From? Modularity, Transactions and the Boundaries of Firms," *Industrial and Corporate Change* 17, no. 1 (2007): 155–95, at 187: "*Modularizations, whatever their stated*

purpose, create new module boundaries with (relatively) low transaction costs. Modularizations thus make transactions feasible where they were previously impossible or very costly" (emphasis in original). See also Thomas W. Hazlett, "Modular Confines of Mobile Networks: Are iPhones iPhony?" (May 2009), http://ssrn.com/abstract=1533441 (accessed October 1, 2012), 13–14: "Modularity simultaneously yields gains from both economies of scale and specialization. When workable interfaces are achievable at low cost, competitive forces are unleashed to create complementary components of a value chain. Modularity eases entry by innovators able to contribute specific inputs in which they exhibit comparative advantage, even when such firms exhibit little or no competence as integrated providers of a larger suite of industry outputs."

107. See, e.g., Jeffrey H. Rohlfs, *Bandwagon Effects in High-Technology Industries* (Cambridge, MA: MIT Press, 2003), 35: "Nevertheless, interlinking [i.e., modularity] also involves costs, which depend on the type of interlinking involved. In some cases, interlinking is not cost-effective. Indeed, it may not even be feasible at reasonable cost."

108. Boudreau provides empirical evidence that limiting the number of providers of complementary inputs leads to more rapid innovation. See Kevin J. Boudreau, "Let a Thousand Flowers Bloom? An Early Look at Large Numbers of Software 'Apps' Developers and Patterns of Innovation," *Organization Science* (September 2011), 11: "Adding producers in the same genre to a platform slowed development in that genre. This is consistent with the presence of intensifying competition and crowding out of incentives among similar offerings."

109. For a general discussion, see e.g., Farrell and Weiser, "Modularity, Vertical Integration, and Open Access Policies," 97–100. See also Rohlfs, *Bandwagon Effects*, 42–43, and Ehrlich et al., "The Impact of Regulation on Innovation," 38–48.

110. See Baldwin and Woodard, "The Architecture of Platforms," 20: "At first glance, it might appear that the architect should retain control of the core of the system, but this conclusion is not always correct. In man-made systems, the core components of the platform can evolve over time, hence may be subject to competitive pressures." In the case of Android, development of the open-source operating system is governed by the Open Handset Alliance. For insight into the governance challenges associated with such an endeavor, see Leslie Grandy, "Why Google's Open Handset Alliance Has Been a Disapointment," MocoNews.net, May 3, 2010, http://moconews.net/article/419-the-reasons-why-googles-open-handset-alliance-has-been-a-disappointment/ (accessed October 1, 2012).

111. A particularly colorful and litigious example of intraplatform competition involved the fight between Rambus and a host of other firms to affect the direction of the market for DRAM technology, where Rambus controls key patents. See, e.g., Federal Trade Commission, *In the Matter of Rambus, Inc*. Docket No. 9302, *Initial Decision* (February 23, 2004), www.ftc.gov/os/adjpro/d9302/040223initialdecision.pdf (accessed October 1, 2012).

112. See Bresnahan and Greenstein, "Technological Competition," 3.

113. ee Bresnahan, "New Modes of Competition," 166.

114. See Bresnahan and Greenstein, "Technological Competition," 3 and 31.

115. For example, mobile wireless carriers have tried, but mostly failed, to lead in the development of "app stores" for mobile broadband devices, the most successful of which are operated by device makers.

116. See Bresnahan, "New Modes of Competition," 166.

117. See Sallet, *The Creation of Value*, 15.

118. Jason Dedrick, Kenneth L. Kraemer, and Greg Linden, "The Distribution of Value in the Mobile Phone Supply Chain," *Telecommunications Policy* 35, no. 6 (2011): 505–21, at 515. See also Joel West and Michael Mace, "Browsing as the Killer App: Explaining the Rapid Success of Apple's iPhone," *Telecommunications Policy* 34, nos. 5–6 (2010): 270–86, at 283: "While firms in the mobile telecommunications industry worked together to create enough value to spur adoption of mobile data services, in response to increasing industry commoditization, they also engaged in zero-sum competition to capture the returns from this adoption. Such competition for profits occurred not only between traditional rivals among vendors, operators and content suppliers, but also between these complementary roles within the value network."

119. See Dedrick et al., "The Distribution of Value," 516: "The handset makers look far better than the carriers in terms of ROA, which reflects the difference between the huge capital investments by the carriers to build and

upgrade their cellular networks and the asset-light business models of these handset makers, who outsource much of their manufacturing."

120. Ibid., 517.

121. Fifteenth Report, ¶138, 143.

122. For an important early contribution to the literature on platform competition, see Feng Li and Jason Whalley, "Deconstruction of the Telecommunications Industry: From Value Chains to Value Networks," *Telecommunications Policy* 26, nos. 9–10 (2002): 451–72.

123. One way firms compete in this way is through a form of "sponsored entry." For example, in April 2012, Verizon CFO Frances Shammo indicated in a conference call with analysts that Verizon planned to push phones using Microsoft's Windows operating system as an antidote to the high costs of the iPhone: "It is important that there is a third ecosystem that's brought into the mix here, and we are fully supportive of that with Microsoft." See Greg Bensinger, "Verizon's Answer to iPhone: Windows," *Wall Street Journal* (April 20, 2012).

124. For a detailed discussion of the role of IP in the competitive dynamics of the Internet, see European Commission, Case No COMP/M.6381—*Google/Motorola Mobility Commission Decision Pursuant to Article 6(1)(b) of Council Regulation No. 139/2004*, http://ec.europa.eu/competition/mergers/cases/decisions/m6381_20120213_20310_2277480_EN.pdf (accessed October 1, 2012).

125. The right to control the customer experience played a key role in Apple's negotiations with wireless ISPs over the iPhone, which included a threat by Apple to start its own Mobile Virtual Network Operator and thus completely eliminate the carriers from the customer experience. See West and Mace, "Browsing as the Killer App," 276.

126. Sallet proposes replacing the notion of the "broadband value chain" with a "broadband value circle," with the consumer (rather than broadband ISPs or some other industry sector) at the center. Sallet's framework explains "the ability of firms anywhere along the value change to approach customers directly and attempt to catalyze a new form of consumer surplus, which is not limited to their products alone." See Sallet, *The Creation of Value*, 12.

127. Ibid., 42.

128. Chris Ziegler, "Nokia CEO Stephen Elop Rallies Troops in Brutally Honest 'Burning Platform' Memo?" Engadget, February 8, 2011, www.engadget.com/2011/02/08/nokia-ceo-stephen-elop-rallies-troops-in-brutallyhonest-burnin/ (accessed October 1, 2012).

129. The launch of the Microsoft-Nokia collaboration was marred by rumors that Rovio—maker of popular smartphone game Angry Birds—might not adapt its content to run on the Windows Phone 7 operating system, which one analyst called a "worrying development" that "may cause some to think twice about the likelihood of Nokia's recovery." See Ingrid Lunden, "Update: Analyst: No Angry Birds Space on WP7 Affects Nokia Recovery," Techcrunch, March 23, 2012, http://techcrunch.com/2012/03/23/analyst-no-angry-birds-space-on-windows-phone-will-cause-others-to-think-twice-about-nokias-recovery/ (accessed October 1, 2012).

130. See Anthony Agnello, "Nokia, MSFT Bet Big on Lumia 900, But . . ." InvestorPlace, April 2, 2012, www.investorplace.com/2012/04/nokia-msft-bet-big-on-lumia-900-but-att-exclusivity-may-hurt-more-than-it-helps-t-nok-aapl-goog/ (accessed October 1, 2012).

131. Markets involving network effects and multisidedness are often referred to as "platforms" (e.g., television broadcasting as a "platform" that brings together advertisers with viewers), but the concept is subtly different from the modularity-defined IT platforms I described in Section 2. Modularity-defined platforms exhibit supply-side complementarities, but do not necessarily involve demand-side economies of scale or scope. Similarly, the "interoperability" between viewers and advertisers provided by a television station does not necessarily involve the realization of supply-side complementarities between inputs. See Baldwin and Woodard, "The Architecture of Platforms," 9–11.

132. See, e.g., Rysman, "The Economics of Two-Sided Markets," 125: "Broadly speaking, a two-sided market is one in which 1) two sets of agents interact through an intermediary or platform, and 2) the decisions of each set of agents affects the outcomes of the other set of agents, typically through an externality."

133. Telecommunications networks were subject to network effects long before there was an Internet. What has changed, as I discuss, is the interaction between the network and complementary goods—the emergence of platforms of which broadband networks are a part.

134. See Michael L. Katz and Carl Shapiro, "Antitrust in Software Markets," in *Competition, Innovation and the Microsoft Monopoly*, Eisenach and Lenard, eds., 29–82, at 30. See also Church and Gandal, "Platform Competition in Telecommunications," 134–6.

135. See generally Rohlfs, *Bandwagon Effects*.

136. As discussed below, there are potential exceptions, including the so-called "terminating monopoly" problem.

137. Philip J. Weiser, "The Internet, Innovation, and Intellectual Property Policy," *Columbia Law Review* 103, no. 3 (2003): 534–613, at 574–5. Similarly, Jeffrey Rohlfs notes that network effects (which he refers to as "bandwagon effects") are limited by the existence of "communities of interest" (subsets of relatively homogeneous consumers). See Rohlfs, *Bandwagon Effects*, 21. See also Michael L. Katz and Carl Shapiro, "Systems Competition and Network Effects," *Journal of Economic Perspectives* 8, no. 2 (Spring 1994): 93–115, at 106: "Consumer heterogeneity and product differentiation tend to limit tipping and sustain multiple networks. If the rival systems have distinct features sought by certain consumers, two or more systems may be able to survive by catering to consumers who care more about product attributes than network size. Here, market equilibrium with multiple incompatible products reflects the social value of variety. In some cases—Apple vs. IBM computers, perhaps—important variety benefits might be lost through standardization."; Rysman, "The Economics of Two-Sided Markets," 134–5; and Peter F. Cowhey and Jonathan D. Aronson, *Transforming Global Information and Communications Markets: The Political Economy of Innovation* (Cambridge, MA: MIT Press, 2009), ch. 3.

138. See Nicholas Economides, "The Economics of the Internet Backbone," in *Handbook of Telecommunications Economics*, ed. Majumdar et al., 373–412, at 401. While Internet peering has become more complex in recent years, ubiquitous interconnection remains the rule. See also Peyman Faratin et al., "The Growing Complexity of Internet Interconnection," *Communications & Strategies* 72 (4th quarter 2008), 51–71, at 67: "In response to [the growth of asymmetric traffic flows] and resultant changes in the Internet industry landscape, the range of interconnection contracts have expanded to include greater reliance on paid peering and partial transit, reflecting a filling in of the contracting space. . . . There is little evidence, aside from a few highly visible events such as de-peering actions, that the range of negotiated contracts, whether discriminatory or not, has harmed the overall connectivity of the Internet."); and Christopher S. Yoo, "Innovations in the Internet's Architecture that Challenge the Status Quo," *Journal on Telecommunications and High Technology Law* 8 (2010): 79–99.

139. See, e.g., Rysman, "The Economics of Two-Sided Markets," 127: "[A] a good exhibits an indirect network effect if demand for the good depends on the provision of a complementary good, which in turn depends on demand for the original good."

140. Ibid.

141. Weiser, "The Internet, Innovation," 589.

142. In the United States, which unlike Europe chose not to mandate a single technology for 2G and 3G wireless technology, interplatform competition between CDMA and GSM standards is credited with generating significant benefits for consumers. See Fifteenth Report, ¶¶106–7: "Competition among mobile wireless providers using incompatible wireless network technologies has other advantages that can benefit consumers, including increased product variety and differentiation of services, more technological competition, and tougher price competition."

143. Weiser, "The Internet, Innovation," 586–7.

144. See Li and Whalley, Deconstruction of the Telecommunications Industry," 465: "Within the value network a multitude of market entry points exist, where a diverse range of companies can conceivably enter the market through different routes. Hence, many powerful new players from other industries are drawn into the previously neatly defined telecommunications market."

145. Indeed, Intel's investment in Clearwire was initially conditioned on Clearwire's agreement to rely exclusively on WiMAX, a condition which was subsequently renegotiated. See Stephen Lawson, "Clearwire Free to Use LTE under Changed Intel Deal," May 5, 2012, www.pcworld.com/article/195699/article.html (accessed October 1, 2012). Intel was, of course, not the only early investor in Clearwire. Others included Google and a coalition of cable companies, each of whom had interests—some "vertical," some "horizontal"—to sponsor a new entrant in the wireless broadband space.

146. See e.g., Abbey Klaassen, "Can Google's G1Smart Phone Be More Than an Apple Knockoff?" AdAgeDigital,

September 23, 2008, http://adage.com/article/digital/google-s-g1-smart-phone-apple-knockoff/131212/ (accessed October 1, 2012): "Of course, the focus for Google is not just the G1 but the many other Android phones that Google hopes will come after it."

147. See, generally, Jean-Charles Rochet and Jean Tirole, "Platform Competition in Two-Sided Markets," *Journal of the European Economic Association*, 1, no. 4 (June 2003): 990–1029.

148. See, e.g., E. Glen Weyl, "A Price Theory of Multi-Sided Platforms," *American Economic Review* 100, no. 4 (September 2010): 1642–72, especially 1667; see also Rysman, "The Economics of Two-Sided Markets," 125–143, at 131: "Another important issue in a two-sided framework is price discrimination. In a situation of demand heterogeneity, standard price discrimination—for instance, by manipulating the prices for participation and usage—allows a platform to capture more of the surplus on the side with discrimination. Thus, discrimination increases the value extracted on one side, which leads to lower prices on the other side which has now become more valuable."

149. The terminating monopoly concept appears to be central to the FCC's rationale in the Open Internet Order. See ¶24, n. 66.

150. See, e.g., Rysman, "The Economics of Two-Sided Markets," 131.

151. See Mark Armstrong, "Competition in Two-Sided Markets," *RAND Journal of Economics* 37, no. 3 (Autumn 2006): 668–91, at 670, n. 2: "This tendency toward high prices for the multi-homing side is tempered when the single-homing side benefits from having many agents from the other side on their platform. Then high prices to the multi-homing side will drive away that side and disadvantage the platform when it tries to attract the single-homing side."

152. See Brito et al., *Net Neutrality Regulation*, 10–19; see also Kevin W. Caves, "Modeling the Welfare Effects of Net Neutrality Regulation: A Comment on Economides and Tåg" (April 2010), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1585254 (accessed October 1, 2012).

153. Broadband ISPs do not appear to be any less prone to interconnection than other IT firms. For example, horizontal interlinking among broadband ISPs (i.e., peering and transit) is both voluntary and universal (see note 138 and accompanying text). On the other hand, platform leaders in other IT markets (e.g., game platforms) sometimes choose not to interconnect with competing platforms at all.

154. As noted above, entry has occurred and is occurring in the broadband ISP market. Casual observation suggests the frequency of successful entry in broadband ISP markets is not significantly lower than, and may be higher than, the frequency of successful entry in the markets for (for example) social networking platforms, search engines, and computer operating systems.

155. See, e.g., Manne and Wright, "Innovation and the Limits of Antitrust."

156. See, e.g., *Northern Pac. Ry. Co. v. United States*, 356 U.S. 1, 4 (1958): "The Sherman Act was designed to be a comprehensive charter of economic liberty aimed at preserving free and unfettered competition as the rule of trade. It rests on the premise that the unrestrained interaction of competitive forces will yield the best allocation of our economic resources, the lowest prices, the highest quality and the greatest material progress, while at the same time providing an environment conductive to the preservation of our democratic political and social institutions."

157. See e.g., Powell, "The Great Digital Broadband Migration."

158. See Open Internet Order, ¶116. Perhaps tellingly, the *National Broadband Plan* speaks not of an "Internet ecosystem" but rather a "broadband ecosystem," within which it subsumes applications and content. See NBP Report, 15: "The broadband ecosystem includes applications and content: e-mail, search, news, maps, sales and marketing applications used by businesses, user-generated video and hundreds of thousands of more specialized uses."

159. As noted above, the FCC's recent data roaming and universal service orders explicitly implicate broadband services.

160. Communications services remain subject to traditional antitrust principles, though the Supreme Court has found that the existence of ex ante regulation makes it unlikely that the antitrust laws "contemplate . . . additional scrutiny." *Verizon Communications Inc. v. Law Offices of Curtis V. Trinko*, LLP (02-682) 540 U.S. 398 (2004).

161. See Farrell and Weiser, "Modularity, Vertical Integration, and Open Access Policies," 86.

162. Antitrust Modernization Commission, *Report and Recommendations*, 3.

163. For example, Section 706 of the Communications Act directs the FCC to "encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans." See 47 U.S.C. § 1302(a). The commission bases its authority to issue net neutrality regulations—i.e., to regulate broadband—largely on this provision, which opponents argue does not constitute a separate grant of regulatory authority.

164. The notion that the commission's role properly includes "promoting" the industries it oversees is not limited to one party or ideology. See, e.g., Statement of Chairman Kevin Martin, En Banc Hearing of the Federal Communications Commission, Cambridge, Massachusetts (February 25, 2009) ("The intent [of the FCC's 'four net neutrality principles'] was … to *foster the creation, adoption and use of Internet broadband content, applications, and services*.") (emphasis added). See also Farrell and Weiser, "Modularity, Vertical Integration, and Open Access Policies," 134: "In particular, regulation sometimes adopts measures rationalized as infant industry protection that seek to produce certain innovative benefits—at the risk of falling victim to the perilous exercise of predicting winners and losers."

165. For a contrary view, see Jonathan B. Baker, "Sector-Specific Competition Enforcement at the FCC," *New York University Annual Survey of American Law* 66 (2011): 413–18, at 418: "The sector-specific agency has the expertise and ability to take a longer view of how the industry should evolve, allowing it to identify and address competitive issues that go beyond the practical ambit of antitrust enforcement. By drawing on the strengths of the sector-specific agency and the competition agency, concurrent review can thus enhance competition enforcement as a whole." The issue of jurisdiction—which agency or agencies should enforce competition policy in the broadband sector—is at least theoretically separate from the substantive issues addressed here.

166. See Andrea Renda, "Neutrality and Diversity in the Internet Ecosystem" (August 19, 2010), 32–33, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1680446 (accessed October 1, 2012).

167. The notion of "promoting" competition in telecommunications markets grew at least in part out of the 1996 Telecommunications Act, which was designed to transform the industry from its legacy-regulated monopoly structure to a more competitive structure as expeditiously as possible. In that context, "promoting competition" meant, in part, removing government barriers to entry (the statutory monopolies enjoyed by local telephone companies). To the extent government continues to erect barriers to entry (e.g., as, until recently, in local cable franchising regulations or by creating false scarcity in the market for spectrum), it is entirely appropriate for competition authorities to seek to lower them.

168. See, e.g., Jonathan Sallet, "The Internet Ecosystem and Legal Regimes: Economic Regulation Supporting Innovation Dynamism" (November 2011), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1957715 (accessed October 1, 2012), 3: "Because rulemaking is necessarily based on a current state of understanding about the market, it is ill-equipped to deal flexibly with the rapidly changing and ever-evolving nature of competition in the Internet marketplace."

169. NBP Report, 41.

170. See, e.g., Julius Genachowski, Hearing on "Ensuring Competition on the Internet: Network Neutrality and Antitrust Law," Statement before the Subcommittee on Intellectual Property, Competition, and the Internet Committee on the Judiciary, US House of Representatives (May 5, 2011), 4: "As we heard during our FCC proceeding, antitrust enforcement is expensive to pursue, takes a long time, and kicks in only after damage is done. Especially for start-ups in a fast-moving area like the Internet, that's not a practical solution."

171. Renda, "Neutrality and Diversity," 51–52: "One may wonder the difficulty of an antitrust authority in having to deal with competition between layers. The Internet ecosystem is indeed evolving towards a competitive arena in which some big players, having reached a strong position in the provision of a key gateway service, try to extend their control over the value chain to secure a bigger share of the value that is created by the whole system architecture. This is how powerful search engines, OS vendors, mainframe champions, mobile operators, fixed-line broadband providers, microprocessor manufacturers and conglomerate producers of proprietary goods ended up challenging themselves on countless battlefields and with a mix of open, semi-open and proprietary standards. Plus, all this is happening in a constantly changing environment, and—

even if one should resist the temptation to predict the future based exclusively on past experience—there is clear evidence that markets have been able to fix in the medium term most of the short-term concerns voiced by industry stakeholders. And there is also sufficient evidence that market developments have been quicker and more effective than antitrust decisions—let alone sectoral regulation—in fixing those problems."

172. See, e.g., Shapiro and Varian, *Information Rules*, 310.

173. Some regulatory regimes seem to attract sufficient constituencies as to be practically impossible to reform. The FCC's efforts to reform its rules for intercarrier compensation, for example, have been ongoing for more than fifteen years since passage of the 1996 Telecommunications Act. By contrast, remedies associated with traditional antitrust enforcement are typically time-limited, and thus subject to automatic "sunset."

174. See Brito et al., *Net Neutrality Regulation*, 2. See also Jonathan B. Baker, "Promoting Innovation Competition through the Aspen/Kodak Rule," *George Mason Law Review* 7 (Spring 1999): 495–521, at 521 ("[W]hen the goal is to promote innovation, it is difficult to devise a general [monopolization] rule appropriate to the circumstances of all industries.")

175. Farrell and Weiser conclude that the lack of an adequate analytical framework to support its regulations has led to policy "vacillation" at the FCC. See Farrell and Weiser, "Modularity, Vertical Integration, and Open Access Policies," 132–33: "We see little evidence of subtle balancing to suggest that changes in circumstances explain the changes in policy, so it is tempting instead to describe the variation as 'vacillating' in an inadequate analytical framework."

176. See Shapiro and Varian, *Information Rules*, 311. The propensity of regulatory agencies to engage in such cross-subsidization is well-documented. See, e.g., Ronald H. Coase, "The Federal Communications Commission," *Journal of Law and Economics* 2 (1959): 1–40, and Richard A. Posner, "Taxation by Regulation," *Bell Journal of Economics and Management Science* 3, no. 1 (Spring 1972): 98–129.

177. See, e.g., Robin S. Lee and Tim Wu, "Subsidizing Creativity through Network Design: Zero-Pricing and Net Neutrality," *Journal of Economic Perspectives* 23, no. 3 (Summer 2009): 61–76, at 67: "Of course, for a given price level, subsidizing content comes at the expense of not subsidizing users, and subsidizing users could also lead to greater consumer adoption of broadband. It is an open question whether, in subsidizing content, the welfare gains from the invention of the next killer app or the addition of new content offset the price reductions consumers might otherwise enjoy or the benefit of expanding service to new users."

178. For a discussion of difficulties of identifying predatory pricing in network markets, even on a case-by-case basis, see Joseph Farrell and Michael L. Katz, "Competition or Predation? Consumer Coordination, Strategic Pricing and Price Floors in Network Markets," *Journal of Industrial Economics* 53, no. 2 (June 2005): 203–31.

179. See Carl Shapiro, "Exclusivity in Network Industries," *George Mason Law Review* 7 (Spring 1999): 673–82, at 678.

180. Baker, "Competitive Price Discrimination," 649.

181. Renda, "Neutrality and Diversity," 47.

182. Ibid., 51. See also Rysman, "The Economics of Two-Sided Markets," 132: "Perhaps it is more natural to observe firms begin with a one-sided model and switch to a two-sided model as they become more established. Doing so allows potential platforms to overcome the 'chicken-and-egg' problem by first providing complementary goods themselves (sometimes requiring daunting capital expenditures). For example, Amazon first established itself as a fairly standard on-line book retailer before introducing its 'marketplace' options where sellers set prices and interact with consumers."

183. For a "new-economy" based critique of the Open Internet Order, see Bruce W. Owen, "Antitrust and Vertical Integration in 'New Economy' Industries with Application to Broadband Access," *Review of Industrial Organization* 38, no. 4 (2011): 363–86.

184. See Federal Communications Commission, *Video Device Competition, Implementation of Section 304 of the Telecommunications Act of 1996, Commercial Availability of Navigation Devices, Compatibility Between Cable Systems and Consumer Electronics Equipment, Notice of Inquiry*, MB Docket No. 10-91, CS Docket No. 97-80, PP Docket No. 00-67, FCC 10-60 (April 21, 2010).

185. On handset exclusivity, see Jeffrey Paul Jarosch, "Reassessing Tying Arrangements at the End of AT&T's iPhone Exclusivity," *Columbia Business Law Review* 2, no. 2 (2011): 296–362, at 361: "iPhone exclusivity has had

meaningfully pro-competitive effects in fostering innovation and differentiation among wireless networks."

186. See, e.g., Ehrlich et al., "The Impact of Regulation on Innovation," 22–23.

187. Weiser, "The Internet, Innovation," 585.

188. Ibid., 590–91. See also *Berkey Photo, Inc. v. Eastman Kodak Co.*, 603 F.2d 263 (2d Cir. 1979), 281: "It is the possibility of success in the marketplace, attributable to superior performance, that provides the incentives on which the proper functioning of our competitive economy rests. If a firm that has engaged in the risks and expenses of research and development were required in all circumstances to share with its rivals the benefits of those endeavors, this incentive would very likely be vitiated."

189. See, e.g., *United States v. Google Inc. and ITA Software, Inc, Competitive Impact Statement* (April 8, 2011), www.justice.gov/atr/cases/f269600/269620.pdf (accessed October 1, 2012), 3: "The proposed Final Judgment therefore strikes an appropriate balance between competing interests by preserving the potential significant efficiencies from the combination of Google's and ITA's complementary expertise while redressing the potential for anticompetitive foreclosure that could result from the acquisition."

190. See Herbert Hovenkamp, "Antitrust and Innovation: Where We Are and Where We Should Be Going," *Antitrust Law Journal* 77, no. 3 (2011): 749–56, at 754. For a dynamic competition-focused critique of mandatory unbundling policies, see Glen O. Robinson and Dennis L. Weisman, "Designing Competition Policy for Telecommunications," *Review of Network Economics* 7, no. 4 (December 2008): 509–46. See also Crandall et al., *The Long-Run Effects of Copper Unbundling*.

191. Renda, "Neutrality and Diversity," 54.

192. For a discussion of proposals for fiber unbundling, for example, see e.g. Crandall et al., *The Long-Run Effects of Copper Unbundling*.

193. On the wisdom of adopting rules for "IP interconnection," see Faratin et al., "The Growing Complexity of Internet Interconnection," 64: "We also have a cautionary conclusion: if one should be motivated (for whatever reason) to contemplate some regulatory rule to manage interconnection, the design of such a rule will be both complex and informationally demanding. Partial transit and paid peering may be seen as efficiency-enhancing responses to changing market conditions. While there may be opportunities for abuse by providers with excessive bargaining power, the complexity of what is in place today, and what seems to be working today, would argue that the best way to address any potential concern would be to focus on the sources of bargaining power and identify anti-competitive opportunism, rather than to impose *ex ante* restrictions on the range of bilateral contracts." See also Analysys Mason, *Overview of Recent Changes in the IP Interconnection Ecosystem* (May 2011), 32: "The commercially-driven evolution of Internet interconnection stands in contrast to the regulation that governs interconnection of telecommunications services, which may share the same network infrastructure with the Internet, and involve many of the same players. For example, in the past decade, during which the evolution in the Internet described above took place, the FCC has made countless attempts to modify the inter-carrier compensation system in response to changes in telecommunications—a process that is still ongoing. In contrast, since the commercialization of the Internet backbone, the Internet ecosystem has long proven itself to be able to develop and sustain interconnection in the absence of sector-specific regulation—and it now has shown itself to also be able to adapt well to rapid and profound market changes without regulatory intervention."

194. See US DOJ and FTC, *Horizontal Merger Guidelines*, 21–22.

195. See e.g., David S. Evans and Michael D. Noel, "The Analysis of Mergers that Involve Multisided Platform Businesses," *Journal of Competition Law and Economics* 4, no. 3 (2008): 663–95, and Lapo Filistrucchi, Tobias J. Klein, and Thomans Michielsen, "Assessing Unilateral Merger Effects in a Two-Sided Market: An Application to the Dutch Daily Newspaper Market" (Tilberg Law and Economics Center, October 2011), http://ssrn.com/abstract=1946163 (accessed October 1, 2012).

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