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MODULARITY, VERTICAL INTEGRATION, AND OPEN ACCESS POLICIES: TOWARDS A CONVERGENCE OF ANTITRUST AND REGULATION IN THE INTERNET AGE*

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I. INTRODUCTION

Just as the dust settles from the Microsoft case, the Federal Communications Commission ("FCC" or "the Commission") is preparing to craft rules to regulate broadband networks.[1] Taken together, these developments may mark the beginning of a new model of regulation for the Internet age. This regulatory regime will govern when a firm must provide "open access" to its platform — be it an operating system, a telecommunications service, or some other technology that facilitates Internet content or services — and will significantly influence the future development of the Internet.

A critical challenge for this emerging model of regulation will be whether and how to integrate antitrust policy and telecommunications regulation into a coherent whole. Antitrust and regulation have starkly contrasting traditions on mandated access. As the Internet, computer software, and telecommunications ("New Economy"[2]) industries converge, affected firms will increasingly seek clear and consistent legal rules.[3] 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.[4]

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1. *See, e.g.*, Inquiry Concerning High-Speed Access to the Internet over Cable and Other Facilities, 17 F.C.C.R. 4798 (2002) (Declaratory Ruling and Notice of Proposed Rulemaking) [hereinafter High-Speed Declaratory Ruling].

2. *See* Richard A. Posner, *Antitrust in the New Economy*, 68 ANTITRUST L.J. 925, 925 (2001).

3. For a discussion of technological convergence and its impact on telecommunications regulation, see NAT'L RESEARCH COUNCIL, BROADBAND: BRINGING HOME THE BITS 9 (2002), which states that "with convergence, everything — video, audio, text, and so forth — has become a digital stream that can be transported across the Internet."

4. For an example of increasing judicial insistence on careful economic analysis by regulators, see United States Telecom Ass'n v. FCC, 290 F.3d 415, 422–28 (D.C. Cir. 2002), in which the court criticized the economic rationale behind the FCC's rules for unbundling the local telecommunications network. *See also* Warren G. Lavey, *Inconsistencies in Applications of Economics at the Federal Communications Commission*, 45 FED. COMM. L.J. 437,

To do so, however, the FCC must develop a framework for regulating what economists call "vertical relations": how a firm relates to other firms in adjacent markets and whether it integrates into those markets.

In broad-brush terms, antitrust policy viewed much vertical conduct as suspect until the 1970s. By the late 1970s, however, the Chicago School of economics influenced mainstream antitrust thinking by establishing that vertical integration (e.g., mergers) and many kinds of vertical contracts had efficiency benefits and were unlikely to harm competition.[5] While post-Chicago School scholarship of the 1980s and 1990s has weakened that view,[6] current antitrust doctrine still generally presumes that vertical agreements, vertical extension, and vertical mergers are unobjectionable unless a fact-intensive investigation shows otherwise.

By contrast, in similarly broad-brush terms, early telecommunications policy positively encouraged integration and close coordination into "one network" under the regulated AT&T monopoly. Starting in the 1970s, however, a series of FCC and court decisions adopted a policy of developing and protecting open interfaces. This open architecture philosophy held that powerful firms at one level should not be allowed to leverage that power into — or perhaps even participate in — adjacent competitive segments. Likewise, the United States government's early support for the Internet encouraged the development of an open architecture based on modular standards.[7]

These contrasting traditions of analyzing open access leave telecommunications policy unsettled. Technological convergence and emerging competition in telecommunications blur the lines between industries regulated primarily by antitrust (notably computing) and those subject to telecommunications law, and telecommunications regulators increasingly pledge fealty to antitrust approaches.[8] The

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439–40 (1993) (calling for increased judicial efforts to promote consistency in the use of economic theory to justify regulation).

5. The landmark event in the rise of Chicago School thinking was the Supreme Court's decision in Continental T.V., Inc. v. GTE Sylvania, Inc., 433 U.S. 36, 48 n.15, 55–56 (1977), which cited heavily to Chicago School criticisms of the Court's earlier doctrine.

6. *See* David S. Evans & Michael Salinger, *Competition Thinking at the European Commission: Lessons from the Aborted GE/Honeywell Merger*, 10 GEO. MASON L. REV. 489, 512 & n.58 (2002) (discussing the impact of post-Chicago School scholarship).

7. As we explain in more detail below, "modularity" is a means of managing complexity. As one commentator defined the term, modularity involves "breaking up a complex system into discrete pieces — which can then communicate with one another only through standardized interfaces within a standardized architecture — [to] eliminate what would otherwise be an unmanageable spaghetti tangle of systemic interconnections." Richard N. Langlois, *Modularity in Technology and Organization*, 49 J. ECON. BEHAV. & ORG. 19, 19 (2002).

8. For two discussions of the impact of convergence on regulatory policy, see Philip J. Weiser, *The Imperative of Harmonization Between Antitrust and Regulation*, *in* TELECOMMUNICATIONS CONVERGENCE: IMPLICATIONS FOR THE INDUSTRY AND FOR THE PRACTICING LAWYER 73 (PLI Intellectual Property Course, Handbook Series No. G-698,

clash of traditions and of arguments on open access is particularly sharp in one of today's central telecommunications problems: the regulatory treatment of broadband transport and its close complements. Broadband transport, usually provided by cable modems or telephone digital subscriber lines ("DSL"), promises to transform the Internet by vastly speeding up downloads and by permitting high-bandwidth applications.[9] Some commentators — most notably Lawrence Lessig — have urged regulators to impose modularity on this market by requiring broadband transport providers to share their facilities with Internet service providers ("ISPs").[10] Others, echoing the Chicago School perspective, argue that the market will facilitate open access to the extent that open access is efficient.

The open access question is even more ubiquitous than it may first appear, as policymakers and commentators often use different terms to describe the issue. Antitrust commentators discuss the "primary" (or "bottleneck") market and the "secondary" (or "complementary") market. In telecommunications, participants talk of "conduits" and "content." This Article, adopting the terminology used in the computer industry, will discuss "platforms" (often "information platforms") and "applications."[11] The essence of the issue is the complementarity between applications and platforms, whether the application is an input to the platform, a buyer of the platform, or neither.[12]

2002) and Philip J. Weiser, *Law and Information Platforms*, 1 J. TELECOMMS. & HIGH TECH. L. 1 (2002) [hereinafter Weiser, *Information Platforms*].

9. Though the definition of "broadband" will evolve over time, the FCC's current dividing line is 200 kilobits per second — bandwidth sufficient "to change web pages as fast as one can flip through the pages of a book and to transmit full-motion video." Inquiry Concerning the Deployment of Advanced Telecommunications Capability, 14 F.C.C.R. 2398, ¶¶ 20, 22 (1999) (Report); *see id.* ¶ 25 (noting that the definition will evolve); *see also* Inquiry Concerning the Deployment of Advanced Telecommunications Capability, 17 F.C.C.R. 2844, ¶ 7 (2002) (Third Report) (adhering to the 200 kilobits per second dividing line). *But see* NATIONAL RESEARCH COUNCIL, *supra* note 3, at 78–80 (proposing alternative definition).

10. *See* LAWRENCE LESSIG, THE FUTURE OF IDEAS 147–67 (2001). This argument builds off a prior piece that addressed critics of mandated modularity. *See* Mark A. Lemley & Lawrence Lessig, *The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era*, 48 UCLA L. REV. 925 (2001) (engaging arguments made in Phil Weiser, *Paradigm Changes in Telecommunications Regulation,* 71 U. COLO. L. REV. 819, 831 (2000) and James B. Speta, *Handicapping the Race for the Last Mile?: A Critique of Open Access Rules for Broadband Platforms*, 17 YALE J. ON REG. 39, 77–90 (2000)).

11. For a further explanation of the information platform concept and how it can frame technology policy debates, see Weiser, *Information Platforms*, *supra* note 8, at 3–8. A notable example of an information platform from the computer industry is the Microsoft Windows operating system, which exposes Application Programming Interfaces ("APIs") that can be used by applications developers to "call" certain functions provided by the operating system. *See* United States v. Microsoft Corp., 253 F.3d 34, 53 (D.C. Cir. 2001).

12. In part for this reason, we define "applications" broadly, not distinguishing between software applications and hardware products (such as peripherals), both of which may connect to an underlying platform. Rather, we will use the term "applications" for all complementary products or services used in conjunction with a platform.

This Article aims to help regulators and commentators incorporate both Chicago School and post-Chicago School arguments in assessing whether regulation should mandate open access to information platforms. Much discussion on such questions focuses on the degree of competition among platforms. By contrast, the central analytical tool — not necessarily the victor — in our discussion is a Chicago School-style argument we call *internalizing complementary efficiencies* or "ICE." ICE claims that even a monopolist has incentives to provide access to its platform when it is efficient to do so, and to deny such access only when access is inefficient. ICE is often a persuasive argument, yet its logic admits several cogent exceptions. Unfortunately, regulators and commentators seldom do justice to the nuances of this principle: some ignore ICE, while others embrace it and underestimate its exceptions. Only by addressing both ICE and its exceptions can regulators make full use of economics in analyzing open access requirements.[13]

In its broadband proceedings, the FCC has an opportunity to embrace the insights of ICE and its exceptions in developing a framework to evaluate independent providers' claims for mandated access to a platform such as broadband transport.[14] Ideally, such a framework would harmonize telecommunications regulation with antitrust policy and guide regulation in related contexts, such as unbundling policy for local telecommunications networks.[15] The FCC could thus more accurately apply economic principles to information platforms and satisfy judicial demands for a better economic explanation of its regulatory policies.

This Article proceeds in five main parts. Part II recounts experiences of the Internet, computer, and telecommunications industries, illustrating the powerful benefits of modularity that inspire proponents of open access regulation. To explain the Chicago School skepticism of such regulation, Part III first discusses how close (i.e., other than arm's-length) vertical relationships can yield important efficiencies.

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13. Christopher Yoo makes a similar observation in his exposition of a project related to ours. *See* Christopher S. Yoo, *Vertical Integration and Media Regulation in the New Economy*, 19 YALE J. ON REG. 171, 177 & n.19, 178 (2002) (describing the project's focus on cable television, broadcast, and broadband markets, but disclaiming any application to telecommunications markets).

14. Such a framework would provide more guidance than prior ad hoc FCC decisions in this area, which typically arose from merger reviews. *See* James B. Speta, *A Common Carrier Approach to Internet Interconnection*, 54 FED. COMM. L.J. 225, 226 (2002) ("[T]he only legal rules governing Internet interconnection are a limited number of company-specific conditions imposed in some merger reviews."); Philip J. Weiser, *Internet Governance, Standard Setting, and Self-Regulation*, 28 N. KY. L. REV. 822, 844 (2001) ("In terms of setting a precedent for future regulation of information platforms, the FCC's AOL/Time Warner Order failed to set forth a principled model of analysis . . . .").

15. *See* United States Telecom Ass'n v. FCC, 290 F.3d 415 (D.C. Cir. 2002) (remanding the development of the standard for unbundling the local telecommunications network back to the FCC).

Part III then explains the ICE principle: even monopoly platform providers have at least some incentive to operate in a modular fashion when it is efficient to do so, because they *internalize complementary efficiencies*. Part IV describes eight holes in the ICE logic: reasons why a monopoly platform provider might inefficiently close its platform. We do not see comparable reasons why such a monopoly might inefficiently open its platform. Part V outlines regulatory tools often used to facilitate open access, discusses factors that regulators should consider when contemplating open access policies, and offers three possible regulatory philosophies consistent with our discussion. Finally, Part VI applies the ICE framework to the FCC's Computer Inquiries, the *Microsoft* case, and the current broadband proceedings, illustrating how the subtleties of ICE and its exceptions, if not carefully addressed, can lead to policy instability. In conclusion, the Article urges the FCC to adopt a coherent model of platform regulation that takes account of ICE and permits a more harmonious convergence between antitrust and regulatory policy.

II. OPEN ARCHITECTURE AND MODULARITY

This Part focuses on the benefits of modularity. Sections A, B, and C explain how the Internet, computing, and telecommunications industries all came to be organized in a relatively modular fashion. Section D then discusses the benefits of modularity in general and the rationale for making it a guiding light for information policy.

A. The Creation of the Internet and Its End-to-End Architecture

The Internet's development was a triumph of United States technology policy. The Internet grew from the Defense Department's Advanced Research Projects Administration's ARPANET and later relied on support from the National Science Foundation. From its early days in the late 1960s until the early 1990s, the Internet remained a government project, relying on the academic and research community for its development.[16] By the time commercial entities developed Internet services and products in the 1990s, its basic architecture was already in place. This architecture reflects the Internet pioneers' conscious strategy that the platform should not anticipate what applications would rely on it, and that no central gatekeeper should decide which applications could be provided.

The Internet can be understood as being comprised of four layers: content, applications, logical, and physical.[17] At its center lies the

16. *See* JANET ABBATE, INVENTING THE INTERNET 54–65 (1999).

17. There are various ways to describe the layers of Internet architecture. Lawrence Lessig, for example, suggests a definition of the content layer that includes what others call the

III. INTEGRATION AND EFFICIENCIES: PUTTING THE MODULARITY MOVEMENT ON ICE

Perhaps partly recognizing the efficiency and competitive benefits of modularity, antitrust policy until the 1970s was wary of allowing dominant firms to integrate into adjacent markets and create closed relationships between complementary products.[47] Over the last twenty-five years, however, antitrust policy has accepted the Chicago School argument that close (even closed) vertical relationships can yield and be motivated by integrative efficiencies. Furthermore, economists' better understanding of how complements boost demand for the primary good has taught antitrust that powerful firms, recognizing the merits of a modular industry structure, will often institute modularity voluntarily. The question for regulators therefore is not whether modularity is good — it very often is — but whether modularity is likely to be good *even when* it will not emerge (or survive) spontaneously, as it often will when it is most valuable to consumers.

This Part explains the logic behind allowing firms (even monopolists) to decide whether or not to integrate vertically into — or, more broadly, depart from an arm's-length relationship with — complementary markets.[48] Section A outlines some important efficiency benefits that can stem from a vertical relationship closer than an arm's-length one (or, equivalently, inefficiencies of arm's-length relationships). Section B goes on to explain the powerful concept of *internalizing complementary efficiencies*. ICE suggests that even a platform monopolist often has incentives to make efficient choices about when to maintain modularity and when to get involved in an adjacent market.

A. Integrative Efficiencies

Palm, which introduced the first successful personal digital assistant, later decided to separate its operating system and software applications divisions from its hardware division.[49] It did not want to follow Apple, which failed to commit to an open licensing strategy for its operating system and subsequently lost its initially strong market

47. *See, e.g.*, United States v. Arnold Schwinn & Co., 388 U.S. 365, 379 (1967) (recognizing the per se illegality of certain types of vertical restraints).

48. For brevity we sometimes talk as if platform firms choose between full integration and an arm's-length modular relationship with a complement, but of course there is a spectrum of vertical relationships, including partial integration (e.g., joint ventures), tie-ins, partial equity investments, long-term contracts, and affiliate relationships.

49. *See* Pui-Wing Tam, *For Palm, Splitting in Two Isn't Seamless*, WALL ST. J., June 27, 2002, at B4.

share.[50] Palm presumably preferred to emulate Microsoft, which has benefited enormously from modularity in the PC market.

The Apple and Microsoft examples might make Palm's decision to vertically separate seem like a no-brainer, but it was not. By separating its operations vertically, Palm lost control of some important aspects of its product deployment. For instance, Palm's reliance on outsiders and an "inability to crack the whip on its far-flung programmers" contributes (according to some observers) to its "slow pace of innovation" in applications.[51] By contrast, Sega developed the operating system, equipment, and leading games (such as Sonic the Hedgehog) for its Sega Genesis system all in-house, presumably in order to control its product offerings and drive consumer demand for its system.[52]

Because the platform and the applications made for it are economically interdependent, an arm's-length relationship can involve contractual hold-up hazards (on both sides, though especially threatening to competitive applications providers).[53] A closer vertical relationship can be an efficient response to such hazards.[54]

An arm's-length relationship can also lead to what economists call "double marginalization." The classic formulation, offered by Augustin Cournot in 1838, is that separate complementary monopolies, each imposing a monopoly markup, wind up with a final product price that exceeds the overall monopoly price. As a result, both consumers and the producers are worse off than they would be if the two firms merged and charged a monopoly price for the two goods together.[55] More generally, this insight explains that firms providing complementary activities or products are in a mutual position of "vertical externality." When Microsoft, for example, improves its software or lowers its price, more consumers buy Intel's complementary microprocessor; similarly, when Intel improves its hardware or lowers

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50. *See id.*

51. Erick Schonfeld & Ian Mount, *Beating Bill*, BUS. 2.0, June 2002, at 36, 39, *available at* http://www.business2.com/articles/mag/print/0,1643,40438,FF.html (last visited Oct. 29, 2003).

52. *See* ADAM M. BRANDENBURGER & BARRY J. NALEBUFF, CO-OPETITION 237–41 (1996). One possible explanation for these differing approaches is that the proprietary strategy is most effective in launching a new system, but, as Palm is discovering, it is difficult to determine when or whether integration has outlived its usefulness and when, if ever, to separate integrated divisions that once worked well together. *See* Tam, *supra* note 49.

53. *See* Yoo, *supra* note 13, at 262–64 (noting that vertical integration guards against free riding, hold-up problems, and other strategic behaviors by vital complementors).

54. More precisely, the hazards arise when fully effective modularity is not available, so that ex post haggling is likely. There may then be an intriguing positive feedback: when modularity works well, it is appealing and may be stable, but when it starts to break down, a platform supplier's best response may eventually be to integrate — perhaps killing off whatever imperfect modularity remains.

55. *See* AUGUSTIN COURNOT, RESEARCHES INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH 103 (Nathaniel T. Bacon trans., MacMillan 1927) (1838).

its price, demand for Microsoft's operating system rises. Thus, when complementors move closer to maximizing joint profits — whether through integration or through a closer contractual relationship than arm's-length pricing — it tends to encourage innovation and price-cutting.[56]

Innovation can require changing the platform/application interface, which can be a slow process if an industry relies on open standards and open interfaces. In such cases, hand-in-glove coordination between the platform sponsor and one or more complementors can accelerate innovation.[57] In particular, a new product that would require new interfaces may be most readily launched in a hand-in-glove, even integrated, fashion. Indeed, Palm first launched its product in an integrated manner before moving to modularity through its voluntary split. Moreover, such coordination can give a platform provider more scope for penetration pricing and other start-up tactics aimed to encourage efficient use and adoption of its platform,[58] particularly when the product is newly introduced and relatively unknown.[59]

Integration or hand-in-glove coordination also helps assure consumers that complementary products will work well, because the platform sponsor retains control over quality and interoperability. Antitrust law, even at the height of its hostility to vertical tie-ins, appreciated this point in a case involving the rollout of cable television and related equipment.[60]

Analyzing a firm's choice of vertical structures is a focus of the "new institutional economics" ("NIE"). Building on insights of Nobel Laureate Ronald Coase,[61] NIE "seeks to extend and enrich understanding of the microanalytic details of business behavior and the in-

56. For development of this point and some important refinements of it, see Joseph Farrell & Michael L. Katz, *Innovation, Rent Extraction, and Integration in Systems Markets*, 48 J. INDUS. ECON. 413 (2000). Of course, when competitors — in contrast to complementors — move closer to maximizing joint profits, the result can readily be anticompetitive.

57. For a development of this theme and a discussion of the virtues of proprietary platform competition, see Philip J. Weiser, *The Internet, Innovation, and Intellectual Property Policy*, 103 COLUM. L. REV. 534 (2003). For a further discussion of how developing stable interfaces can be too expensive and time consuming to merit the effort, see Langlois, *supra* note 7, at 23.

58. *See* Douglas Lichtman, *Property Rights in Emerging Platform Technologies*, 29 J. LEGAL STUD. 615, 616–17 (2000).

59. *See* JEFFREY H. ROHLFS, BANDWAGON EFFECTS IN HIGH-TECHNOLOGY INDUSTRIES 197 (2001).

60. *See* United States v. Jerrold Elec. Corp., 187 F. Supp. 545, 556–57 (E.D. Pa. 1960), *aff'd per curiam*, 365 U.S. 567 (1961) (allowing leeway for bundling in introducing a new product when reputation matters).

61. *See generally* Ronald H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386 (1937); Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960). The subject is also known as "transactions cost economics."

dustry settings that shape firm conduct."[62] Usefully, if tautologically, NIE suggests that firms will vertically integrate or depart from arm's-length market dealing when such arm's-length dealing would be more costly.[63] Thus, firms will sometimes opt for modularity as a means of bringing maximum imagination and diversity to the problem of developing applications on a platform, and minimizing the need for complex coordination. Conversely, firms will sometimes opt for vertical integration in order to facilitate complex coordination and strengthen incentives for product development and deployment.[64]

B. ICE and the Rationale Against Open Access Regulation

In an ideal world, a firm could obtain the benefits of vertical integration while still employing some degree of modularity to spur independent innovation. In attempting such strategies, platform providers who integrate into applications development often take pains "not to compete with customers" so as to minimize any ill effects of integration on independent applications.[65] But because getting the best of both worlds in this way is hard, firms may give up and stick to their core business. In this respect, Palm's decision to divest its operating system can be seen as a step to reassure its licensees that it can be trusted as a steward of the standard, that it will not leverage its control of the platform into related markets, and that it will remain focused on serving the needs of independent developers — particularly now that Microsoft's rival handheld operating system is offered on a modular basis (i.e., without a hardware component).[66] Similarly, AT&T divested its equipment manufacturing arm, Lucent, perhaps to reassure

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62. Timothy J. Muris, Chairman, Fed. Trade Comm'n, Remarks at George Mason University Law Review's Winter Antitrust Symposium (Jan. 15, 2003), *at* http://www.ftc.gov/speeches/muris/improveconfoundtio.htm (last visited Oct. 29, 2003).

63. For discussions of this point and citations to relevant literature, see Alan J. Messe, *Tying Meets the New Institutional Economics: Farewell to the Chimera of Forcing*, 146 U. PA. L. REV. 1, 50–66 (1997) and Gregory J. Werden, *The Law and Economics of the Essential Facility Doctrine*, 32 ST. LOUIS U. L.J. 433, 462–64 (1987).

64. Because it is seldom obvious which of these two strategies is superior, antitrust courts have waded carefully into the area of "technological tying," requiring plaintiffs to establish that any competitive harms outweigh the efficiencies produced by such integration. *See, e.g.*, United States v. Microsoft Corp., 253 F.3d 34, 92–94 (D.C. Cir. 2001); ILC Peripherals Leasing Corp. v. IBM, 458 F. Supp. 423, 443–44 (N.D. Cal. 1978), *aff'd sub nom.* Memorex Corp. v. IBM, 636 F.2d 1188 (9th Cir. 1980); Telex Corp. v. IBM*,* 367 F. Supp. 258, 347 (N.D. Okla. 1973), *rev'd on other grounds*, 510 F.2d 894 (10th Cir. 1975).

65. This phrasing is most natural when applications developers buy the platform product and then sell a combined product downstream. Nonetheless, the same issues arise whether this is the market structure, or whether the platform provider buys from the applications developers, or whether end users or intermediaries buy both products.

66. *See* Ian Fried & Dawn Kawamoto, *Two Palms Better Than One?* (Feb. 4, 2002), *at* http://news.com.com/2100-1040-828446.html (last visited Oct. 29, 2003).

equipment customers who competed with other parts of AT&T that Lucent would not favor the latter.[67]

If a monopoly platform provider chooses to stick to its core platform business, it would prefer that applications — the complements to its product — be cheaply, innovatively, and efficiently supplied. Thus, in choosing how to license interface information, certify complementors, and otherwise deal with developers, such a firm has a clear incentive to choose the pattern that will best provide it or its customers with applications. That is, a firm will *internalize complementary efficiencies* arising from applications created by others. Although antitrust law has not always appreciated it,[68] we call this point Obvious ICE.

Obvious ICE can be illustrated with a numerical example involving a platform monopolist in the game console market.[69] Assume that competition in the market for applications (video games) will yield a selection of applications such that each user of the platform values it at $100, while a monopoly in applications will yield platform valuations of only $70.[70] Under these conditions, if the platform provider were to monopolize the applications market, the platform's value to a buyer would fall by $30; consequently, the platform provider would have to either sell fewer platforms or lower its platform price by $30. In that way, the platform provider *internalizes* the *complementary efficiencies* (here $30) from a better performing applications market.[71]

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67. *See* T. Randolph Beard et al., *Why Adco? Why Now? An Economic Exploration into the Future Structure for the "Last Mile" in Local Telecommunications Markets*, 54 FED. COMM. L.J. 421, 457 n.83 (2002).

68. Judge Posner makes this point sharply in discussing the antitrust rule governing minimum resale price maintenance. *See* RICHARD A. POSNER, ANTITRUST LAW 177–78 (2d ed. 2001).

69. In antitrust, a company need not control 100% of a market (and even "market" is a nuanced term of art) to be considered a "monopolist"; rather, a "monopolist" is a company with considerable control over prices and output (and/or the ability to exclude competitors). *See id.* at 195–96 (noting that courts use market shares of 50% to 70% as threshold indicators of when a firm is a monopolist); United States v. DuPont & Co., 351 U.S. 377, 391 (1956) (defining "monopoly power" as "power to control prices or exclude competition"); *see also* ABA SECTION OF ANTITRUST LAW, ANTITRUST LAW DEVELOPMENTS 235–36 (4th ed. 1997) (noting the 50% and 70% benchmarks and citing supporting federal case law); *id.* at 238 (listing factors relevant to monopoly power determinations such as "presence and degree of barriers to entry or expansion, technological superiority resulting in cost advantages, economies of scale and scope, ability to price discriminate, the relative size of competitors, competitors' performance, pricing trends and practices, homogeneity of products, potential competition, and the stability of market shares over time"); United States v. Syufy Enters., 903 F.2d 659, 664 (9th Cir. 1990) ("A high market share, though it may ordinarily raise an inference of monopoly power, will not do so in a marker with low entry barriers . . . .").

70. Such valuations reflect the quality, variety, and price of the available applications, and are measured assuming that the platform is already purchased.

71. The argument as formulated yields a slightly sharper conclusion than is usually stated. First, it is the incremental value to the marginal platform purchaser that counts. Second, if the platform provider chooses a different price strategy than that described, it will more than capture the advantage of the more efficient downstream organization. *See* Joseph

Obvious ICE neither proves nor assumes that competition in applications markets is efficient. If, for instance, it is exceptionally hard to avoid spillovers of innovation among applications developers, then competition among developers might lead to less rather than more innovation. Or, if consumers cannot easily judge the quality of applications, fly-by-night entry into applications could spoil the market. If, for such reasons, a competitive applications market would yield less value than a monopolized one, the monopoly platform provider would gain by efficiently preventing competition in the market for applications. Thus, Obvious ICE does not say what structure of the applications market is optimal, but simply observes that the unintegrated platform monopolist has an incentive to favor whichever form of organization of applications is most efficient (or delivers the most value to users).

But often a platform monopolist *does* integrate into (and remain in) the market for applications for its platform.[72] For at least three reasons, it will often be able to take a dominant position in that business. First, it has a stronger incentive than an independent firm to work harder on its applications: while innovators can seldom capture all their incremental value through simple pricing, the integrated provider (as ICE reminds us) can capture some — perhaps all — of the residue in its platform sales. Second, even if a platform provider truly tries to cooperate with independent applications developers, it is unlikely to be as open with them as with its own applications division (unless it builds a "Chinese wall" to keep information from the latter). Third, if the integrated firm wants to hamstring applications rivals, it might be very easy to bias interface design, the timing of new releases, pricing policy, and other choices. Moreover, such subtleties would only be necessary if blunter means (e.g., rendering an application inoperable) were unavailable. For these reasons, a platform provider's decision to integrate vertically may well hurt independent complementors, seemingly posing formidable competitive concerns.[73]

Obvious ICE does not address these concerns. But a stronger and less obvious version of ICE claims that platform monopolists will act efficiently even in deciding whether or not to integrate into adjacent markets. Similarly, this version of ICE claims that if a platform monopolist integrates into an adjacent market, it will still welcome value-added innovations by independent firms. Thus, according to this form of ICE, such close vertical relationships do not raise economic policy concerns.

Farrell, *Integration and Independent Innovation on a Network*, 93 AM. ECON. REV. 420 (2003).

72. This need not be literal integration; alliances with particular applications developers could have similar effects. Therefore, this Article sometimes refers to "close vertical relationships" instead of using the traditional term "vertical integration."

73. *See* Farrell & Katz, *supra* note 56, at 421–26; Farrell, *supra* note 71, at 421–23.

Suppose, in the hypothetical above, that the platform provider could integrate into the applications market, and by participating in that market improve the platform's value to users from $100 to $105, while breaking even on its applications. Then, it will be able to charge $5 more for its platform and sell as many as before. Whether or not it chooses just that pricing, it will profit from vertical integration, as it should, since by hypothesis integration increases value. Suppose, on the other hand, that the platform provider contemplates integrating into applications, monopolizing that market, and making a profit of $20 per user there while users value the platform at $70 rather than at $100. Because the $20 profit is less than the $30 harm created by this action — harm that is in the first instance to applications buyers, but that redounds to the platform monopolist's bottom line because consumers will be willing to pay less for the platform — it will lose by such a strategy, as it should since, by hypothesis, this strategy leads to lower overall value. To be sure, a platform provider would choose to monopolize the applications market if it could make $40 (per user) rather than $20 in doing so, but only because the assumptions imply that this monopolization would somehow increase rather than decrease total value.[74]

ICE maintains that the platform monopolist cannot increase its overall profit by monopolizing the applications market, because it could always have charged consumers a higher platform price in the first place; it has no incentive to take profits or inefficiently hamper or exclude rivals in the applications market because it can appropriate the benefits of cheap and attractive applications in its pricing of the platform. To the contrary, ICE claims that a platform monopolist has an incentive to innovate and push for improvements in its system — including better applications — in order to profit from a more valuable platform.[75]

For the reasons discussed above, firms may hesitate to enter an applications market where they must compete with the platform provider. More generally, efficient applications competition can be problematic if one of the competitors controls the platform.[76] In such cases, ICE teaches that platform providers may choose to stay out of (or exit from) the applications market altogether as a means of ensur-

74. That is, the platform provider makes an extra $40 per user at the cost of only $30 per user of reduced value. Admittedly, the assertion that this increases total value rides on an assumption that excluded applications firms do not capture more than the $10 difference in pure profits.

75. *See, e.g.*, United States v. Microsoft Corp., 84 F. Supp. 2d 9, 26 (D.D.C. 1999) ("[I]f there are innovations that will make Intel-compatible PC systems attractive to more consumers, and those consumers less sensitive to the price of Windows, the innovations will translate into increased profits for Microsoft.").

76. *See, e.g.*, Farrell, *supra* note 71, at 421–24.

ing efficient competition in that market. (Palm's recent break-up may illustrate such a motive.)

The more ambitious version of ICE is a close kin to the "one monopoly profit theory,"[77] which dates back to early Chicago School thinking and the later work of Richard Posner and Robert Bork.[78] But the "one monopoly profit" label[79] captures only part of ICE. It claims that a platform monopolist cannot gain by inefficiently leveraging its market power into applications: this is ICE's claim that where competition in the applications market is efficient, the platform monopolist will protect it. But ICE goes further, stressing the broader principle that the platform monopolist gains from an *efficient* applications market — whether that be unbridled competition, integration without independents, licensing of a limited set of independents, or some attempt to combine these or other structures. The "one monopoly profit" label fails to suggest this broader point. In sum, ICE better conveys the claim that the platform monopolist has an incentive to be a good steward of the applications sector for its platform[80] and thus better captures the argument for laissez-faire vertical policies.

The stronger form of ICE largely explains modern antitrust law's reluctance to worry broadly about spillovers and leveraging of market power. It also underlies the basics of Chicago School doctrine, as well as its more ambitious arguments for the per se legality of tying ar-

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77. Judge Posner has outlined the argument succinctly for the case where the complement is an input into the platform product:

> But the bare fact that a firm has monopoly power in Market X does not imply that it will have an incentive to obtain monopoly power over Y, an input into X. In general a monopolist like any other firm wants to minimize its input costs; the lower those costs are, the greater the monopoly profits it will be able to make. Therefore the rational monopolist will usually want his input markets to be competitive, for competition usually will minimize the costs that he has to pay for his inputs.

Olympia Equip. Leasing Co. v. W. Union Tel. Co., 797 F.2d 370, 374 (7th Cir. 1986); *see also* POSNER, *supra* note 68, at 200–02.

78. The classic statement of the Chicago School position came in Ward S. Bowman, Jr., *Tying Arrangements and the Leverage Problem*, 67 YALE L.J. 19 (1957). The orthodox restatements of it came in RICHARD A. POSNER, ANTITRUST LAW: AN ECONOMIC PERSPECTIVE 171–84 (1976) and ROBERT H. BORK, THE ANTITRUST PARADOX 372–75 (1978).

79. *See* BORK, *supra* note 78, at 229 ("[V]ertically related monopolies can take only one monopoly profit."); RICHARD A. POSNER & FRANK H. EASTERBROOK, ANTITRUST 870 (2d ed. 1981) ("There is only one monopoly profit to be made in a chain of production."). Judges, too, have used the "one monopoly profit" label. *See, e.g.*, Town of Concord v. Boston Edison Co., 915 F.2d 17, 23 (1st Cir. 1990) (Breyer, J.); W. Resources, Inc. v. Surface Transp. Bd., 109 F.3d 782, 787 (D.C. Cir. 1997).

80. In this spirit, some commentators have argued that intellectual property holders should be able to control the development and deployment of complementary products. *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 277–78 (1977); *see also* Lichtman, *supra* note 58, at 615. *But see* SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES (forthcoming 2004) (manuscript ch. 5, on file with authors).

rangements.[81] Surprisingly (and, as we see below, not always correctly), it suggests that antitrust and regulation should generally not worry even if an integrated firm engages in behavior within the applications market that is plainly exclusionary.

IV. HOLES IN THE ICE: WHEN ITS LOGIC CAN FAIL

ICE is a central organizing principle for the analysis of vertical competitive effects. But its claims do not always hold. In this Part, we explain eight ways in which it can fail: (1) Baxter's Law; (2) price discrimination; (3) potential competition; (4) bargaining problems; (5) incompetent incumbents; (6) option value; (7) regulatory strategy; and (8) incomplete complementarity. There are other exceptions,[82] but we find these eight particularly relevant to the information industries.

A. Baxter's Law

Even classical Chicago School adherents concede an exception to ICE where the platform (the core monopoly) is subject to regulation but the applications market is not.[83] The economics of "Baxter's Law" echo the ICE argument itself: ICE argues that a monopolist can capture in its platform profits improvements in consumer value in applications, but it generally cannot do so if the platform price is regulated. Thus, regulated platform prices can lead a monopolist to relate differently to the applications market than ICE would ordinarily suggest.

Two simple economic reasons underlie Baxter's Law. First, suppose that there is an "ideal" price cap that constrains the price of the platform product and that will not respond if platform-level profits change over time. Now consider how the regulated platform monopolist will view an opportunity to raise the price of applications and take a profit there. Assuming fixed one-to-one proportions between the platform and the applications market, suppose that the platform pro-

81. *See* BORK, *supra* note 78, at 288 (arguing that all vertical restraints should be per se legal).

82. *See* Steven C. Salop & R. Craig Romaine, *Preserving Monopoly: Economic Analysis, Legal Standards, and Microsoft*, 7 GEO. MASON L. REV. 617, 625 (1999).

83. *See* Olympia Equip. Leasing Co. v. W. Union Tel. Co., 797 F.2d 370, 374 (7th Cir. 1986) ("There are, however, special circumstances in which a rational monopolist may want to restrict competition in an input market; as it happens, one of those circumstances is where the monopolist's rates are regulated."); Jefferson Parish Hosp. Dist. No. 2 v. Hyde, 466 U.S. 2, 36 n.4 (1984) (O'Connor, J., concurring) ("In a regulated industry a firm with market power may be unable to extract a supercompetitive profit because it lacks control over the prices it charges for regulated products or services. Tying may then be used to extract that profit from sale of the unregulated, tied products or services." (citations omitted)). Bowman's initial argument contemplated this exception, *see* Bowman, *supra* note 78, at 22, but later commentators criticized this argument as too deferential to the regulatory process. *See* Louis Kaplow, *Extension of Monopoly Power Through Leverage*, 85 COLUM. L. REV. 515, 522 n.26 (1985).

vider can take an additional profit of $1 per unit in the applications market by monopolizing that market. As ICE stresses, this profit potential lowers the profit-maximizing price for its platform by $1 (in the simplest case), given the level of platform sales. But whereas this "normally" lowers platform profits by $1, it may have a far smaller effect on platform profits when the platform price is already regulated below the profit-maximizing level.[84] In a sense, the platform provider can compensate for the fact that its platform is priced below the profit-maximizing price by taking additional — and perhaps otherwise inefficient — profits in the applications market.

The second reason for Baxter's Law does not apply under an ideal price cap but does hold under some other common forms of price regulation. Suppose that the platform provider is regulated in a rate-of-return fashion, or by a price cap that responds over time to changes in platform profits. Then, by raising the price of its application product by $1 and gaining profits there, a platform provider would benefit on balance even if in the short term its profits in the platform market would fall by the full $1, because the regulatory process will over time make its platform operations whole and restore that "lost" $1.

This exception to ICE has figured prominently in telecommunications policy.[85] In particular, the Bell System allegedly leveraged its way to market power in complementary markets, denying equal access to its network to competitors in long distance and equipment manufacturing.[86] By excluding such competitors, AT&T could rent telephones to its customers and sell equipment from its Western Electric affiliate to its operating companies or telephone subscribers at inflated rates. Such a strategy was *available* to AT&T because of its network-level market power, but ICE would claim the option should be *unattractive* because it would decrease demand for telephone sub-

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84. The loss of demand is the $1 divided by the absolute slope of the demand curve, so it is -dx/dp, or (-dx/dp)/x per unit sales. Multiplying by the gross margin (p-MC) gives (p-MC)(-dx/dp)/x, or [(p-MC)/p] * (-p/x dx/dp). This is the Lerner markup index times the absolute elasticity of demand; this amounts to 1 if p is profit-maximizing, and is less than 1 if p is below the profit-maximizing level.

85. This issue also emerged in cases involving railroad regulation. *See* N. Pac. R.R. v. United States, 356 U.S. 1, 8 (1958) (noting that land grant sales conditioned on "preferential routing" might well be an example of a tie used as a substitute for an unlawful rebate); *see also* Kaplow, *supra* note 83, at 522 n.26.

86. *See* Roger G. Noll & Bruce M. Owen, *The Anticompetitive Uses of Regulation:* United States v. AT&T, *in* THE ANTITRUST REVOLUTION 328, 339–44 (John E. Kwoka, Jr. & Lawrence J. White eds., 2d ed. HarperCollins 1994), *available at* http://www.oup.com/us/antitrustrevolution (last visited Oct. 29, 2003). In theory, an ideal "global price cap" could restore ICE, but modern telecommunications regulation rarely focuses on this goal, instead aiming to deregulate workably competitive segments. For more extensive discussions of the relationship of ICE to regulation, see JEAN-JACQUES LAFFONT & JEAN TIROLE, COMPETITION IN TELECOMMUNICATIONS (2000); B. Douglas Bernheim & Robert D. Willig, The Scope of Competition in Telecommunications (1996) (unpublished manuscript, on file with authors); and MARK ARMSTRONG ET AL., REGULATORY REFORM: ECONOMIC ANALYSIS AND BRITISH EXPERIENCE (1994).

scription. But that decrease did not deter AT&T because of the price regulation of local telephone service. In the Carterfone decision and its aftermath, the FCC imposed an "unbundling" requirement on AT&T to prevent it from requiring consumers to rent phones, and thereby opened the customer premises equipment ("CPE") market to competition.[87] This issue was at the heart of the government's antitrust case against AT&T, even though AT&T's long-distance rates — like its local ones — were regulated.[88] Because then-Assistant Attorney General Baxter highlighted this hole in ICE in championing the consent decree that broke up AT&T, this exception is termed "Baxter's Law" or the "Bell Doctrine."[89]

B. Price Discrimination

Participating in, or dominating, the applications market can help a platform monopolist to price discriminate; this objective may make even inefficient vertical leveraging profitable.[90] Control over applications can help a platform monopolist to engage in price discrimination, charging different markups on combinations of the platform with different sets of applications.[91] It can customize its offerings for different buyers, separating "inframarginal" customers who are willing to pay more, from "marginal" customers who would switch to other alternatives in the face of a price increase.[92] Price discrimination is familiar in airline travel, where airlines use various means to segment

87. *See supra* note 34 and accompanying text.

88. AT&T was federally regulated as a dominant carrier in the interstate long-distance market until 1995. *See* Motion of AT&T Corp. to be Reclassified as a Non-Dominant Carrier, 11 F.C.C.R. 3271, ¶¶ 10–13 (1995) (Order) (ending rate regulation of AT&T in the long-distance market). The fact that AT&T faced regulation in its complementary markets — both in long distance and, in some cases, in CPE — suggests that the justification for regulatory action based on Baxter's Law is more complicated than often appreciated. Three possible variations on this classic explanation might address this complication. First, areas that regulation did not address — such as certain CPE markets, particularly where AT&T sold equipment to itself — may have been open to abuses. Second, imperfections of regulation may have enabled the AT&T monopoly to take greater advantage of consumers by providing both the monopoly and complementary service — i.e., the end of vertical integration helped consumers by facilitating better regulation. Finally, the ability to prevent competition might have helped AT&T to forestall innovation in complementary markets that would force it to depreciate its sunk investments more quickly than it wished.

89. *See supra* note 40 and accompanying text.

90. Proponents of the "leverage theory" of tying regularly invoke this explanation. *See, e.g.*, Lawrence A. Sullivan, *Section 2 of the Sherman Act and Vertical Strategies by Dominant Firms*, 21 SW. U. L. REV. 1227, 1237 (1992); *see also* Kaplow, *supra* note 83, at 523 ("[P]ractices merely increasing profits to an existing monopoly, without 'extending' it, can increase the welfare loss that results.").

91. For example, in the Internet environment, customer identity might be more readily tracked through the complement than through the platform product.

92. For a discussion and explanation of the difference between "marginal" and "inframarginal" customers, see James A. Keyte, *Market Definition and Differentiated Products: The Need for a Workable Standard*, 63 ANTITRUST L.J. 697, 739–45 (1995).

the market and extract premium prices from inframarginal business travelers who cannot plan in advance. In telecommunications, both incumbents and entrants practice price discrimination by offering different tiers of packages or sets of offerings to different customers.[93]

Price discrimination need not in itself be inefficient or anti-consumer, but the platform monopolist's desire to price discriminate can outweigh ICE and lead it to exclude efficient innovation or price competition in complementary products. In the classic case, the monopolist does so more or less intentionally because control of the complementary market allows it to maximize profits through large markups on complementary goods — for example, the substantially higher ticket prices charged to first class airline passengers for better meal service.[94] In other cases, profit maximizing price discrimination involves *below*-cost pricing of complements. The platform provider has no motive to exclude such offerings per se and probably would be delighted if independent complementors were to offer cheap and innovative offerings; independent developers, however, may refrain from providing such products where the platform provider offers its own complements below cost.[95]

Economists recognize that price discrimination can either harm or benefit consumers overall (and is likely to harm some and benefit others).[96] Some forms of price discrimination, like Ramsey pricing,[97] can raise profits at the lowest possible cost to consumers as a group, and

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93. *See, e.g.*, Tiffany Kane, *Legislators Laud Debut of Covad's Service* (June 19, 2002) (reporting on Covad's tiered pricing structure), *at* http://news.com.com/2100-1033-937523.html (last visited Oct. 29, 2003); *see also* CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES 300 (1998) (indicating that price discrimination is predictably prevalent in information industries).

94. This, of course, does not explain why the platform monopolist seeks to co-opt and tame independent innovation rather than welcoming it. But allowing independent innovation while restricting the available independent product offerings to facilitate price discrimination may prove either infeasible or unadministrable.

95. *See* Farrell & Katz, *supra* note 56 (formally modeling such an effect). A platform provider could alternatively offer a uniform subsidy to independent as well as its own complements, which might avoid this problem but raise others.

96. *See* Richard A. Posner, *The Chicago School of Antitrust Analysis*, 127 U. PA. L. REV. 925, 926–28 (1979) (explaining how price discrimination can reduce the "misallocative effects of monopoly"). Moreover, if price discrimination increases output and thus generates economies of scale and/or "learning by doing" efficiencies, unit cost of production will drop. *See* Jerry Hausman & Jeffrey MacKie-Mason, *Price Discrimination and Patent Policy*, 19 RAND J. ECON. 253, 257 (1988). Finally, even if price discrimination is harmful, policies to limit it may have unintended consequences, such as leading firms to use cruder means of achieving the same purpose. *See* Hal R. Varian, *Price Discrimination*, *in* 1 HANDBOOK OF INDUSTRIAL ORGANIZATION 597, 644–46 (Schmalensee & Willig eds., 1989); Hausman & MacKie-Mason, *supra*, at 257.

97. As Justice Breyer explained, "Ramsey pricing is a classical regulatory pricing system that assigns fixed costs in a way that helps maintain services for customers who cannot (or will not) pay higher prices." AT&T v. Iowa Util. Bd., 525 U.S. 366, 426 (1999) (Breyer, J., concurring in part and dissenting in part).

this is valuable where profits are an important spur to innovation.[98] Thus modern economics is not generally hostile to price discrimination.

As a result, some commentators do not see price discrimination as an exception to ICE.[99] But it is. Even where price discrimination itself *enhances* efficiency, the platform monopolist may impose highly inefficient restrictions on applications competition in order to engage in price discrimination.

To illustrate, consider the attitude of cable providers toward streaming video applications over their cable modems. ICE would suggest that cable providers should happily endorse this use of their platform, as it would make the platform more valuable to users and therefore more profitable. But a cable provider who allows video streaming will find it harder to engage in the profitable and customary price discrimination that sets high markups for premium cable programming. Thus, a cable provider might rationally, but inefficiently, try to stop this innovative method of distribution.[100]

C. Potential Competition

Platform monopolists will evaluate actions in complementary markets through two lenses. On the one hand, ICE reminds us that the platform franchise often is worth more when the complement is efficiently supplied. On the other hand, competition in the complement can sometimes threaten the primary monopoly.[101] Thus, even if a two-

98. *See* Hausman & MacKie-Mason, *supra* note 96, at 263 (allowing for price discrimination in the sale of a patented product can spur innovation and thus substitute for longer intellectual property protection).

99. *See, e.g.*, Town of Concord v. Boston Edison Co., 915 F.2d 17, 24 (1st Cir. 1990); BORK, *supra* note 78, at 241–42; POSNER, *supra* note 68, at 203–06.

100. For an anecdotal suggestion that cable providers may fear such effects, see David Lieberman, *Media Giants' Net Change Major Companies Establish Strong Foothold Online*, USA TODAY, Dec. 14, 1999, at B3 (reporting that Dan Somers, CEO of AT&T Broadband, dismissed suggestions that it would allow video streaming of programming on the ground that "AT&T did not spend $56 billion to get into the cable business 'to have the blood sucked out of our veins'").

101. Some have argued that this point adds a dynamic element to the analysis that the traditional Chicago School model lacks. *See* Kaplow, *supra* note 83, at 524, 527–29 (arguing that a monopolist's "motivation is to change the structural conditions it faces in the future in order that it may receive greater profits," and contrasting "dynamic" and "static" approaches); *see also* Steven C. Salop & R. Craig Romaine, *Preserving Monopoly: Economic Analysis, Legal Standards, and Microsoft*, 7 GEO. MASON L. REV. 617, 625–26 (1999) (discussing the "preserving monopoly theory" that posits that vertical integration can be used "to impede the efforts of firms that might reduce the monopolist's power and thereby cause it to reduce its prices, increase innovation or perhaps lose out to a superior rival"); Herbert Hovenkamp, *Antitrust Policy After Chicago*, 84 MICH. L. REV. 213, 261 (1985) (criticizing Chicago School orthodoxy as focused on "static" analysis and unable to take account of "strategic behavior"). For an economic model of tying strategy, see Dennis W. Carlton & Michael Waldman, *The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries*, 33 RAND J. ECON. 194 (2002).

level monopoly may not yield more than one monopoly profit, it can protect the monopolist against entry in several ways.[102]

First, if there are no independent applications suppliers, any potential platform rival would need to enter at both the platform and applications levels.[103] This "two-level entry" theory is familiar to both telecommunications regulation and antitrust policy. For example, the program access provisions of the Cable Policy Act of 1992 give satellite firms access to cable networks affiliated with rival cable operators in order to ensure that satellite providers can compete effectively with cable and are not hindered by a lack of programming availability.[104]

The two-level entry theory also underlaid the Justice Department's challenge to General Electric's licensing policies for medical imaging equipment. The company had contractually restricted hospitals from servicing the equipment of other hospitals. The DOJ argued that these restrictions illegally raised barriers to entry in the market for medical imaging equipment.[105] If hospitals' service staffs learned to service outside equipment, new equipment providers would need only to enter the equipment market, relying on hospital service staffs to service their own equipment and that of other hospitals.[106] Thus, this case fits our framework, with equipment playing the role of the "platform" and service the role of "applications."

Second, complements may ultimately make possible substitutes for the platform. In the *Microsoft* case, for example, Netscape's web

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102. In his *Town of Concord* opinion, then-Chief Judge Breyer set out this justification:

> Insofar as it is more difficult for a firm to enter an industry at two levels than at one, the monopolist, by expanding its monopoly power, has made entry by new firms more difficult. And insofar as the monopolist previously set prices cautiously to avoid attracting a competitive challenge, the added security of a two-level monopoly could even lead that monopolist to raise its prices.

915 F.2d at 23–24; *see also* Matsushita Elec. Indus. Co. v. Zenith Radio Corp., 475 U.S. 574, 591 n.15 (1986) ("[W]ithout barriers to entry, it would presumably be impossible to maintain supracompetitive prices for an extended time."); POSNER, *supra* note 68, at 202 ("[T]he possibility that tying might discourage entry into the monopolized market for the tying product cannot be excluded altogether."). For an argument along these lines, see Jay Pil Choi & Christodoulos Stefanadis, *Tying, Investment, and the Dynamic Leverage Theory*, 32 RAND J. ECON. 52 (2001) and Jay Pil Choi, *Preemptive R&D, Rent Dissipation, and the "Leverage Theory,"* 111 Q. J. OF ECON. 1153 (1996).

103. Artificially created entry barrier issues emerged as an early post-Chicago School concern. *See, e.g.*, Jonathan B. Baker, *Recent Developments in Economics That Challenge Chicago School Views*, 58 ANTITRUST L.J. 645, 651–52 (1989).

104. *See* 47 U.S.C. § 548(c)(5) (2000); Implementation of Cable Television Consumer Protection and Competition Act of 1992, 16 F.C.C.R. 19074 (2001) (Notice of Proposed Rulemaking); News Release, FCC, FCC Extends Program Access Exclusivity Rules (June 13, 2002), *at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-223381A1.doc (last visited Oct. 29, 2003).

105. *See* Competitive Impact Statement at 4–5, United States v. Gen. Elec. Co., No. CV-96-121-M-CCL, 1999 U.S. Dist. LEXIS 598 (D. Mont. Jan. 11, 1999), *at* http://www.usdoj.gov/atr/cases/f1800/1842.htm (last visited Oct. 29, 2003).

106. *See id.*

browser was a complementary application in the short term, but could have facilitated operating systems competition in the long term.[107] By exposing its own application programming interfaces, the browser could ultimately "commoditize" the underlying operating system.[108] As the district court found (and the court of appeals affirmed), Microsoft concluded that this was a serious threat to its core monopoly and undertook a campaign to undermine Netscape's browser.[109]

Finally, independent providers of complements may themselves be likely entrants into the platform market. Carl Shapiro, a leading economist, recently concluded that while "network monopolies can be very strong, they are most vulnerable to attack by firms in a strong position in a widely-used *complementary product*."[110] Complementors know the market and have an economic interest in lowering the price of the underlying platform (lower platform prices will raise demand for their product). For the same reason, complementors need not fear a

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107. Lessig has called this scenario a "partial substitute." *See* Brief of Prof. Lawrence Lessig as Amicus Curiae at 46–47, United States v. Microsoft Corp., 87 F. Supp. 2d 30 (D.D.C. 2000) (No. 98-1232), *at* http://www.lessig.org/content/testimony/ab/ab.pdf (last visited Oct. 29, 2003). This term, however, does not emphasize the temporal nature of what is often called "middleware." *See* James B. Speta, *Tying, Essential Facilities, and Network Externalities: A Comment on Piraino*, 93 NW. U. L. REV. 1277, 1282 (1999) (pointing out that Microsoft's predatory actions vis-à-vis Netscape can be explained on the ground that Microsoft viewed the browser as a partial substitute for the operating system); Michael D. Whinston, *Exclusivity and Tying in* U.S. v. Microsoft: *What We Know, and Don't Know*, J. ECON. PERSP., Spring 2001, at 63, 73.

108. For a discussion based on Microsoft's internal documents (as revealed by the trial), see Timothy F. Bresnahan, *Network Effects and Microsoft*, at 23–25, *at* http://www.stanford.edu/~tbres/Microsoft/Network_Theory_and_Microsoft.pdf (last visited Oct. 29, 2003); *see also* Timothy F. Bresnahan, *A Remedy That Falls Short of Restoring Competition*, ANTITRUST, Fall 2001, at 67, 67 [hereinafter Bresnahan, *Restoring Competition*] ("[T]he development of a spectacularly innovative complementary product . . . can lower entry barriers into the monopolized market and create an opening for substitutes to make inroads and competition to emerge.").

109. United States v. Microsoft Corp., 87 F. Supp. 2d 30, 38 (D.D.C. 2000) ("In this case, Microsoft early on recognized middleware as the Trojan horse that, once having, in effect, infiltrated the applications barrier, could enable rival operating systems to enter the market for Intel-compatible PC operating systems unimpeded. Simply put, middleware threatened to demolish Microsoft's coveted monopoly power."), *aff'd,* 253 F.3d 34 (D.C. Cir. 2001); *see also* Bresnahan, *Restoring Competition*, *supra* note 108, at 67–68 (describing Microsoft's campaign).

110. Declaration of Carl Shapiro at 6, United States v. Microsoft Corp., 87 F. Supp. 2d 30 (D.D.C. 2000) (No. 98-1232), *at* http://www.usdoj.gov/atr/cases/f4600/4642.pdf (last visited Oct. 29, 2003); *see id.* (listing examples). To address Microsoft's anticompetitive tactics to defeat a complementary product that threatened its monopoly platform, Shapiro's testimony recommended divesting Microsoft's applications division from its operating systems division in order to create additional competition in the operating systems market. *See id*. at 6–7. *But see* Howard A. Shelanski & J. Gregory Sidak, *Antitrust Divestiture in Network Industries*, 68 U. CHI. L. REV. 1, 99 (2001) (criticizing Shapiro's proposal). On entry by complementors in the computer industry more broadly, see Timothy F. Bresnahan & Shane Greenstein, *Technological Competition and the Structure of the Computer Industry*, 47 J. INDUS. ECON. 1 (1999).

platform monopoly's price cuts or quality enhancements in response to entry as much as a stand-alone entrant would.[111]

In television programming and distribution, the FCC's financial interest and syndication ("finsyn") rules effectively barred the major networks (then ABC, NBC, and CBS) from the programming market and kept the major studios (then Fox, Warner Brothers, and Paramount) out of the network market.[112] In court, however, the FCC failed to justify them and they were invalidated.[113] The studios — who had been the complementary providers of programming — then entered the platform market, creating three new networks. The existing networks likewise moved quickly to create their own programming.[114] Similarly, the Telecommunications Act of 1996 ("Telecom Act") arguably assumed that the long-distance providers — who rely on the local network — were likely entrants into the local telephone market and that the local providers were almost certain entrants into the long-distance market.[115]

D. Bargaining Problems

An independent innovator and a gatekeeping platform monopolist may fail to reach a mutually beneficial access arrangement. We identify two ways in which this can happen. In the simplest such bargaining problem, a complementor develops an innovative application, but transaction costs obstruct agreement with the platform gatekeeper, and the innovation lies fallow.[116] Thus, this problem has an immediate

111. *See* Joseph Farrell, *Prospects for Deregulation in Telecommunications,* 6 INDUS. & CORP. CHANGE 719, 727 (1997).

112. *See* Schurz Communications, Inc. v. FCC, 982 F.2d 1043, 1045–48 (7th Cir. 1992).

113. Judge Posner remarked of the FCC's justification for these rules: "Stripped of verbiage, the opinion, like a Persian cat with its fur shaved, is alarmingly pale and thin." *Id.* at 1050. Many commentators have concurred with Judge Posner's critical assessment. *See, e.g.*, Crandall, *supra* note 40, at 178–79.

114. In so doing, the networks often eschewed outside programming, only much later realizing the benefits of contracting out. *See, e.g.*, Bill Carter, *Ailing ABC Turns to HBO in Search of TV Hits*, N.Y. TIMES, Aug. 5, 2002, at C1 (reporting that, after its initial hesitation, ABC decided not to rely largely on its internal production of programming, but to solicit programming from outside sources). To a degree, therefore, the finsyn rules did protect modularity and prevent vertical integration, whether or not that was desirable.

115. *See* 47 U.S.C. § 271 (2003); *see also* Joel I. Klein, Address before the American Enterprise Institute (Nov. 5, 1997) ("In essence, then, the Act envisions that the local and long distance companies will enter each other's markets and offer new and improved services, including bundled offerings of local and long distance, at better prices to consumers."), *at* http://www.usdoj.gov/atr/public/speeches/1268.htm (last visited Oct. 29, 2003).

116. *See* Michael L. Katz, *Intellectual Property Rights and Competition Policy: Four Principles in a Complex World*, 1 J. TELECOMMS. & HIGH TECH. L. 325, 342 (2002).

impact, and also discourages independent innovations in the longer run.[117]

A second kind of bargaining problem arises if the platform provider threatens to withhold access to the platform unless the application inventor licenses its new application very cheaply. If the inventor reluctantly agrees, this may be an efficient solution after the fact, but the prospect of this outcome discourages future independent invention.[118] Invoking this theory, the Federal Trade Commission ("FTC") complained that Intel's demand for intellectual property licenses from its licensees (complementors) violated the antitrust laws.[119]

Such discouragement of efficient independent innovation might be a problem inherent in closed architectures.[120] In a fully modular structure without a gatekeeper, the innovation could quickly be introduced,[121] and the innovator would profit to an extent commensurate with its innovation. But, in the longer term, ICE suggests a possible self-correcting dynamic: if the platform sponsor thinks that more complementary innovation will be forthcoming as a result, it could set up a private commons or otherwise implement modularity. Microsoft exposes many of its APIs to independent developers, spending money and resources to cooperate with complementary (applications) providers.[122] Similarly, Intel carefully manages its complementors.[123]

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117. Economists would call this the "short run" both because it is immediate and because it is inefficient given the set of applications that have been developed, in contrast to the problem of discouraging innovations.

118. *See* Farrell & Katz, *supra* note 56, at 430 (providing an economic model to support this conclusion).

119. *See* Carl Shapiro, *Technology Cross-Licensing Practices:* FTC v. Intel, *in* THE ANTITRUST REVOLUTION 350, 361–63 (John E. Kwoka, Jr. & Lawrence J. White eds., 4th ed. Oxford Univ. Press 2004).

120. To mitigate these potential barriers to innovation, intellectual property law has sought to develop certain open access doctrines. *See* Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989 (1997). For an argument that copyright law should not allow complementors to access a platform standard through reverse engineering as a means of addressing transaction cost issues, see Lichtman, *supra* note 58, at 637–38. For an argument that patent law should give second-generation inventors legal protection to facilitate fair arrangements with original inventors and to address the hold-up problem, see Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, J. ECON. PERSP., Winter 1991, at 29. Moreover, real property law also recognizes that "strategic behavior" can prevent a socially desirable arrangement and provides for flexibility in crafting appropriate relief to avoid this outcome. *See, e.g.*, Walgreen Co. v. Sara Creek Prop. Co., 966 F.2d 273, 276–79 (7th Cir. 1992) (Posner, J.).

121. In the Internet environment, for example, the openness of the logical standard allows developers like Napster to introduce applications without first reaching agreement with a network owner. *See supra* notes 20–21 and accompanying text.

122. *See* MICHAEL A. CUSUMANO & RICHARD W. SELBY, MICROSOFT SECRETS: HOW THE WORLD'S MOST POWERFUL SOFTWARE COMPANY CREATES TECHNOLOGY, SHAPES MARKETS, AND MANAGES PEOPLE 166–74 (1995). Under the proposed consent decree reached with the Justice Department, Microsoft would formalize — and be subject to judicial oversight related to — the disclosure of information on its otherwise proprietary interfaces. *See* Joe Wilcox, *Microsoft Tallies Antitrust Efforts* (Aug. 5, 2002), *at* http://news.com/2100-1009-948440.html (last visited Oct. 29, 2003).

A platform monopolist may find it hard to make a credible commitment to modularity. One way may be to stay out of the complementary sector altogether. Just as in the *AT&T* case, where the Justice Department was skeptical that equal access was credible without divestiture and quarantine, some platform gatekeepers think their complementors will find voluntary quarantine the best guarantee of fair treatment. This could involve spinning off divisions, as AT&T and Palm did.

E. Incompetent Incumbents

A platform monopolist will not behave as ICE predicts if it fails to understand ICE. Some applications of ICE are surprising even for professional economists.[124] Thus, even if there is only one monopoly profit, some may think otherwise and inefficiently seek a second.[125] And even when top management appreciates ICE, other employees may not.[126]

In our experience, businesspeople are often reluctant to help outside firms compete against internally supplied applications.[127] This may be particularly likely if the benefit of modularity comes in the form of "a hundred flowers" of diverse paths of innovation in the

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123. On Intel's strategy, see GAWER & CUSUMANO, *supra* note 26, at 15–38. For related antitrust issues concerning Intel, see Intel Corp., 64 Fed. Reg. 20134 (Fed. Trade Comm'n Apr. 23, 1999) (Analysis to Aid Public Comment and Commissioner Statements) and Intergraph Corp. v. Intel Corp., 195 F.3d 1346 (Fed. Cir. 1999). For an economic model that explains "the theoretical rationale for the contrast between Intel's stated concern for complementors and its inability to fully commit not to behave aggressively towards them," see David Miller, *Invention Under Uncertainty and the Threat of Ex Post Entry* (June 20, 2003), *at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=319180 (last visited Oct. 29, 2003). *See also* Farrell & Katz, *supra* note 56.

124. For example, consider competition when a platform monopoly such as an incumbent local exchange company ("ILEC") charges an "access charge" above marginal cost to its downstream rivals (for example, long-distance providers). If demand is totally inelastic, ICE implies that no imputation rule is necessary to ensure that the ILEC should charge itself the same access charge as it charges rivals. *See, e.g.*, Farrell, *supra* note 71, at 423. In our experience, however, this "opportunity cost argument" is not obvious to policymakers, businesspeople, or even distinguished economists.

125. *See* Kaplow, *supra* note 83, at 548–49 ("[O]ne might argue that even if a leveraging strategy is unprofitable or doomed to complete failure in the long run, many firms cling to a misguided belief that they can succeed.").

126. Some courts have acknowledged this possibility. For example, the court in *Time Warner Entertainment Co. v. FCC* noted that a company may be "reluctant to ditch or curtail an inefficient in-house operation because of the impact on firm executives or other employees, or the resulting spotlight on management's earlier judgment." 240 F.3d 1126, 1138 (D.C. Cir. 2001). Such resistance to change might be rational for individual managers wanting to avoid the detection of their own mistakes, but irrational for the company as a whole, which would suffer from the lack of superior applications for its platform product. In economics, this is called a "principal-agent" problem.

127. *See, e.g.*, Bruce T. Allen, *Vertical Integration and Market Foreclosure: The Case of Cement and Concrete*, 14 J. L. & ECON. 251, 270–72 (1971) (offering this explanation for vertical integration).

complement.[128] Incumbents may fail to imagine the potential benefits of increased competition in the market for applications, and thus fail to implement modularity even when it would spur greater innovation and thus increase their platform profits.

ICE's insights for business strategy may be particularly hard to see for industries emerging from a regulated environment of end-to-end service.[129] ICE-aware business commentators have argued that the customer relationship business, the product innovation business, and the infrastructure business can be "unbundled" from one another to great efficiency benefits,[130] but that regulated incumbent firms often miss this opportunity.[131] Thus, two commentators claim that the local telephone companies have "deliberately limited the growth and profitability of their infrastructure businesses to protect their customer relationship businesses."[132]

ICE-savvy commentators also argue that Apple erred in the early 1980s by not licensing its operating system so that others could build computer systems around it.[133] Apple had developed an operating system widely viewed as better than Microsoft's MS-DOS (which IBM and others licensed),[134] but thought it could make more money by

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128. This recalls Mao Tse-Tung's famous adage: "Let a hundred flowers bloom, let a hundred schools of thought contend." THE ENCYCLOPEDIA OF WORLD HISTORY (Peter N. Stearns ed., Houghton Mifflin CD-ROM 6th ed. 2001), *available at* http://www.bartleby.com/67/4149.html (last visited Nov. 30, 2003). For explorations of the economics of innovation and diversity, see Raaj Kumar Sah & Joseph E. Stiglitz, *The Invariance of Market Innovation to the Number of Firms*, 18 RAND J. ECON. 98 (1987) and Joseph Farrell et al., *Market Structure, Organizational Structure, and R&D Diversity*, *in* ECONOMICS FOR AN IMPERFECT WORLD (Richard Arnott et al. eds., 2003).

129. *See* Clifford Winston, *U.S. Industry Adjustment to Economic Deregulation*, J. ECON. PERSP., Summer 1998, at 89, 89 (stating that, under the influence of regulation, "managers and employees of regulated firms settle into patterns of inefficient production and missed opportunities for technological advance and entry into new markets"); *id.* at 98 (noting that it takes time for the management of formerly regulated monopolists to move to a more entrepreneurial culture).

130. *See* John Hagel III & Marc Singer, *Unbundling the Corporation*, MCKINSEY Q., 2000, No. 3, at 148, *available at* http://www.optimizemagazine.com/mckinsey/2002/0408.htm (last visited Oct. 29, 2003).

131. *See id.* This concern underlies the much-discussed proposal of imposing a wholesale-retail separation of the incumbent local telephone providers' operations. For debate on this, compare Beard et al., *supra* note 67, at 421 (2002) with Robert W. Crandall & J. Gregory Sidak, *Is Structural Separation of Incumbent Local Exchange Carriers Necessary for Competition?*, 19 YALE J. ON REG. 335 (2002).

132. Hagel & Singer, *supra* note 130, at 154.

133. *See* Charles R. Morris & Charles H. Ferguson, *How Architecture Wins Technology Wars*, HARV. BUS. REV., Mar.–Apr. 1993, at 86, 90 (noting how Apple's refusal to open the Macintosh platform hurt it in the marketplace); *see also* Joseph Farrell, *Standardization and Intellectual Property*, 30 JURIMETRICS J. 35, 42 (1989) ("As the IBM PC experience reminds us, moreover, a technology may be much more likely to set a standard if its owner chooses to renounce at least part of the prospective proprietary gains, by making the system 'open' or by widespread licensing."); Joseph Farrell & Nancy Gallini, *Second Sourcing as a Commitment: Monopoly Incentives to Attract Competition*, 103 Q. J. ECON. 673 (1988).

134. *See* Stanley M. Besen & Joseph Farrell, *Choosing How to Compete: Strategies and Tactics in Standardization*, J. ECON. PERSP., Spring 1994, at 117, 118.

bundling the operating system with its own computers. Thus, considered as an operating system platform provider, Apple bet on its own production and distribution channel rather than on a competitive hardware sector. Whether it failed to see that it was making this bet or simply overrated its hardware and distribution prowess, Apple lost the chance to be the leading producer of operating systems, realizing too late that it would have done better to promote an open architecture.[135]

If incumbents do not always fully understand ICE, what policy implications follow? Sensibly, public policy does not normally let courts or regulators tell a business how to maximize its profits.[136] Similarly, the antitrust laws and regulatory policy generally do not seek to correct business strategy failures.[137] Although we agree with this reluctance to second-guess platform providers' calculations of their best interests, one lesson does follow: the less we can count on a monopolist to be efficient even on its own terms, the more we should value platform-level competition, perhaps especially diverse competition.[138] In the case of Apple, for example, the presence of a rival platform protected customers; it also made the punishment for Apple's error more striking and more visible. Even monopolists who fail to understand ICE are punished with lower profits, but the punishment is sharper or at least more visible when there is competition among platforms. Thus, the arcane complexities of ICE and its implications boost the (already strong) case for platform-level competition.[139]

If, as Judge Posner claims, an economics-based approach has won in antitrust,[140] we urge that this salutary triumph be leavened by recognizing that competition protects not only against powerful firms with bad incentives (on which economics-based antitrust mainly focuses), but also against powerful firms with incompetent or dishonest management. When a firm fails to optimize modularity (or anything else) in a fully competitive industry, its shareholders suffer, but customers broadly do not. When a monopoly fails to do so, however, cus-

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135. On the inferiority of Apple's strategy, see Langlois & Robertson, *supra* note 43, at 308–12.

136. For example, the "business judgment rule" used in corporate law instructs courts not to substitute their judgment for business decisions in assessing liability, provided that the decision at issue "can be attributed to any rational business purpose." *See* Sinclair Oil Corp. v. Levien, 280 A.2d 717, 720 (Del. 1971).

137. *See* William Baxter, *Legal Restrictions on Exploitation of the Patent Monopoly: An Economic Analysis*, 76 YALE L.J. 267, 318 (1966) (rejecting use of "antitrust laws to assure that private economic interests are perceived correctly"); Kaplow, *supra* note 83, at 549 (stating that the "purpose of the antitrust laws is not to improve the effectiveness of management").

138. The importance of such competition is elaborated in Weiser, *supra* note 57.

139. In evaluating, for example, mergers between platform providers, antitrust enforcers should be mindful of the competitive impact related to the loss of rival platforms and the associated experimentation that arises from such platform diversity.

140. *See* POSNER, ANTITRUST LAW, *supra* note 68, at ix.

tomers often suffer. Antitrust and regulation should thus aim to protect against incompetent monopolies as well as against rapacious ones.

F. Option Value

Perversely, fear of access regulation may itself discourage a firm from opening its platform. After a monopolist allows open access to its platform, it may not later be allowed to pursue a closed or fully integrated strategy. Under current antitrust jurisprudence, for example, a firm is far more likely to get into trouble for closing a previously open platform than for never opening it in the first place.[141] Some commentators and judges have noted the adverse ex ante effect of imposing liability for changing a cooperative practice and have cautioned courts against imposing such liability,[142] but the fear of such liability will not dissipate any time soon. Consequently, a firm may keep its platform closed even if opening it would be more profitable, if the option value of later being able to close it is important.

Thus, suppose that the platform provider can extract $10 of profits per customer in applications by monopolizing that market and knows the demand for its platform that will result, but is uncertain about how much more valuable the platform would be to its customers if applications were competitively supplied. Suppose in particular that the firm thinks it equally likely that customers will value the platform at only $6 more (the advantages of applications competition are small) or that customers will value the platform at $12 more (competitively supplied applications are very valuable). Then the efficient path, which also (as in ICE) maximizes the firm's overall profits, is to open the platform initially, learn how much customers value that openness, and leave it open if customers turn out to value open competition in applications at $12, but close it and take over the applications market if they turn out to value openness at only $6.

But if that path is prohibited (or will attract antitrust liability), the firm must choose between opening the market forever and keeping it closed. Note that an equal chance of a $6 or $12 boost to platform demand (from applications competition) is worth less than the $10 applications profits. Therefore, if denied the option to close the plat-

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141. *See, e.g.*, Aspen Skiing Co. v. Aspen Highlands Skiing Corp., 472 U.S. 585, 603 (1985); Eastman Kodak Co. v. Image Technical Servs., Inc., 504 U.S. 451, 483 (1992). For a sense of the debate over these cases, compare Dennis W. Carlton, *A General Analysis of Exclusionary Conduct and Refusal to Deal — Why* Aspen *and* Kodak *Are Misguided*, 68 ANTITRUST L.J. 659, 668–71 (2001) (criticizing these cases) with Jonathan B. Baker, *Promoting Innovation Competition Through the* Aspen/Kodak *Rule*, 7 GEO. MASON L. REV. 495, 501–02 (1999) (endorsing these cases).

142. *See, e.g.*, Olympia Equip. Leasing Co. v. W. Union Tel. Co., 797 F.2d 370, 376 (7th Cir. 1986).

form later (should customers value openness at only $6), the firm will inefficiently close the platform *ab initio*.[143]

G. Regulatory Strategy Considerations

A second "iatrogenic"[144] exception to ICE arises if a firm thinks allowing open access in one context will increase its regulatory duties elsewhere. For instance, a broadband transport provider might refuse to open its platform even where open access increases its profits, because it does not want to risk having to provide access elsewhere. Thus, competitive provision of broadband Internet service might add value to a cable broadband transport product, but in another, related market — say, video content — competitive providers will hurt the cable company's core product offering. If the company believed that opening up its pipe to ISPs would make it substantially more likely to have to open up to video providers, it might rationally resist open access even for ISPs. Similarly, it is unclear why AT&T would have disliked the Hush-A-Phone itself, but it might well have feared that welcoming it would have created a precedent for other attachments. In this way, the likely response of law and regulation can affect a firm's stance toward modularity.

Some firms may be more inclined than others to believe that "their" regulators will extrapolate across markets. Certainly, regulators do sometimes do so, using benchmarking between regional monopolists in devising public policy.[145] Thus, in the cable market, they may seek to preserve cable firms with different sets of assets or business strategies on the view that some cable firms will be more willing than others to experiment with open access arrangements.

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143. A version of ICE survives: with the efficient path unavailable, the firm chooses efficiently among those that remain. But this may be cold comfort to both the firm and the rest of society.

144. This term literally means "induced in a patient by a physician's activity, manner, or therapy." AMERICAN HERITAGE DICTIONARY 867 (4th ed. 2000), *available at* http://dictionary.reference.com/search?q=iatrogenic (last visited Oct. 29, 2003).

145. This rationale underlaid the creation of different regional companies as part of the AT&T consent decree. *See* United States v. W. Elec. Co., 993 F.2d 1572, 1580 (D.C. Cir. 1993) ("[T]he existence of seven [Bell Companies] increases the number of benchmarks that can be used by regulators to detect discriminatory pricing . . . in evaluating compliance with equal access requirements . . . ."). Similarly, in approving the SBC/Ameritech merger, the FCC recognized lost benchmarking opportunities as a harm caused by the merger. *See* Ameritech Corp., 14 F.C.C.R. 14712, ¶ 5 (1999) (Memorandum Opinion and Order) ("The merger will substantially reduce the Commission's ability to implement the market-opening requirements of the 1996 Act by comparative practice oversight methods."). In that proceeding, one of us (Farrell) made this very argument on behalf of Sprint Corporation. Note that differences among regional monopolies may be what causes them to choose different strategies, so it is arguable whether regulators should be willing, a priori, to impose on one monopoly what another seemingly similarly situated one finds acceptable.

H. Incomplete Complementarity

If applications can be valuable without the platform, platform providers may profit by monopolizing the applications market. As Michael Whinston has explained, this exception to ICE arises where (1) the platform is not essential for all uses of the application (creating the incentive), and (2) there are economies of scale or network effects in the application (creating the opportunity).[146] Consider for instance a restaurant on a beach resort that some travelers visit for day trips, while others stay for a week. A monopolist hotel might profitably bundle the complement (meals) with its core offering (rooms) if doing so would foreclose the restaurant market to rivals. As ICE insists, raising the price of meals lowers longer-stay visitors' willingness to pay for rooms (if they know about it before booking), but part of the profits on meals will be extracted from day-trippers and of course the higher meal prices cannot reduce their demand for rooms.

In the information industries there are often strong complementarities between platforms and applications, so we have assumed in our exposition that applications are strict complements with the platform. In reality, however, an application for one platform — say, broadband transport — may also be useful for another — say, narrowband transport — and this may lead the broadband transport provider to try to control the applications market. Thus, this exception could prove important.

V. LESSONS FROM ICE AND ITS EXCEPTIONS, AND TOWARDS A COGENT FRAMEWORK FOR OPEN ACCESS POLICIES

As discussed in Part III, modern antitrust generally supposes that ICE is broadly right with limited and fairly easily diagnosed exceptions, and thus usually permits even dominant firms to make their own vertical choices. Courts and commentators have often heeded the basic ICE argument for skepticism about claims that a monopolist would "leverage" its primary monopoly into a second market,[147] but have often adopted a simplistic form of this logic that does not fully address ICE's exceptions.

In contrast, as telecommunications policy moved away from its disposition toward regulated integration, it turned sharply toward mandating modularity or "openness." The Hush-A-Phone and Carter-

146. *See* Michael D. Whinston, *Tying, Foreclosure, and Exclusion*, 80 AM. ECON. REV. 837, 850–55 (1990).

147. *See, e.g.*, G.K.A. Beverage Corp. v. Honickman, 55 F.3d 762, 767 (2d Cir. 1995) ("Once having achieved the alleged bottling monopoly, therefore, appellees' sole incentive is to select the cheapest method of distribution."); Advo, Inc. v. Phila. Newspapers, Inc., 51 F.3d 1191, 1203 (3d Cir. 1995) (arguing that leveraging theory "makes no sense").

fone decisions, followed by the breakup of the Bell System and the Telecom Act's unbundling provisions, reflect this shift.

Thus, some take ICE very seriously, others take its exceptions very seriously,[148] but few integrate the two in a sophisticated manner. In light of this divide, a central question is whether ICE is the rule, with relatively rare or minor exceptions, or whether ICE is actually the exception.[149] This Part discusses how ICE and its exceptions can help frame and evaluate open access obligations.

In traditional telecommunications markets, the monopoly platform was generally price-regulated, and Baxter's Law provides that ICE does not apply to regulated monopolies.[150] And the Telecom Act's unbundling obligations can be viewed and justified within this tradition. In particular, the Act's ambitious effort to regulate "bottleneck" wholesale inputs, such as the local lines to residential telephone subscribers, aims in part to replace the legacy system of retail regulation.[151] But increasingly, as with broadband platforms, telecommunications regulators confront arguments for open access regulation where the market is not generally price-regulated. To address such arguments in a fashion that is consistent with antitrust policy, policymakers must understand the different regulatory tools for facilitating modularity, the difficult tradeoffs in developing a regulatory regime, and the possible regulatory philosophies for addressing the issue. This Part addresses each issue in turn.

A. Regulatory Strategies to Facilitate Modularity

When a regulator believes (despite ICE) that modularity is both efficient and yet threatened by actual or potential vertical integration, it may seek a remedy. Competitive remedies are often divided into "structural measures" and "conduct remedies."[152] Antitrust law tends

148. For two classic responses to Chicago School thinking, see Lawrence A. Sullivan, *Section 2 of the Sherman Act and Vertical Strategies by Dominant Firms,* 21 SW. U. L. REV. 1227 (1992) and Kaplow, *supra* note 83.

149. *See* Herbert Hovenkamp, *Post-Chicago Antitrust: A Review and Critique*, 2001 COLUM. BUS. L. REV. 257, 278–79 ("The principal difference between Chicago and post-Chicago economic analysis is" the prevalence in the latter of "a complex set of assumptions about how a market works, [which make] anticompetitive outcomes seem more plausible."); *see also* POSNER, *supra* note 68, at 194–95 (maintaining that policy deviations from ICE should be the exception, not the rule). Some "die-hard" Chicagoans believe that vertical arrangements can never have anticompetitive effects (i.e., they believe that there are no exceptions to ICE), but the heavy weight of economic opinion agrees that vertical integration and vertical market restrictions can injure competition in certain cases. *See* Posner, *supra* note 96, at 932 (discussing "die-hard" Chicagoans who refuse to accept subsequent refinements of early Chicago School ideas).

150. *See* Joskow & Noll, *supra* note 40, at 1249–50.

151. For a description of the Telecom Act's market opening strategy, see Philip J. Weiser, *Federal Common Law, Cooperative Federalism, and the Enforcement of the Telecom Act*, 76 N.Y.U. L. REV. 1692, 1733–67 (2001).

152. *See* Shelanski & Sidak, *supra* note 110, at 15–16.

to favor structural measures, both to avoid enmeshing itself in closely regulating behavior and to get at the heart of the incentive and opportunity for the unlawful conduct.[153] Nonetheless, as demonstrated during the debates over remedy in the *Microsoft* case, structural remedies pose their own risks, which may ultimately dispose even antitrust courts towards conduct relief.[154]

The classic and pure structural remedy is a "quarantine" that forbids the platform monopolist from participating in the applications sector. For those who distrust a platform monopolist's stewardship of an applications market, and yet also doubt regulators' ability to stop anticompetitive behavior by other means, this approach remains a favored option.[155] But it precludes (by definition) any integrative efficiencies.[156] In addition, unless the platform/applications boundary is clean and natural, a quarantine risks becoming clumsy and artificial, as (some have argued) the quarantine imposed on the Bell Companies under the AT&T consent decree illustrates.[157]

Recognizing such problems, regulators sometimes try to get the best of both worlds, allowing the platform provider to integrate but trying to ensure that it not abuse its position. The aim is to limit the platform monopolist's behavior in the applications market only to activities associated with integrative efficiency. A fundamental problem with such best-of-both-worlds regulatory strategies is that it is difficult to know whether the anticompetitive effects of a particular approach will outweigh the efficiencies it generates; by and large, stricter rules against anticompetitive problems also risk greater collateral damage to the integrative efficiencies that presumably motivated the rejection of a quarantine. Nonetheless, regulators often seek to develop compromise approaches between quarantine and vertical laissez-faire.

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153. *See, e.g.*, United States v. AT&T, 552 F. Supp. 131, 193 n.251 (D.D.C. 1982), *aff'd sub nom*. Maryland v. United States, 460 U.S. 1001 (1983) (recognizing core economic incentives for anticompetitive conduct and discussing the limitations of antitrust courts in superintending regulatory relief).

154. *See, e.g.*, Shelanski & Sidak, *supra* note 110, at 73–90 (examining the weaknesses of divestiture relief in the *Microsoft* case).

155. *See, e.g.*, Charles H. Ferguson, *The United States Broadband Problem: Analysis and Policy Recommendations*, at 1, 6–8 (Brookings Inst., Policy Brief #105, July 2002), *at* http://www.brookings.edu/comm/policybriefs/pb105.pdf (last visited Oct. 29, 2003).

156. Restrictions on entry may well limit competition in the applications market, but because of the possible countervailing effect, this is not a certainty.

157. *See* United States v. AT&T, 552 F. Supp. 131, 227 (D.D.C. 1982), *aff'd sub nom.* Maryland v. United States, 460 U.S. 1001 (1983) (forbidding the Bell Companies from "provid[ing] interexchange telecommunications services or information services"). For the argument that this quarantine reflected an artificial distinction between local and long-distance telecommunications services, see Mark A. Jamison, *Competition in Networking: Research Results and Implications for Further Reform*, 2002 L. REV. M.S.U.-D.C.L. 621, 622–23.

One intermediate option is a structural separation requirement. Under the Telecom Act, for example, the Bell Companies may enter the long-distance market once certain conditions are met, but must do so through a structurally separate entity.[158] This form of regulation does not necessarily change a firm's ability to discriminate against rivals, but aims to make such discrimination easier to detect and prevent by requiring the firm to deal with its own affiliate at arm's length. This approach may require policing equal access arrangements and overseeing the management of the separate subsidiary (including the imputation of any access charges).[159]

Other intermediate approaches do not control scope or structure, but order the platform provider not to discriminate in certain ways, contrary (presumably) to its assessed incentives. Conduct remedies try to control behavior directly, often requiring ongoing supervision by a regulator or court.[160] Non-structural remedies also include mandated unbundling and compatibility.[161]

Mandated unbundling requires an integrated platform provider to offer the platform without (at least some of) its applications. In its simplest form, mandated unbundling is meant to protect applications competition even for a monopoly platform. When regulators fear that an integrated platform provider will inefficiently hinder independent applications on its platform — presumably because of an exception to ICE — they may mandate that the platform product be truly open to independent applications on terms comparable to those (perhaps only implicitly) given by the platform provider "to itself."

Telecommunications regulators used an unbundling strategy to facilitate competition in the terminal equipment (applications) market

158. *See* 47 U.S.C. § 272 (2003).

159. *See, e.g.*, Amendment of Section 64.702 of the Commission's Rules and Regulations (Second Computer Inquiry), 77 F.C.C.2d 384, ¶ 205 (1980) (Final Decision) (detailing measures imposed on telephone companies to facilitate monitoring of structurally separated subsidiaries) [hereinafter Computer II], *aff'd sub nom.* Computer & Communications Indus. Ass'n v. FCC, 693 F.2d 198 (D.C. Cir. 1982).

160. *See, e.g.*, Roland Mach. Co. v. Dresser Indus., Inc., 749 F.2d 380, 391–92 (7th Cir. 1984) (Posner, J.); *see also* Ken Auletta, *Final Offer*, THE NEW YORKER, Jan. 15, 2001, at 40, 43 (quoting Chief Judge Posner, mediator in the *Microsoft* case, as stating that conduct remedy-based consent decree provisions must be "sufficiently clear to be judicially administrable and that (even if clear) they would not impose an undue administrative burden on the district court, which would have to administer the decree").

161. For ease of exposition, we use the general term "open access" to describe all measures that require the platform provider to deal with other firms with whom it might otherwise choose not to deal. Some suggest that there is little need to parse the term more narrowly, but, like most commentators, we believe that the approaches discussed above are worth analyzing separately. *Compare* Lemley & Lessig, *supra* note 10, at 969 n.139 (quarreling with the suggestion that interconnection regulation and unbundling regulation are distinct approaches) *with* Gerald R. Faulhaber, *Access ≠ Access1 + Access2*, 2002 L. REV. M.S.U.-D.C.L. 677 (making this distinction), Speta, *supra* note 14, at 252 (same), Weiser, *supra* note 10, at 826 (same), *and* Joseph D. Kearney & Thomas W. Merrill, *The Great Transformation of Regulated Industries Law*, 98 COLUM. L. REV. 1323, 1350–57 (1998) (same).

by defining an interface to AT&T's telephone network (the platform), and permitting all customer premises equipment compatible with that interface and with certain requirements to plug into the network.[162] Similarly, MCI demanded and won the right to compete against AT&T in the long-distance component (an application) of a long-distance call,[163] complementing the Bell System's provision of local exchange access (the platform, or the first and last miles of such a call). In these cases, the exception to ICE was Baxter's Law, and the goal of unbundling was to protect competition in applications, which regulators thought likely to be efficient notwithstanding AT&T's opposition. And the Telecom Act's unbundling provisions[164] are in part intended to ensure competition in the parts of the network that have the potential to sustain competition, despite whatever natural monopoly network elements remain. Again, Baxter's Law disarms ICE.

In the antitrust realm, the Ninth Circuit required Kodak to cooperate with independent providers of service (applications) for its copiers (the platform).[165] Similarly, the FTC required AOL Time Warner to offer broadband transport (the platform) separately from Internet access (applications) and to cooperate with independent Internet access providers. To regulate this requirement, the FTC relied on a benchmark arrangement between AOL Time Warner and Earthlink and appointed a monitor to oversee other such arrangements.[166] In the *Kodak* case, the exception to ICE was a concern that Kodak had engaged in a hold-up strategy; by contrast, in the AOL matter, the FTC did not clearly identify any exception to ICE.

As the AT&T antitrust litigation and Telecom Act examples illustrate, unbundling often (though not always, as the CPE example shows) requires both complex regulation and difficult price-setting.[167] Because of this requirement and because most antitrust problems do not confront Baxter's Law, antitrust commentators are often skeptical of unbundling policies.

Antitrust is, however, open to unbundling remedies when the potential competition exception to ICE applies, as our discussion of the

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162. *See* Proposals for New or Revised Classes of Interstate and Foreign Message Toll Telephone Service (MTS) and Wide Area Telephone Service (WATS), 56 F.C.C.2d 593, ¶ 16 (1975) (First Report and Order), *modified by* 58 F.C.C.2d 716 (1976) (Memorandum Opinion and Order), *modified by* 58 F.C.C.2d 736 (1976) (Second Report and Order), *aff'd sub nom*. N.C. Utils. Comm'n v. FCC, 552 F.2d 1036 (4th Cir. 1977).

163. *See* MCI Communications v. AT&T, 708 F.2d 1081, 1105 (7th Cir. 1983).

164. 47 U.S.C. §§ 251–52 (2003).

165. *See* Image Technical Servs. v. Eastman Kodak Co., 125 F.3d 1195, 1224–28 (9th Cir. 1997).

166. *See* Faulhaber, *supra* note 161, at 684–85.

167. As Justice Breyer explained, forced sharing regimes risk undermining investment incentives if prices for the shared facilities are set too low, and create considerable administrative costs if the regime is ambitious. *See* AT&T v. Iowa Utils. Bd., 525 U.S. 366, 427–30 (1999) (Breyer, J., concurring in part and dissenting in part).

General Electric case above shows. If complementors are important in providing potential platform competition, then unbundling may be required so as to increase the chance of such competition. In the *Microsoft* case, for example, the DOJ sought and obtained a judicially overseen regime for how Microsoft manages the APIs for its Windows operating system. In particular, the court imposed regulations aimed to ensure that rival "middleware applications" can be as compatible with Microsoft's Windows operating system as are Microsoft's applications.[168] The *Microsoft* remedy aims to restore the chance of platform competition indirectly facilitated by independent middleware. Likewise, the Telecom Act's unbundling provisions are meant in part as stepping stones for the many-level entry otherwise required in order to compete against the platforms of incumbent local exchange providers.

As in the CPE example, an unbundling remedy may require regulators to ensure that technical interface standards allow independent complementors to work with the platform. A different set of policies, directed at platform-level competition, also involve compatibility mandates. Such mandates can help make "small" platforms more effective competitors when economic network effects are important.[169] Regulators can flatly require compatibility or establish a right for any firm (or only for non-dominant firms) to request or ensure it.[170] The relevant kind of compatibility depends on the nature of the network effects.

Network effects sometimes arise directly from the size of a platform's customer base, in which case a compatibility mandate should ensure *access to customers*, requiring firms to share the benefits of their combined customer networks, even if one firm contributes the majority of customers. For example, with instant messaging, the value of the service rises as a subscriber can communicate with more users. In a compatibility mandate in that market, the FCC required AOL, as part of a merger approval, to develop an interoperable instant messaging system.[171] Similarly, the Telecom Act requires every telecommu-

168. United States v. Microsoft Corp., 231 F. Supp. 2d 144 (D.D.C. 2002).

169. Economists describe a greater value of a larger network as a "network effect." For an overview, see Joseph Farrell & Paul Klemperer, *Coordination and Lock-In: Competition with Switching Costs and Network Effects*, *in* 3 HANDBOOK OF INDUSTRIAL ORGANIZATION (Mark Armstrong & Robert Porter eds., forthcoming 2004) (on file with authors) and Mark A. Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 CAL. L. REV. 479 (1998).

170. On rights of reverse engineering to ensure compatibility, for instance, see Pamela Samuelson & Suzanne Scotchmer, *The Law and Economics of Reverse Engineering*, 111 YALE L.J. 1575 (2002).

171. *See* Applications for Consent to the Transfer of Control of Licenses and Section 214 Authorizations by Time Warner Inc. and America Online, Inc., Transferors, to AOL Time Warner Inc., Transferee, 16 F.C.C.R. 6547, ¶¶ 191–200 (2001) (Memorandum Opinion and Order); *see also* Faulhaber, *supra* note 161, at 704–05 (discussing the interoperability mandate).

nications provider to terminate calls to its subscribers from other providers, thus "socializing" the network effect.[172]

In other cases the network effect arises from a greater variety of complements available for a particular platform — an example is the "applications barrier to entry" in the *Microsoft* case.[173] To address such a network effect, a compatibility requirement may be imposed that reduces porting costs and thus ensures that applications written for one platform are readily available on others. An extreme compatibility requirement would make the platform/applications interface public and common, and thus modularize the market.

B. Considerations for Regulatory Policy

Our analysis suggests that regulators should consider two basic questions: whether an exception to ICE exists, and, if this seems likely, how well the regulator can address the competitive harms that might result. A regulatory regime that addresses both questions will minimize the opportunity for anticompetitive conduct while also being less apt to chill efficient conduct. This Section will discuss each consideration in turn.

In assessing possible exceptions to ICE, regulators should consider error costs. Courts are accustomed and explicitly instructed to weigh error costs, for instance as part of a preliminary injunction inquiry.[174] Moreover, the law has adopted a number of doctrinal devices to guard against false positives, which, in antitrust, include the opportunity for a monopolist to offer an efficiency explanation for challenged conduct.[175] Error costs include both "false positives" and "false negatives." Some Chicago School commentators argue that policymakers should worry less about false negatives, because the marketplace can ultimately address regulatorily unremedied market power abuses whereas ill-conceived regulation faces no such self-correcting mechanism.[176]

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172. For discussion and an analogy to intellectual property policy, see Joseph Farrell, *Creating Local Competition*, 49 FED. COMM. L.J. 201, 202–04 (1996).

173. *See* United States v. Microsoft Corp., 84 F. Supp. 2d 9, 18–23 (D.D.C. 1999).

174. *See, e.g.*, Am. Hosp. Supply Co. v. Hosp. Prods. Ltd., 780 F.2d 589, 593 (7th Cir. 1986) (noting that harm calculations should account for the probability of error); *see also* Frank H. Easterbrook, *The Limits of Antitrust,* 63 TEX. L. REV. 1, 3 (1984) ("[J]udicial errors that tolerate baleful practices are self-correcting while erroneous condemnations are not."); William F. Baxter, *Reflections upon Professor Williamson's Comments*, 27 ST. LOUIS U. L.J. 315, 320 (1983) (urging courts to be mindful of "error rates" and "false positives" in judging exclusionary conduct).

175. *See* Baker, *supra* note 141, at 518.

176. For an example of the debate on this score, compare Salop & Romaine, *supra* note 82, at 653–55 (discussing varying perspectives on the relative degree of harm associated with false positives and false negatives) with Ronald A. Cass & Keith N. Hylton, *Preserving Competition: Economic Analysis, Legal Standards, and Microsoft*, 8 GEO. MASON L. REV. 1, 30–33 (1999) (arguing that false positives are more harmful than false negatives).

Regulators should also evaluate how well they can address any identified anticompetitive conduct. As antitrust law recognizes, not all marketplace harms are easily remediable. Professor Donald Turner first made this point in regard to the difficulty of policing tacit collusion between oligopolists,[177] and remediability concerns continue to figure prominently in debates over whether and how antitrust law can address single-firm conduct, as in the *Microsoft* case.[178] In the regulatory arena, this concern is both less pronounced — as regulatory bodies have greater resources than courts — and also less well considered. Remedies can also have unintended negative side effects.[179] Remedies should aim to avoid chilling efficient conduct, creating large administrative costs, or allowing opportunities for rivals to engage in strategic behavior. One guard against overbroad regulatory remedies is to ask whether less intrusive measures could be equally effective at addressing the harmful conduct.

C. Regulatory Philosophies

Our analysis suggests three basic models for the regulation of vertical relations. Each of these models ultimately converges with antitrust policy by taking account of integrative efficiencies, appreciating the logic of ICE, and acknowledging its exceptions, but each proceeds from different basic premises. In particular, the models differ in their presumptions about the reliability of assessing claimed exceptions to ICE, about the importance of vertical efficiencies, and about the FCC's ability to administer vertical regulation.[180]

In the model closest to antitrust practice, the FCC could intervene only after careful investigation compellingly shows that ICE fails along the lines of an analytically coherent exception, and that the benefits of regulation likely outweigh its costs.[181] This model thus expects that exceptions to ICE can be fairly reliably diagnosed or predicted (placing the burden on the regulator to overturn the presump-

177. *See* Donald F. Turner, *The Definition of Agreement Under the Sherman Act: Conscious Parallelism and Refusals to Deal*, 75 HARV. L. REV. 655, 671 (1962).

178. *See* Weiser, *supra* note 39, at 14–21.

179. In criticizing the finsyn rules, Judge Posner made this very argument. *See* Schurz Communications, Inc. v. FCC, 982 F.2d 1043, 1045–48 (7th Cir. 1992).

180. Of course, these models could be used not only to consider new regulation but also to consider removing old regulations in light of changed market conditions or new economic learning. In some recent decisions, the Commission has lifted restrictive regulations based on this very logic. *See* Policy and Rules Concerning the Interstate, Interexchange Marketplace, 16 F.C.C.R. 7418, ¶¶ 10, 34, 35 (2001) (Report and Order) [hereinafter Unbundling Order].

181. One of us has advocated this approach previously. *See* Philip J. Weiser, *Changing Paradigms in Telecommunications Regulation*, 71 U. COLO. L. REV. 819, 835 (2000); *see also* W. Res., Inc. v. Surface Transp. Bd., 109 F.3d 782, 788 (D.C. Cir. 1997) (noting that the Surface Transportation Board took roughly this approach).

tion that ICE applies), and that regulators are reasonably good at predicting, or diagnosing and correcting, their own failures.[182]

The two other models, while differing in substance, both reflect pessimism about regulators' ability to diagnose exceptions to ICE. Such pessimism is hardly unreasonable, since some of the exceptions sketched above might be genuinely widespread, and yet might be colorably asserted even where they do not really arise. One response to such pessimism could be a categorical protection of modularity, as advocated by some commentators.[183] An opposite response is a categorical presumption that ICE applies, as in a hard-line Chicago approach. Stating the strategies in this manner suggests a helpful way to frame the contrast between an open architecture strategy and the Chicago School approach. Some Chicago scholars appear to trust ICE more than they trust imperfect regulators or courts to diagnose its exceptions.[184] Open architecture advocates, such as Lawrence Lessig, appear to trust the history and future prospects of successful innovation through modularity more than they trust either ICE or regulators' ability to diagnose its exceptions.

VI. THE FRAMEWORK IN ACTION

Agencies and courts are often asked to decide what vertical conduct should be regulated. ICE and its exceptions, as well as the considerations noted above, can help them towards a sophisticated and consistent treatment of platform monopolists.[185] Such sophistication

182. Such rules would thus focus on "readily observable conduct whose presence or absence is highly correlated with a conclusion a court would reach were it to conduct a full analysis." Baker, *supra* note 141, at 496.

183. *See, e.g.*, Francois Bar et al., *Access and Innovation Policy for the Third Generation Internet*, 24 TELECOMM. POL'Y 489, 496 (2000) (insisting that "open access to the network led to rich experimentation by many actors whose ideas had previously been excluded from shaping network evolution"). This categorical protection might also rely on two arguments that telecommunications uniquely justifies regulatory oversight that deviates from the logic of ICE's suggestion that platform providers can be trusted. First, network industries might create greater incentives for predatory strategies, particularly those that would raise entry barriers. *See* A. Douglas Melamed, *Network Industries and Antitrust*, 23 HARV. J.L. & PUB. POL'Y 147, 149–52 (1999) (suggesting this possibility). Second, telecommunications networks — as platforms for transporting ideas — might warrant open access not based on competition policy, but on First Amendment values.

184. A compatible argument, based on Joseph Schumpeter's theory of creative destruction, is that successive battles for dominance mean that any market power gained through predatory tactics will only be temporary and thus not worth addressing. *See, e.g.*, Shelanski & Sidak, *supra* note 110, at 10–12 (discussing Schumpeterian competition, in which "firms compete through innovation for temporary market dominance, from which they may be displaced by the next wave of product advancements"); *see also* Richard Schmalensee, *Antirust Issues in Schumpeterian Industries*, 90 AMER. ECON. REV. PAP. & PROC. 192, 195 (2000) (discussing Schumpeterian competition between Microsoft and Netscape in the Internet browser market).

185. Such treatment would not only mean better results, but also a reduction in regulatory uncertainty and its associated impact on investment incentives. *See* Warren G. Lavey, *Mak-*

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Regulation, Competition, and Liberalization

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In many countries throughout the world, regulators are struggling to determine whether and how to introduce competition into regulated industries. This essay examines the complexities involved in the liberalization process. While stressing the importance of case-specific analyses, this essay distinguishes liberalization policies that generally are procompetitive from corresponding anticompetitive liberalization policies.

1. *Introduction*

Economists have developed an extensive set of principles for regulating a monopoly supplier. The benefits of unfettered, pervasive competition are also well documented and well understood. However, our understanding of the precise conditions under which regulated monopoly supply is preferable to unregulated competition is limited. Furthermore, we know relatively little about optimal liberalization policies—the policies that govern the transition to competitive market conditions—in cases where competition is deemed superior to monopoly.

The purpose of this essay is to explore these two issues, both of which are of substantial practical importance throughout the world. These issues are particularly relevant in key network industries (such as the telecommunications, natural gas, electricity, transport, and water industries) where scale economies can render production by many firms uneconomic, but where some competition may be useful to help discipline incumbent suppliers of key services. Our analysis of the choice between regulated monopoly and unregulated competition, like our analysis of the design of liberalization policies, emphasizes the problems that imperfect information and imperfect institutions pose for the design of industry policy.

This essay has three main parts: (1) section 2 reviews some recent experience with liberalization policy; (2) sections 3 through 5 consider the choice between unregulated competition and regulated monopoly; and (3) sections 6 and 7 consider the design of liberalization policies in settings where competition is preferred to monopoly.

Section 2 summarizes selected experiences with liberalization in three network industries where liberalization has garnered significant attention in recent years:

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telecommunications, natural gas, and electricity. The experiences in Chile's telecommunications industry, the United Kingdom's natural gas industry, and the state of California's electricity industry have varied greatly, ranging from substantial success in Chile to substantial failure in California.

Section 3 begins the discussion of the choice between unregulated competition and regulated monopoly by analyzing simple formal models of these two forms of industrial organization. The models emphasize the role of imperfect information. Section 4 considers additional factors that affect the choice between regulation and competition, including the resources available to the regulator, the regulator's independence and autonomy, the need to ensure ubiquitous service at affordable prices, and the importance of investment and innovation. Section 5 notes that, even when monopoly supply is the preferred mode of industry operation, some of the benefits of competition may be secured by allowing potential operators to bid for the right to serve as a regulated monopoly supplier.

Section 6 begins the discussion of liberalization policies in settings where the benefits of competition outweigh its costs. The potential merits and risks of direct entry assistance are considered first. Liberalization policies that are likely to reduce the intensity of long-term industry competition (and therefore generally are not recommended) are reviewed next. These policies include providing temporary monopolies or oligopolies, excluding foreign investors, specifying market share targets for industry participants, restricting incumbent suppliers asymmetrically, and affording competitors unduly favorable long-term access to the incumbent's infrastructure. Section 7 discusses liberalization policies that typically will enhance the intensity of long-term industry competition (and therefore are recommended). These policies include reducing the costs that customers incur when they switch suppliers; rebalancing the prices charged by the incumbent supplier to better reflect its operating costs and otherwise redesigning the regulations imposed on the incumbent supplier to account explicitly for emerging competition; privatizing state-owned enterprises; establishing appropriate access prices; and increasing monitoring, data reporting, and antitrust scrutiny, at least during the early stages of liberalization.

Two central themes emerge in this essay. First, even the comparatively simple choice between regulated monopoly and unregulated competition can be intricate and complex in practice. Second, the decision to introduce competition into an industry is only the beginning of a journey down a long and winding road that can present many obstacles and detours. Furthermore, the best route from monopoly to competition can differ substantially in different settings. Therefore, there is no single set of directions that can guide the challenging journey from monopoly to competition in all settings.

Even though detailed, comprehensive directions typically are not available, some broad conclusions (summarized in section 8) that can serve as useful guide posts can be drawn. These broad conclusions include the following five. First, the greatest potential gains from competition tend to arise when (1) industry scale economies are limited relative to consumer demand; (2) the industry regulator has limited information, limited resources, and limited instruments with which to craft policy; (3) the regulator's commitment powers are limited; and (4) subsidization of the consumption of some of the dominant supplier's services either is not critical or can be achieved by means other than through distortions in the supplier's price structure. Second, there are a wide variety of liberalization policies, and the merits of the different policies vary considerably. Therefore, it generally is more appropriate to inquire about the benefits and costs of specific liberalization policies than to ask whether liberalization per se is desirable or undesirable. Third, liberalization policies

that primarily aid some competitors and handicap others on an ongoing basis can hinder the development of vigorous long-term competition. Fourth, liberalization policies that remove entry barriers and empower consumers to discipline industry suppliers typically are the best means by which to foster vigorous long-term competition. Fifth, well-designed liberalization policies can facilitate a transition from stringent, detailed regulatory control to less intrusive antitrust oversight. However, during the transition process, heightened regulatory and antitrust scrutiny may be required.

2. *Recent Experience with Liberalization*

To help ground the ensuing discussion of the principles of liberalization policy, we begin by reviewing briefly the recent experience with liberalization in Chile's telecommunications industry, the United Kingdom's natural gas industry, and California's electricity industry.

2.1 *Liberalization in Chile's Telecommunications Industry*[1]

The General Law of Telecommunications opened Chile's telecommunications industry to competition in 1982. This law generally did not restrict the number of licenses that would be granted to deliver telecommunications services in Chile. Importantly, the licenses were for *nonexclusive* provision of wireline and wireless services, both local and long distance. The primary obligation imposed on all telecommunications operators in Chile was to connect their networks in compliance with specified technical requirements. Other terms and conditions of interconnection typically were left to negotiation among the operators.

In 1982, local telecommunications services were supplied almost exclusively by Compeñía de Teléfonos Chile (CTC), while long distance telecommunications services were supplied almost exclusively by Entel. Not surprisingly, these two state-owned enterprises were not anxious to connect their networks with the networks of emerging rivals. Few interconnection agreements were signed and competition was limited until Chile implemented a dispute resolution process that ensured the timely execution of interconnection agreements. Long distance competition also was limited until an equal access requirement was imposed in 1994. The requirement stipulated that every time a customer placed a long distance call, she had to explicitly designate (via dialing a special code) a long distance company to carry the call. The special code for each long distance carrier—incumbent and entrant alike—had the same number of digits. Most importantly, a call was not automatically carried by Entel if the caller did not specify an alternative carrier.

Once new suppliers were afforded substantial opportunity to provide telecommunications services on terms comparable to those faced by incumbent suppliers, competition began to flourish in Chile. The number of fixed lines more than tripled (from roughly one million to more than three million) between 1992 and 2000, and the extensive waiting list for (fixed) wireline telephone service that had inconvenienced Chile's citizens for so many years quickly disappeared. The number of mobile telephone subscribers in Chile increased nearly tenfold (from roughly 36,000 to more than 3.4 million) during the 1991–2000 period and nearly doubled again (to more than 6.7 million) between 2000 and 2003. Prices for most telecommunications services in Chile also have declined substantially since 1990.

By 2003, nearly one-fourth of the fixed telecommunications lines in Chile were supplied by CTC's competitors rather than by the incumbent supplier. Competitors

[1] The following discussion is drawn primarily from Ahmed Galal (1996), Pablo T. Spiller and Carlo G. Cardilli (1997), David M. Newbery (1999, pp. 123–25), Cecile Aubert and Jean-Jacques Laffont (2002, pp. 39–41), Laffont (2005, pp. 214–16), and Ricardo D. Paredes (2005).

secured especially large market shares in Chile's urban regions. This pattern of entry likely reflects in part the lower unit costs of serving urban areas given their relatively high population densities. This entry pattern also may reflect regulated prices of basic telephone service that are further above costs in urban regions than in rural regions. The regulated prices of local telephone services in rural regions often do not reflect fully the relatively high unit costs of serving these regions. Instead, prices in rural regions tend to be set closer to (and sometimes below) cost while prices in urban regions often are set substantially in excess of cost. Such pricing patterns are designed to ensure that basic telephone service is affordable to all citizens. These patterns may be less pronounced in Chile than in some countries because a separate fund has been established to subsidize the purchase of basic telephone service in rural regions and low-income urban regions. Nevertheless, in jurisdictions where CTC is deemed to be a dominant supplier of local telephone services, it is required to set the same price for basic services across substantial geographic regions. Some suggest that this restriction on CTC's ability to target price reductions to those regions in which competition is most intense may be one cause of the substantial market share that competitive suppliers of local telecommunications services have been able to secure in Chile.[2]

2.2 *Liberalization in the United Kingdom's Natural Gas Industry*[3]

Natural gas was one of the principal network industries in the United Kingdom targeted for privatization under Margaret Thatcher's program of industrial reform. Natural gas was first extracted from the U.K. Continental Shelf in 1965 and British Gas (BG) was formed as a state-owned company in 1972. BG held a legal monopoly over the sale of gas to consumers and a legal monopsony over the purchase of gas from producers in the U.K. fields. Since gas exploration and production involve substantial sunk costs, BG's monopsony power necessitated the use of long-term (e.g., twenty-five year) purchase contracts to limit expropriation of the substantial investments made by gas producers.

An initial attempt to liberalize the gas sector occurred in 1982 when entrants were authorized to employ BG's pipelines (at terms negotiated with BG) to supply gas to final customers. In addition, BG's legal monopsony was removed. Although these steps were intended to facilitate competition in the gas industry, competition did not emerge immediately.

BG was privatized as a vertically integrated monopoly in 1986.[4] At this time, consumers were divided into two categories for regulatory purposes: (1) the tariff market, consisting of those consumers who purchased less than 25,000 therms of gas per year, and (2) the contract market, consisting of the remaining higher-volume consumers. BG continued to enjoy a legal monopoly in the tariff market after privatization. BG's prices in this sector were regulated: the annual increase in the average price per therm was limited to $RPI + Y - X$, where RPI is the inflation rate, Y is a measure of the increase in the price BG pays for gas, and X is a productivity improvement factor.[5] X was set at 2 percent in 1986, but raised to 5 percent in 1992.[6]

[2] See Paredes (2005), for example.

[3] The material is drawn from Mark Armstrong, Simon Cowan, and John Vickers (1994, chapter 8) and Newbery (1999, chapter 8).

[4] Alternatively, BG could have been separated into a national pipeline business and several regional suppliers before privatization, an approach subsequently pursued in the U.K. electricity industry.

[5] This Y factor enabled BG to pass through its costs of purchasing gas to consumers, and thereby limited BG's incentive to secure low gas prices. Subsequent regulation permitted BG to pass through only a more exogenous index of gas costs.

[6] The 2 percent value for X was widely believed to underestimate the realistic potential for productivity gains. Of course, lenient price regulations enhance revenues from privatization.

Competition in the contract market was potentially open to competition and BG's prices in this market were not regulated. Although it was legal, competition did not emerge in this market until 1990. The delay reflected in part limited regulation of the prices BG charged retail competitors for access to its pipelines. BG also practiced price discrimination in the contract market, charging higher prices for gas to those industrial users who had no reasonable alternative energy source (e.g., electricity).

To combat these perceived problems, new regulations were imposed in 1988. The regulations required BG to (1) publish a tariff on which any customer in the contract market could purchase gas (in an attempt to limit price discrimination); (2) publish a corresponding tariff of network access charges (although these charges remained otherwise unregulated); and (3) purchase no more than 90 percent of the gas in any newly discovered gas field. This final requirement essentially forced some limited entry into the contract market. By 1990, though, BG supplied 93 percent of the gas sold in this market.

Limited competition in the contract market promoted three further regulatory reforms in the early 1990s. First, the monopoly threshold in the tariff sector was reduced from 25,000 therms to 2,500 therms, thereby permitting smaller customers to purchase gas from competitors. Second, the prices charged for access to BG's pipelines came under regulatory control.[7] Third, BG was required to reduce to 40 percent (by volume) its share of sales to the contract market by 1995. At the same time, new gas fields were being opened, and entrants were able to buy supplies from these new fields.[8]

Although regulation did not force BG to separate its pipeline and gas supply operations, intense regulatory scrutiny and onerous separate accounting requirements led BG to undertake such vertical divestiture voluntarily. Furthermore, the monopoly franchise threshold of 2,500 therms was removed entirely in 1998, so all consumers were permitted to purchase gas from suppliers other than BG. Competition intensified, and all retail price controls were removed in 2002. Only access charges continue to be regulated. Many consumers continue to purchase natural gas from BG even though BG charges more than some competitors for what is largely a homogeneous product. This fact may suggest that customer switching costs or other causes of customer inertia are important in this industry.

2.3 *Liberalization in California's Electricity Industry*[9]

Although the state of California's experience with liberalization in its electricity industry is quite recent, the experience is already legendary. In 1996, California enacted legislation that introduced five primary changes in the state's electricity sector. First, electricity generation and wholesale prices for electricity were deregulated. Second, as they were required to do, the three incumbent (vertically integrated) suppliers of electricity sold a sizable portion of their generation capacity, focusing instead on the transmission and delivery of electricity. By 1999, the incumbent suppliers had sold to five independent suppliers generation capacity that produced roughly one-third of

[7] These access charges were distance related. Because BG's retail prices did not vary across geographic regions, this pricing policy enabled entrants to secure a higher profit margin when serving customers located close to the gas landing point.

[8] As a result, BG was left with long-term obligations to purchase gas that it no longer needed to serve its own consumers. When BG was privatized, investors were promised that BG would be able to supply approximately two-thirds of the demand for natural gas by volume until 2009. As regulation and liberalization developed, this promise was not honored.

[9] The following discussion is based primarily on Severin Borenstein (2002).

the state's electricity consumption. Third, retail competition was introduced as retail customers were permitted to purchase electricity from firms other than the incumbent suppliers. Fourth, a ceiling was imposed on the retail price that incumbent suppliers charged for electricity. Fifth, the three incumbent suppliers were afforded strong financial incentives to buy and sell electricity through the California Power Exchange (Cal PX) during its first four years of operation. Cal PX was established in 1998 to run the day-ahead market for electricity in the state of California. Although the incumbent suppliers' participation in Cal PX helped to ensure substantial short-term supply of and demand for electricity, the incumbents' corresponding limited use of long-term contracts for the purchase or sale of electricity ultimately proved to be detrimental.

In the summer of 2000, unusually high temperatures and very dry conditions produced both a substantial increase in the demand for electricity and a significant reduction in the available supply of electricity from hydroelectric generating units in the state. When less efficient generating units were dispatched to meet the high demand for electricity, the wholesale price of electricity soared well above the ceiling that had been imposed on retail electricity prices. Consequently, incumbent suppliers incurred severe financial losses. The higher wholesale prices were not sufficient to augment the supply of electricity greatly due to the long lead time necessary to construct new generating capacity and due to the particularly high costs faced by established producers of peak load capacity. These high costs reflected less efficient operating technologies, particularly high wholesale prices for natural gas, and expensive pollution permits.[10]

[10] It has also been suggested that some of the few large suppliers of electricity may have exacerbated the problem by intentionally reducing their supply of electricity, thereby raising the market-clearing price of electricity and, hence, the profits of electricity suppliers. (See Paul L. Joskow and Edward Kahn 2002, for example.)

In 2001, the state of California adopted drastic measures to quell the crisis that had developed in its electricity industry. The state established itself as the wholesale buyer of power for the incumbent suppliers in response to the reluctance of other parties (including wholesale suppliers of electricity) to deal with the financially distressed incumbents. The state also raised substantially the prices incumbent suppliers could charge for electricity, especially to large retail customers. In addition, to prevent these customers from securing electricity from alternative suppliers at lower prices, the state terminated retail competition. In essence, California's experiment with deregulation and liberalization had ended.

3. *Regulated Monopoly and Unregulated Competition*

In an economic paradise, where a regulator is omniscient, benevolent, and able to fulfill any promise he makes, competition cannot improve upon regulated monopoly. In such a paradise, the regulator will ensure the firm produces the ideal range of services at the lowest possible cost and will set welfare-maximizing prices for these services. Consequently, industry performance would not improve if an additional firm operated in this setting.

Of course, the real world differs markedly from this paradise. In practice, regulators invariably lack important information about the markets they oversee and so will not be able to direct and control perfectly the activities of a monopoly producer. Because of its daily operation in the industry and its direct contact with consumers, the regulated firm will be better informed than the regulator about the demand for the regulated services it supplies, the minimum possible current cost of delivering the services, and the potential for less costly future provision. This information asymmetry generally gives rise to an unavoidable trade-off between

rent and efficiency: the firm can be motivated to operate efficiently but only if it is awarded substantial rent for doing so. In particular, the firm will operate at minimum cost and attempt to satisfy the needs and desires of customers only if it is awarded the full surplus that its activities generate.[11] However, such a generous award to the regulated firm typically will provide it with significant rent and thereby reduce the net benefits enjoyed by consumers. To limit the rent that accrues to the regulated firm, some inefficiency typically is tolerated.

To examine the optimal resolution of this trade-off and to examine the impact of limited information on the choice between regulated monopoly and unregulated competition, consider the following simple model.[12]

3.1 *A Simple Model of Regulated Monopoly*

Suppose that when regulated monopoly is implemented the regulator faithfully pursues the social goal of maximizing the expected value of $V + \alpha U$, where V denotes the surplus enjoyed by consumers, U is the firm's rent, and $\alpha \in [0,1]$ is a parameter. Because $\alpha \leq 1$, society values consumer welfare at least as highly as the welfare of shareholders, perhaps because consumers are less wealthy than shareholders or because many shareholders reside in other jurisdictions.

A transfer payment T from consumers to the firm entails a reduction of $[1 + \lambda]T$ in the surplus enjoyed by consumers. The parameter $\lambda \geq 0$ represents the social cost of public funds. This cost arises from the distortions created by the taxes imposed on consumers/taxpayers to raise the funds.[13] Notice that because public funds entail unit cost $1 + \lambda$, each dollar of public funds secured by taxing the profit of the regulated firm can be employed to increase consumer/taxpayer welfare by $1 + \lambda$ dollars.

The monopoly supplies a single product at regulated unit price $p \geq 0$. The demand curve for this product, $q(p)$, is common knowledge. The regulator sets both the unit price, p, for the regulated product and a transfer payment, T, from consumers to the regulated firm. The firm is obligated to serve all customer demand at the established price.

The firm incurs a fixed cost of operation, F, and a constant marginal cost of production, c. For simplicity, the firm's marginal cost can take on one of two values, c_L or c_H. Let $\Delta \equiv c_H - c_L > 0$ denote the difference between the high and the low marginal cost. The firm knows from the outset of its interaction with the regulator whether its marginal cost is high or low. The regulator does not share this information and never observes the firm's marginal cost directly. The regulator perceives the two possible cost realizations to be equally likely. For simplicity, the firm's fixed cost of operation, F, is assumed to be common knowledge. The firm seeks to maximize its rent, U, which is the sum of its profit, $\pi \equiv q(p)[p - c] - F$, and the transfer payment, T, it receives from the regulator.

[11] Martin Loeb and Wesley A. Magat (1979) provide a formal statement and proof of this conclusion. William W. Sharkey (1979) critiques Loeb and Magat's analysis. Jorg Finsinger and Ingo Vogelsang (1981, 1982) and David E. M. Sappington and David S. Sibley (1988) suggest dynamic modifications of the Loeb and Magat policy that afford less rent to the regulated firm and/or can be implemented with less precise information about the surplus generated by the firm's activities.

[12] This model is drawn from the large literature that examines the design of regulatory policy when the regulated firm is better informed about its environment than the regulator. Reviews of this literature include Bernard Caillaud, Roger Guesnerie, Patrick Rey, and Jean Tirole (1988), David P. Baron (1989), Laffont and Tirole (1993), Laffont (1994), and Armstrong and Sappington (forthcoming). Joskow and Richard Schmalensee (1986), Armstrong, Cowan, and Vickers (1994), Glenn Blackmon (1994), Sappington (1994), Robert Mansell and Jeffrey Church (1995), Sappington and Dennis L. Weisman (1996), and Joskow (2005), among others, provide less technical discussions of incentive regulation. Michael A. Crew and Paul R. Kleindorfer (2002) and Vogelsang (2002), for example, provide critiques of this literature.

[13] Laffont (2005, pp. 1–2) reports that for each dollar of tax revenue the government collects, citizens in a developed country bear a cost of approximately \$1.30 (so $\lambda = 0.3$). The corresponding cost typically is substantially greater in developing countries.

Suppose the regulator announces that he will set unit price p_i and deliver transfer payment T_i to the firm when the firm reports its marginal cost to be c_i, for $i \equiv L,H$. When the firm with cost c_i chooses the (p_i,T_i) option, its rent will be $U_i \equiv q(p_i)[p_i - c_i] - F + T_i$. The revelation principle ensures there is no loss of generality in examining regulatory policies that induce the firm to report its marginal cost truthfully.[14] Therefore, social welfare when the firm's marginal cost is c_i is:

$$v(p_i) - [1 + \lambda]T_i + \alpha[q(p_i)[p_i - c_i] - F + T_i] = w_i(p_i) - [1 + \lambda - \alpha]U_i,$$

where $w_i(p_i) \equiv v(p_i) + [1 + \lambda][q(p_i)[p_i - c_i] - F]$, and where $v(p)$ denotes consumer surplus when price p is established. ($v(\cdot)$ is a convex function of p.)

If the firm's realized marginal cost were observed publicly, the regulator would implement the (Ramsey) price that maximizes $w_i(\cdot)$ when cost c_i is realized, for $i \equiv L,H$. These full-information prices will be marginal-cost prices ($p_i = c_i$) when λ is zero because transfers from consumers to the firm entail no direct social costs in this case. In contrast, when λ is large, payments to consumers financed by the firm's profit are highly valued and the full-information prices will approximate the prices chosen by an unregulated profit-maximizing monopolist.

When the firm's marginal cost is not observed publicly, it must be the case that $q(p_L)[p_L - c_L] - F + T_L \geq q(p_H)[p_H - c_L] - F + T_H$ or, equivalently,

$$U_L \geq U_H + \Delta q(p_H), \tag{1}$$

to ensure the firm truthfully reports its low marginal cost of production. To ensure the firm finds it profitable to operate when its marginal cost is high, it must be the case that $U_H \geq 0$. Because social welfare declines as the firm's equilibrium rent increases (when $\alpha < 1$ or $\lambda > 0$), U_H is optimally held to zero. To limit the firm's equilibrium rent, constraint (1) also will hold as an equality under the optimal regulatory policy, so $U_L = \Delta q(p_H)$. Therefore, total expected welfare if price p_i is set when marginal cost c_i is realized (for $i \equiv L,H$) will be:

$$\tfrac{1}{2}[w_L(p_L) - [1 + \lambda - \alpha]\Delta q(p_H)] + \tfrac{1}{2}\, w_H(p_H) - [1 + \lambda]G, \tag{2}$$

where G is a (fixed) cost of regulation that is financed with public funds. This cost might include the salary of the regulator and his staff, for example, and all other costs associated with acquiring essential information about the regulated industry.[15] Differentiating expression (2) with respect to p_H reveals that, when the regulator cannot observe the firm's marginal cost, he is able to achieve the level of expected welfare that he could achieve if the firm's costs were observable, but the high marginal cost was $\hat{c}_H$, where:

$$\hat{c}_H \equiv c_H + [1 - \frac{\alpha}{1 + \lambda}]\Delta > c_H. \tag{3}$$

Therefore, the optimal price when the high marginal cost is realized is the full-information (Ramsey) price corresponding to the inflated cost $\hat{c}_H$. The inflated price when c_H is realized reduces the number of units of output on which the firm can exercise its cost advantage when c_L is realized. Therefore, the increase in p_H and the associated reduction in T_H limit the rent that accrues to the firm when its marginal cost is c_L. Because the firm has no incentive to understate its production cost, there is no value to distorting the firm's activities when it reports its marginal cost to be c_L. Consequently, the optimal price when the low marginal cost is realized will be the full-information price corresponding to the firm's actual cost (c_L).[16]

[14] See Roger B. Myerson (1979), for example.

[15] G might also include the surplus lost when regulation retards industry innovation. Charles Jackson, Tracey Kelly, and Jeffrey Rohlfs (1991) and Jerry A. Hausman (1997) estimate that delays in licensing wireless telecommunications providers in the United States reduced consumer surplus by billions of dollars.

[16] This fact is evident from expression (2).

Three features of the optimal regulatory policy in this simple setting characterize optimal regulatory policy in more general settings where the monopoly supplier is better informed than the regulator about key features of the regulated industry. First, the firm generally commands rent from its superior information. Second, to limit this rent and thereby generate greater surplus for consumers, the regulator will design a menu of options from which the firm can make a binding choice. A well-structured menu of options can induce the firm to employ its superior knowledge to secure outcomes that are better for both the firm and consumers in more favorable environments (e.g., when the firm has lower operating costs). Third, the optimal regulatory policy generally induces inefficient performance to limit the firm's rent.

3.2 *A Simple Model of Unregulated Competition*

Now consider the following simple model of unregulated competition. Suppose two firms produce a homogeneous product and engage in Bertrand price competition. Each firm knows its own constant marginal cost of production and its rival's marginal cost, $c \in \{c_L, c_H\}$, when it sets its price. No transfer payments to or from the firms in the industry are possible in this setting. In particular, the firms' profits cannot be appropriated by the government to reduce the general tax burden elsewhere. Therefore, the social cost of public funds λ plays no role in this setting and social welfare is $v(p) + \alpha\pi$, where π is industry profit. Both firms find it profitable to operate in the industry.[17]

Each firm has the low marginal cost, c_L, with probability 1/2. The firms' costs may be correlated. Let $\rho \in [1/2,1]$ represent the probability that the two firms have the same cost.[18] The firms' costs are perfectly correlated when $\rho = 1$. Their costs are uncorrelated when $\rho = 1/2$. Bertrand competition ensures the equilibrium price will be c_H except when both firms have low cost, which occurs with probability $\rho/2$. A firm's operating profit is zero unless it has the low marginal cost while its rival has the high marginal cost, in which case the firm's profit is $\Delta q(c_H)$.[19] A firm realizes this positive profit with probability $[1 - \rho]/2$. Consequently, expected industry profit in this duopoly setting is $[1 - \rho]\Delta q(c_H)$, which declines as the firms' costs become more highly correlated. Notice that the probability that the industry supplier has low marginal cost is $(1 - \rho/2)$. This probability decreases as ρ increases. In contrast, the probability that the industry price will be c_L is $\rho/2$, which increases as ρ increases.

Ignoring the firms' fixed costs of production (F) for now, social welfare in this unregulated duopoly setting is:

$$(4)\ \frac{\rho}{2}v(c_L) + [1 - \frac{\rho}{2}]v(c_H) + \alpha[1 - \rho]\Delta q(c_H).$$

3.3 *Comparing Regulated Monopoly and Unregulated Competition*

Regulated monopoly offers four potential advantages over unregulated competition in this simple setting: (1) industry prices can be controlled directly; (2) transfer payments can be made to the firm to provide desired incentives; (3) the firm's profit can be taxed to generate public funds, thereby reducing the deadweight losses associated with other sources of public funds; and (4) duplicative fixed costs of production can be avoided because there is only one industry supplier.

[17] Section 6 considers the possibility that both firms may not find it profitable to operate in the industry. See Emmanuelle Auriol and Laffont (1992) and Michael H. Riordan (1996), for example, for related models in which the duopoly is regulated.

[18] The probability that both firms have high cost is $\rho/2$, the probability that both firms have low cost is $\rho/2$, and the probability that a given firm has low cost while its rival has high cost is $[1 - \rho]/2$.

[19] The profit-maximizing price for a firm with the low marginal cost is assumed to exceed c_H. Consequently, when only one firm has the low marginal cost, it will serve the entire market demand at price c_H in equilibrium.

Unregulated competition has three corresponding potential advantages: (1) the likelihood that the industry producer has the low marginal cost is higher than under monopoly because even if one firm fails to secure the low cost, its rival may do so; (2) the presence of a rival with correlated costs reduces the information advantage of the industry producer; and (3) any direct, operational costs of regulation (e.g., the salaries of regulators and their staff) are avoided. The first of these potential advantages of unregulated duopoly is referred to as the *sampling benefit of competition*. The second potential advantage will be referred to as the *rent-reducing benefit of competition*.

To compare the performance of regulated monopoly and unregulated competition in this setting, initially suppose $\lambda = 0$, $F = 0$, and $G = 0$, so there is no social cost of public funds, no fixed cost of production, and no direct cost of regulation. Expressions (2) and (3) reveal that the maximum expected welfare under monopoly regulation in this case is:

$$(5) \qquad \tfrac{1}{2}v(c_L) + \tfrac{1}{2}v(c_H + [1 - \alpha]\Delta).$$

A comparison of expressions (4) and (5) provides four conclusions regarding the relative performance of regulated monopoly and unregulated duopoly.

First, unregulated duopoly delivers a higher level of expected social welfare than does regulated monopoly when the duopolists' costs are perfectly correlated (so $\rho = 1$).[20] When costs are perfectly correlated, the industry producer never has a cost advantage over its rival and so commands no rent in the duopoly setting. Furthermore, competition drives the industry price to the level of realized marginal cost. Therefore, the ideal (full-information) outcome is achieved under duopoly but not under monopoly, where regulated prices diverge from marginal cost in order to limit the rent the monopolist commands from its privileged knowledge of costs. In this case, then, unregulated duopoly is preferred to regulated monopoly even though the former offers no sampling benefit. The benefits of competition arise entirely from rent reduction in this case.

Second, when demand is perfectly inelastic, unregulated duopoly produces a higher level of expected welfare than does regulated monopoly.[21] When demand is perfectly inelastic, price distortions do not affect output levels and, therefore, do not serve to limit rent. Consequently, only the probability of obtaining a low-cost supplier affects expected welfare, and this probability is higher under duopoly than under monopoly because of the sampling benefit of competition.

Third, regulated monopoly will generate a higher level of expected welfare than unregulated duopoly when demand is sufficiently elastic (and $\rho < 1$). When demand is very elastic, prices that do not track costs closely entail substantial losses in surplus. Prices track costs more closely under regulated monopoly than under unregulated duopoly.[22]

Fourth, unregulated duopoly outperforms regulated monopoly when the difference between the high and the low marginal cost (Δ) is sufficiently close to zero. Monopoly rent and duopoly profit are both negligible in this case, and so the choice between monopoly and duopoly depends upon which regime produces the low marginal cost more frequently. The sampling benefit of competition ensures the duopoly regime does so

[20] If $\alpha = 1$, regulated monopoly and unregulated duopoly provide the same level of expected social welfare.

[21] When demand is perfectly inelastic (so $q(p) \equiv 1$, for example), expression (4) is weakly greater than expression (5) whenever $\rho/2 \geq \alpha[\rho - \frac{1}{2}]$, which is always the case.

[22] The convexity of $v(\cdot)$ implies the expression in (5) is at least $[v(c_L) + v(c_H) - [1 - \alpha]\Delta q(c_H)]/2$. Therefore, the difference between expressions (5) and (4) is at least $[1 - \rho][v(c_L) - v(c_H)]/2 - \Delta q(c_H)[(1 - \alpha)/2 + \alpha(1 - \rho)]$. Because this expression is nondecreasing in α, it is at least $[1 - \rho][v(c_L) - v(c_H)]/2 - \Delta q(c_H)/2$. This term is positive when demand is sufficiently elastic.

whenever costs are not perfectly correlated (so $\rho < 1$).[23]

More generally, if the fixed costs of operation (F) are sufficiently large, regulated monopoly will outperform unregulated duopoly in the simple model analyzed here because monopoly avoids the duplication of fixed costs.[24] This conclusion is a corollary of the more general observation that monopoly supply will minimize industry costs if prevailing scale economies are pronounced relative to industry demand.[25] Scale economies often are pronounced in network industries, where substantial physical infrastructure (e.g., a gas, water, or electricity distribution system or a telecommunications network) must be deployed in order to deliver service to customers.

When the social cost of funds (λ) is considered, regulated monopoly offers an additional advantage over unregulated duopoly. The monopolist's rent can be taxed to fund desirable social projects, thereby reducing the need to employ other (potentially more costly) means to raise revenue.

4. *Additional Considerations*

The simple models considered in section 3 abstracted from several important institutional factors that can affect the optimal choice between regulated monopoly and unregulated competition. These institutional factors include (1) the resource constraints the regulator faces; (2) the potential role of regulation in pursuing distributional objectives; (3) the instruments available to the regulator; (4) the prevailing degree of regulatory independence and accountability; (5) the ownership structure of the incumbent industry producers; and (6) the importance of industry investment and innovation. These factors are now considered in turn.[26]

4.1 *Resource Constraints*

Although the regulator was not omniscient in the models of section 3, he had considerable knowledge of the regulated industry. In practice, a regulator's information can be far more limited.[27] A regulator's difficult task of overseeing and directing the activities of a monopoly supplier can become nearly impossible when the regulator's information and expertise are severely limited and when he lacks the physical and financial resources to overcome these limitations. Consequently, allowing competition to replace regulatory oversight as the primary means of motivating and disciplining the incumbent supplier can be advantageous when the efficacy of regulatory oversight is severely compromised by limited regulatory resources.[28]

[23] The benefits of unregulated competition may be less pronounced if industry competition is less pronounced. For example, Cournot competition may better describe industry interaction than Bertrand competition. Alternatively, industry producers might collude in setting prices. (Recall that limited industry competition may have contributed to the substantial increase in the wholesale price of electricity in California in 2000.)

[24] In contrast, if the fixed cost of regulation, G, is sufficiently large, unregulated duopoly will outperform regulated monopoly because the former avoids this cost, by assumption.

[25] In developing countries where consumers have limited income, the corresponding limited demand for key services can result in higher average production costs when scale economies are present.

[26] For further discussion of the effects of institutions on regulatory policy, see Brian Levy and Spiller (1994, 1996), Newbery (1999), Roger G. Noll (2000), J. Luis Guasch (2004), Ioannis N. Kessides (2004), Mark A. Jamison, Lynne Holt, and Sanford V. Berg (2005), and Laffont (2005), among others. We focus on the effects, rather than the origins, of a country's institutions. Daron Acemoglu, Simon Johnson, and James Robinson (2005) trace a country's institutions to its colonial origins. In countries where poor living conditions rendered settlement unattractive, for example, little effort was devoted to developing the country's institutions. Such effort was more prominent in countries where long-term settlement was more attractive and more widespread.

[27] The theory of optimal regulation when the firm is privately informed about several aspects of its operation awaits further development. Jean-Charles Rochet and Lars Stole (2003) provide a survey of the theory of multidimensional screening.

[28] Jon Stern (2000) documents the limited regulatory resources that are available in many countries. Stern suggests that resource sharing among regulatory agencies can help to mitigate partially the effects of severe shortages of critical regulatory resources in some settings. Noll (2000) also emphasizes the merits of sharing regulatory resources.

The resources of other oversight agencies also influence the relative merits of monopoly supply and liberalization. For example, competition may be less likely to impose meaningful discipline on a dominant incumbent supplier if the antitrust agency that oversees industry competition has limited expertise and meager physical and financial resources. Consequently, both the relative and absolute level of resources available to oversight agencies influence the relative merits of monopoly and liberalization.

4.2 *Income Redistribution and Universal Service Goals*

The analysis in section 3 abstracted from any differences in the cost of serving different customers and did not model explicitly differences in the wealth levels of different consumers. Such differences can raise concerns about *universal service*—the ubiquitous delivery of essential services at affordable rates. When a government has limited ability to redistribute income directly (perhaps because income taxes are widely evaded, for example), the regulated prices of essential services can constitute an important means to promote universal service.[29] To illustrate, suppose a country wishes to ensure that all its citizens have access to clean water or to basic communications services at low prices. Because prices tend to reflect costs under unfettered competition, individuals that are particularly costly to serve (because of their geographic location, for example) may face unduly high prices for key services under unregulated competition. In contrast, a regulated monopolist will agree to serve high-cost (e.g., rural) customers at relatively low prices if it is permitted to offset the associated financial losses by charging prices sufficiently above the costs of serving low-cost (e.g., urban) customers. Consequently, universal service (and other distributional) concerns can cause regulated monopoly to be preferred to unregulated competition.

4.3 *Available Instruments*

The policy instruments available to oversight agencies also influence the relative merits of monopoly and competition. To illustrate, return to the simple setting considered in section 3, where the regulator was able to set prices and deliver transfer payments. In practice, regulators are not always able to deliver transfers to the firms they regulate. If the regulator lacked this ability in the setting analyzed in section 3.1 and wished to ensure the monopolist never terminated its operations, the regulator could do no better than to set a single price equal to the high marginal cost, $p = c_H$ (assuming fixed costs are zero). This policy would generate expected welfare

$$v(c_H) + \tfrac{1}{2}\alpha\Delta q(c_H). \tag{6}$$

It is apparent that the level of expected welfare in expression (6) is less than the corresponding level in expression (4).[30] Consequently, unregulated duopoly is always preferred to this restricted form of monopoly regulation in the setting considered in section 3.1.

More generally, if a regulator has limited ability to reward a monopoly supplier for superior performance and penalize the firm for inferior performance, the regulator may be unable to motivate the firm to serve consumers well. This is the case regardless of how well the regulator understands the firm's capabilities and consumers' preferences. Similarly, if the regulator is not

[29] The public finance literature (e.g., Anthony B. Atkinson and Joseph E. Stiglitz 1976) notes that when a nonlinear income tax is feasible, prices of goods and services often should reflect production costs. Laffont and Tirole (2000, section 6.2) consider the implications of this conclusion for pricing policy in regulated industries. Robin Burgess and Stern (1993) review the theory and the practice of tax policy in countries with limited wealth.

[30] The difference between expressions (4) and (6) is $[v(c_L) - v(c_H)]\rho/2 + \alpha\Delta q(c_H)[\frac{1}{2} - \rho]$. The convexity of $v(\cdot)$ implies this expression is at least $[\rho/2 - \alpha(\rho - \frac{1}{2})]\Delta q(c_H)$. This expression is nonnegative because it is a decreasing function of ρ and is nonnegative at $\rho = 1$.

authorized to compel the firm to report data on its operations, the regulator will find it difficult, if not impossible, to make informed policy decisions, even if the regulator has ample resources and ability to analyze and interpret data. Consequently, limited powers to reward or penalize the firm or to compel data reporting can render monopoly regulation ineffective, and so can increase the relative merits of unregulated competition.

A regulator's powers to control the activities of new suppliers also can affect the relative merits of monopoly and competition. To illustrate, suppose the regulator cannot impose any regulations on new competitors. In particular, suppose a regulator cannot limit the range of services that competitors offer or tax any of these services. In this case, even though liberalization may help to motivate the incumbent supplier to reduce its operating costs, it may allow competitors to engage in cream-skimming. Cream-skimming is the act of serving the most profitable (e.g., urban, business telecommunications) customers and leaving the incumbent supplier to serve the less profitable (e.g., rural, residential telecommunications) customers. Cream-skimming can limit the ability of the incumbent supplier to finance particularly low prices on some services with substantial profit earned on other services and thereby undermine socially desirable pricing structures.[31] Therefore, even though managed competition (which entails the regulation of both incumbent suppliers and new entrants) might be preferable to monopoly, monopoly may be preferable to unfettered competition when an ineffective tax system requires that universal service be pursued through industry prices.[32]

[31] See Nicolas Curien, Bruno Jullien, and Rey (1998) and Laffont and Tirole (1990a), for example.

[32] Of course, a country with limited ability to collect taxes also may have limited ability to enforce desired prices. The relative strengths of the country's institutions are important to consider in such cases. A country may be better able to measure electricity consumption and enforce associated charges than to prevent citizens from hiding wealth in order to evade income taxes, for example.

4.4 *Private versus State Ownership*

The extent of government ownership of the dominant incumbent supplier also can affect both the merits and the most appropriate form of liberalization. A firm that is largely owned by the government can be less responsive to the oversight and demands of shareholders than are privately owned firms.[33] Furthermore, state-owned enterprises (SOEs) can face softer budget constraints than their privately owned counterparts in the sense that the government may be more willing to tolerate losses by the firm and to finance the firm's continued operation despite poor historic financial performance. Because of the corresponding diminished incentive to minimize production costs,[34] an SOE may operate with higher costs than a privately owned monopoly.[35] Therefore, liberalization may have greater potential to reduce industry costs when the incumbent monopoly supplier is owned primarily by the government than when it is owned primarily by private investors.[36]

4.5 *Regulatory Independence and Accountability*

The simple models considered in section 3 presumed the regulator faithfully pursued the social objective. In practice, a "captured"

[33] For instance, Michael I. Cragg and I. Alexander Dyck (2003) find that the financial compensation of managers is not as closely linked to the performance of the firm in state-owned enterprises as it is in privately owned firms.

[34] See János Kornai, Eric Maskin, and Gerald Roland (2003).

[35] William L. Megginson, Robert C. Nash, and Matthias van Randenburgh (1994), Juliet D'Souza and Megginson (1999), Rafael La Porta and Florencio López-de-Silanes (1999), Kathryn L. Dewenter and Paul H. Malatesta (2001), Megginson and Jeffry M. Netter (2001), Scott J. Wallsten (2001), and Simeon Djankov and Peter Murrell (2002), among others, present (sometimes mixed) evidence that the efficiency of SOEs increases after privatization, particularly in the presence of substantial industry competition and independent regulators.

[36] Of course, in practice, this greater potential need not always translate into more pronounced reductions in industry costs. Fumitoshi Mizutani and Shuji Uranishi (2003), for example, report that liberalization in Japan's postal industry did not substantially increase the productivity of the SOE.

regulator may not do so. A regulator is said to be captured by the firm he regulates when the regulator generally implements policies that further the interests of the firm at the expense of the broader social interest.[37] Many factors increase the likelihood of regulatory capture. For example, a regulatory agency with limited expertise and resources may be forced to rely heavily on the advice and information supplied by the firm when formulating policy. Alternatively, the firm may routinely offer attractive employment opportunities to regulators who have proved to be cooperative, and the country's laws may not preclude such offers.[38] Also, the firm may provide a sizable portion of the regulator's ongoing budget and may have some discretion over the timing and magnitude of its contributions to the regulator's budget. When factors like these lead to a high likelihood of regulatory capture, the entry of additional competitors may be the best way to impose meaningful discipline on the incumbent supplier and otherwise ensure long-term gains for consumers.[39]

The importance of regulatory independence from short-term popular opinion also is apparent. Producers in network industries typically incur substantial sunk (nonrecoverable) costs. These producers also often deliver services to a large portion of the population, and so the prices of these services are of substantial public concern. Together, these two elements create substantial risk of expropriation by well-meaning but short-sighted regulators. In response to public pressure, regulators may reduce prices as far as possible toward variable production costs. As long as regulated prices allow the firm to recover its variable production costs, the firm will prefer to continue to produce than to terminate its operations. Thus, in the short run, the regulator gains by securing low prices and ongoing production of key services. Although such a policy may provide short-term gains, it can have substantial long-term costs. Potential and actual producers will realize they are unlikely to recover any sunk costs they incur. Consequently, they will be reluctant to incur such costs, and so existing network infrastructure will be permitted to decay and new network infrastructure will not be built. Thus, if regulators are to design and implement policies that best serve the long-term interests of consumers, they must be able to develop policy credibility by resisting short-term pressures to renege on long-term promises.[40]

A regulator's commitment powers can be enhanced by a variety of factors, including strong legal institutions and a long tenure. Strong legal institutions can thwart attempts by other government agencies to intervene in the day-to-day operations of the regulatory agency and can thereby enhance a regulator's commitment powers by reducing the likelihood that the terms of announced regulatory policies will be changed.[41] In particular, strong legal institutions can enforce long-term

[37] See George J. Stigler (1971), Richard A. Posner (1974), Gary S. Becker (1983, 1985), Laffont and Tirole (1993, chapter 11), and James F. Dewey (2000), for example, for models of capture and the strategic choice of expenditures to influence regulators.

[38] See Yeon-Koo Che (1995) and David J. Salant (1995), for example.

[39] Bengt Holmstrom and Paul Milgrom (1991), Holmstrom (1999), and Mathias Dewatripont, Ian Jewett, and Tirole (1999) examine the effects of long-term career concerns on short-term behavior. Such concerns can, for example, induce a regulator to focus primarily on performance dimensions that are readily observed (e.g., short-term price reductions) and less on performance dimensions that are more difficult for potential employers to observe in a timely fashion (e.g., prospects for viable long-term industry competition).

[40] See Oliver Williamson (1975) for a pioneering treatment of the problem and Newbery (1999) for an extensive discussion of the problem of regulatory commitment. Some authors (e.g., Witold J. Henisz 2000) have developed indices to measure expropriation risk in different countries. Jamison, Holt, and Berg (2005) review these indices.

[41] Wallsten (2001) finds that the privatization of state-owned telecommunications providers in Latin America and Africa is associated with improved industry performance when the industry regulator is independent (in the sense of not being directly under the control of a government ministry), but not otherwise. Geoff Edwards and Leonard Waverman (2006) find that regulatory independence is associated with lower charges for access to the network infrastructure of state-owned incumbent suppliers of telecommunications services.

contracts between the regulator and the firm, and can prevent a regulator from changing the terms of announced policies (including promised returns on investment) in response to pressure from other government agencies or the citizenry at large. When legal institutions are weak, pressure groups may anticipate substantial benefits from convincing the regulator to renege on the promises he has made to the firm.[42] Thus, the independence of a country's judicial system and the ability of a country to enforce the terms of legal contracts can affect the optimal design of industry policy.

A regulator may also be better able to pursue policies (such as delivering promised rewards to the regulated firm) that promote the long-term, rather than the short-term, interests of consumers if his tenure as regulator is relatively long. Long-lived regulators with sufficient concern about future industry outcomes will realize that short-term expropriation of an incumbent producer's investment will discourage future investment by the same firm or its successor.[43] In addition, a regulator may feel less pressure to pander to popular opinion if he is not elected by direct vote of the citizenry.[44] Thus, a setting where the regulator serves a fairly long term and faces reappointment by the government may provide an appropriate trade-off between independence and accountability.[45]

There is an additional benefit of a reasonable degree of regulatory independence from direct intervention by other government agencies. A government that is unable to intervene in the short-term operations of a regulatory agency is compelled to state as fully and clearly as possible the mission of the regulatory agency. Failure to do so will afford the regulatory agency the opportunity to pursue its own mission and goals, rather than those of the government more broadly.[46] A coherent and transparent statement of the principles that will guide industry policy provides greater certainty for industry participants, which can encourage investment and facilitate long-term planning.[47]

When regulatory capture is likely, explicit restrictions on the regulator's autonomy and commitment powers may be desirable in order to limit the regulator's ability to pursue interests other than the long-term social interest.[48] For example, key powers might be dispersed among multiple regulators or divided between a regulator and other government agencies.[49] Alternatively or in addition, the regulator's discretion in formulating

[42] Kessides (2004, p. 102) describes settings where governments have changed the terms of legal contracts.

[43] See Newbery (1999), Salant and Glenn A. Woroch (1992), and Paul Levine, Stern, and Francesc Trillas (2005) for formal analyses of this effect. Levine, Stern, and Trillas (2005) also emphasize the potential value of delegating authority to an independent regulator with substantial concern for the welfare of the firms he regulates.

[44] Timothy Besley and Stephen Coate (2003) employ data from the United States to examine the effects of the method by which state regulators are selected on performance in the state's electric power industry. The authors find lower prices and reduced investment (as proxied by the frequency of power outages) in states where regulators are elected than in states where regulators are appointed.

[45] See Maskin and Tirole (2004) for a formal analysis of this trade-off.

[46] In this respect, regulatory independence can deliver benefits similar to those provided by the privatization of a state-owned enterprise. Privatization increases the cost to the government of intervening in the day-to-day operations of the firm, and thereby renders more credible the government's promise to refrain from such intervention (Sappington and Stiglitz 1987). Regulatory independence enhances the commitment powers of regulators in similar fashion, once the mission and goals of the regulatory agency are stated clearly.

[47] Spiller and Vogelsang (1997) and Tonci Bakovic, Bernard Tenenbaum, and Fiona Woolf (2003) emphasize the value of coupling substantial regulatory independence with a clearly specified regulatory contract (e.g., a regulatory license). Under such coupling, regulators will have the independence required to implement impartially the details of a politically popular contract, but will not be empowered to implement any policy of their choosing. Using a large dataset of monopoly franchise auctions, Guasch (2004, table 1.16) reports that the original terms of the franchise contract were renegotiated 61 percent of the time when there was no separate regulatory body responsible for contract administration. The corresponding percentage was only 17 percent when the contracts were administered by a separate regulatory body.

[48] The independence granted the telecommunications regulator in Jamaica is believed to have led to a decline in industry investment as investors feared the regulator would use his autonomy to expropriate investments (Levy and Spiller 1994).

[49] See Laffont and David Martimort (1999) and Martimort (1999b).

policy might be substantially restricted.[50] The tenure of individual regulators might also be limited.[51]

Competition can play a particularly valuable role in disciplining and motivating the incumbent supplier to pursue the best interests of consumers when the regulator's powers to do so are (inherently or intentionally) limited. However, competition is not necessarily a panacea. Weak commitment powers may limit nonfungible investment under both unregulated competition and regulated monopoly. Competitors, like the incumbent supplier, will recognize that their investments may be expropriated by a regulator with substantial expropriation powers and limited commitment powers, and so may be reluctant to undertake the investment required to improve industry performance.[52] Thus, there is seldom an effective substitute for strong commitment powers.

4.6 *Investment and Innovation*

The link between industry structure and the incentive to innovate and to reduce costs is complex even in the absence of regulation.[53] Competing firms may have greater incentive than an unregulated monopoly provider to reduce operating costs in part because industry output (and thus the potential cost savings from a reduction in marginal production cost) is greater under competition than under unregulated monopoly.[54] In contrast, substantial market concentration can encourage innovation for at least two reasons. First, the profit a monopolist generates can serve as a valuable source of research and development (R&D) funding.[55] Second, the prospect of substantial monopoly profit can be a compelling reason to undertake R&D investment.[56]

Regulatory policy can affect infrastructure investment differently than it affects innovative effort and investment designed to reduce operating costs.[57] To illustrate this point, first consider rate of return regulation, which promises a fair return on prudently incurred investment. When expropriation can be avoided, such a promise can deliver strong incentives for infrastructure investment. In contrast, because it requires revenues to track costs closely, rate of return regulation (like other forms of "cost-plus" regulation) typically provides limited incentive for innovation and cost reduction.[58] Now consider price cap regulation, which typically permits revenues to diverge from realized costs for a specified period of time (e.g., four years) but does not promise

[50] See Laffont and Tirole (1990b).

[51] Martimort (1999a) shows that it can be optimal to impose more severe restrictions on a regulatory agency over time as the potential for regulatory capture increases.

[52] If competition undermines a regulator's (otherwise substantial) powers to promise attractive returns to the incumbent monopoly supplier, it is possible that competition may be inadvisable when the incumbent monopolist is investing and otherwise satisfying the long-term needs of consumers reasonably well. In extreme cases, unregulated monopoly might be the most effective way to deliver strong investment incentives if the absence of regulation, itself, constitutes a meaningful commitment not to expropriate a monopolist's earnings. Notice that, although a regulator may have particularly pronounced ability to expropriate investors because of his direct control over a broad range of industry policies, other government entities also may have substantial ability to expropriate investors by imposing excessive profit taxes or indirect taxes, for example.

[53] Wesley M. Cohen and Richard C. Levin (1989) review empirical studies of the relationship between market structure and innovation.

[54] See Kenneth J. Arrow (1962). Of course, this argument presumes that intellectual property protection precludes competitors from immediately copying the innovator's discovery and thereby eliminating the financial gain from innovation.

[55] This argument presumes that capital markets are imperfect. This is a reasonable assumption in the context of innovation because innovators often are unable to convince investors of the merits of their potential innovation without revealing the details of the innovation (and thereby forfeiting some of the potential financial gains from the innovation). See, for example, James J. Anton and Dennis A. Yao (1994, 2002).

[56] See Joseph Schumpeter (1950) and Glenn C. Loury (1979), for example.

[57] Guthrie (forthcoming) provides a more complete review of the literature that examines the impact of regulation on infrastructure investment.

[58] A regulatory policy that delivers no extra profit to a firm as its realized production costs decline effectively expropriates any investment the firm might make in an attempt to secure lower production costs.

specific long-term returns on investment. Although such a policy can provide substantial incentive for short-term innovation and cost reduction,[59] it may provide limited incentive for long-term infrastructure investment.[60] Therefore, the choice between rate of return regulation and price cap regulation will depend in part on the type of investment that is most important to secure. In settings where the top priority is to induce the regulated firm to employ its existing infrastructure more efficiently, price cap regulation may be preferable. In contrast, in settings where it is important to reverse a history of chronic underinvestment in key infrastructure, rate of return regulation may be preferable.[61]

The appropriate choice between rate of return regulation and price cap regulation also is influenced by industry volatility and regulatory commitment powers.[62] As costs and demands change over an extended time period, prices and costs will invariably diverge under price cap regulation, possibly leading either to financial distress or to particularly large profit for the regulated firm.[63] Neither of these outcomes is likely to be credibly sustained in settings where the country's institutions are weak. Therefore, in such settings, rate of return regulation may be preferable to price cap regulation in the presence of considerable industry volatility, particularly if infrastructure investment is desirable.[64] The cost-plus nature of rate of return regulation, which ensures profits are neither excessive nor insufficient, can render its implicit commitment to set prices that track costs closely more credible than the price commitments encompassed in a price cap plan.[65]

5. *Franchise Bidding*

Even when pronounced scale economies render direct competition in the market prohibitively costly, competition for the right to serve as a regulated monopoly supplier (in the form of franchise bidding) can sometimes capture for consumers much of the surplus that strong competition in the market would generate.[66] To illustrate the potential value of franchise bidding, return to the simple model considered in section 3 and suppose two firms bid for the right to serve as the sole provider of the product in question under terms specified by the regulator. Each firm is

[59] The regulatory policy implemented for British Gas in 1986 (which permitted the average price of natural gas to increase at the rate $RPI + Y - X$) is an example of price cap regulation. Sappington (2002) provides an overview of price cap regulation plans. Also see Jan Paul Acton and Vogelsang (1989), Jordan Jay Hillman and Ronald R. Braeutigam (1989), Armstrong, Cowan, and Vickers (1994), and Jeffrey I. Bernstein and Sappington (1999), for example. Notice that a promise to allow revenues to diverge from realized costs can play much the same role as intellectual property rights protection that allows an innovator to derive substantial financial gain from her innovation.

[60] A. Michael Spence (1975) observes that, when quality cannot be regulated directly, rate of return regulation may provide stronger incentives to supply quality than price cap regulation. Sappington (2005a) reviews the literature on service quality regulation in utility industries.

[61] Regulatory policies that deliver a consistent rate of return on investment also can reduce the variance in investors' financial returns, and thereby reduce the regulated firm's cost of capital.

[62] Alternatives to these two forms of regulation also merit consideration. As Schmalensee (1989) notes, earnings sharing plans (which specify explicit rules for sharing the firm's realized earnings with consumers) can help to avoid extreme distributions of rent that can prove difficult to enforce in practice. Sappington (2002) provides a discussion of earnings sharing plans and relevant references to the literature. Vogelsang (2005) explains how earnings sharing policies might be coupled with other regulatory regimes to provide appropriate short-term incentives for cost reduction and long-term incentives for investment.

[63] This is the case even if the price cap plan makes explicit adjustments for changes in economywide output prices and changes in key input prices.

[64] Of course, if a regulator has considerable discretion over which of the firm's investments qualify for the promised rate of return, serious problems of opportunism can arise under rate of return regulation, just as they can arise under price cap regulation.

[65] Guasch (2004, table 1.16) reports more widespread renegotiation of franchise contracts under price cap regulation than under rate of return regulation.

[66] Harold Demsetz (1968) provides the seminal discussion of this observation. Laffont and Tirole (1987), R. Preston McAfee and John McMillan (1987), and Riordan and Sappington (1987), among others, provide formal analyses of the optimal design of monopoly franchises.

privately informed about its own marginal cost of production ($c \in \{c_L, c_H\}$). The two possible cost realizations again are equally likely for each firm. Furthermore, for simplicity, the firms' cost realizations are uncorrelated.[67]

The optimal franchise bidding policy in this setting takes the following form. The two firms report their cost realizations simultaneously. If only one firm reports the low cost realization (c_L), that firm is selected to be the monopoly supplier, sell the product at unit price p_L, and receive transfer payment T_L. If both firms report low costs, one of the firms is selected at random to operate the (p_L, T_L) contract. If both firms report high costs (c_H), one of the firms is selected at random to operate under the (p_H, T_H) contract.

The contracts are optimally designed to ensure the firms report their costs truthfully. Consequently, a firm with the low marginal cost will be selected to serve as the monopoly supplier with probability 3/4. (Thus, franchise bidding secures the sampling benefit of competition.) A firm with the high marginal cost will operate with probability 1/4. Truthful reporting by the low cost firm will be a best response to truthful reporting by the rival potential producer if

$$(7) \qquad \frac{3}{4} U_L \geqq \frac{1}{4}[U_H + \Delta q(p_H)],$$

where $U_i \equiv [p_i - c_i]\, q(p_i) - F + T_i$ for $i = L,H$. The binding participation constraint will be that of the firm with the high marginal cost, so U_H is optimally held to zero. Inequality (7) will optimally be satisfied as an equality to limit the rent afforded a firm with the low marginal cost. Consequently, expected welfare under the optimal pricing policy is:

$$(8) \qquad \frac{3}{4}[w_L(p_L) - \frac{1}{3}[1 + \lambda - \alpha]\Delta q(p_H)] + \frac{1}{4} w_H(p_H).$$

Expression (8) reveals that p_H is optimally chosen to maximize $w_H(\cdot) - [1 + \lambda - \alpha]\Delta q(\cdot)$, while p_L is optimally chosen to maximize $w_L(\cdot)$. Therefore, prices in this franchise bidding setting are the same prices that are implemented in the regulated monopoly setting. (Recall expression (2).) The transfer payment (T_L) to the low-cost supplier is reduced in the franchise bidding setting, though. The firm will reveal its superior capabilities despite being promised a smaller transfer payment because cost exaggeration entails substantial risk of being excluded from the industry. (Thus, franchise bidding secures the rent-reducing benefit of competition.)

Because franchise bidding and monopoly regulation implement the same price for a given cost realization, total expected welfare is the same under the two regimes except that the likelihood of a low-cost supplier increases from 1/2 to 3/4. In the case where there is no cost of social funds (so $\lambda = 0$), expected welfare in the franchise bidding setting is:

$$(9) \qquad \frac{3}{4} v(c_L) + \frac{1}{4} v(c_H + [1 - \alpha]\Delta).$$

It is apparent that expression (9) exceeds expression (5). Expression (9) also exceeds expression (4) when $\rho = 1/2$.[68]

In summary, franchise bidding outperforms both monopoly regulation and duopoly competition in this simple setting.[69] It

[67] The regulator can achieve the ideal (full-information) outcome in this setting if the firms' costs are correlated. See, for example, Joel S. Demski and Sappington (1984) and Jacques Crémer and Richard P. McLean (1985).

[68] This is the case because $v(c_H + [1 - \alpha]\Delta) \geq v(c_H) - [1 - \alpha]\Delta q(c_H)$. Therefore, expression (9) will exceed expression (4) if $2[v(c_L) - v(c_H)] \geq \Delta q(c_H)[1 + \alpha]$. This inequality holds for all values of $\alpha \leq 1$.

[69] In practice, franchise auctions often take different forms. For example, firms often are invited to specify a price at which they are willing to supply the product in question to consumers, and the firm that bids the lowest price might be awarded exclusive production rights. This auction, which involves no transfer payments from firms to the government (or vice versa), typically will result in the most efficient firm serving consumers at a price that reflects its average cost of production. Such an auction resembles normal price competition but has the added advantage that it can permit profitable operation even in the presence of scale economies. Alternatively, the supply price might be determined in advance and firms could bid on the amount they will pay the government (or the payment they will require from the government) for the right (and obligation) to provide the service at the stipulated price.

does so by employing both transfer payments and price regulation to pursue social goals by ensuring the benefit of scale economies through the selection of a single supplier and by securing the sampling and rent-reducing benefits of competition.

More generally, franchise bidding can have its drawbacks. If potential operators do not have comparable skills, accurate information, and substantial financial resources, bidding for the right to serve as the monopoly supplier may not be intense. Firms will have little interest in bidding for a contract they expect to lose to a more capable operator. In addition, a firm will be reluctant to bid aggressively on a contract if it may win the contract not because it is the most capable producer but because it underestimates most severely the true (common) cost of operating the franchise.[70] A firm may be similarly reluctant to bid for a contract when it suspects other bidders (e.g., an incumbent provider of the service in question or a firm that provides similar services in another geographic region) have better information regarding the financial returns the contract is likely to provide. Furthermore, a firm cannot bid more for a contract than its financial resources allow.[71] When pronounced differences in skills or information and/or a dearth of qualified bidders with substantial financial resources limit the intensity of franchise bidding, such bidding will not capture for consumers the surplus they would enjoy if multiple, well-informed firms with similar capabilities competed against each other in the marketplace.[72]

Franchise bidding also may provide opportunities for the selected producer to "hold up" the government. After it is awarded the monopoly franchise, the chosen producer may attempt to renegotiate the terms of the original contract in order to secure more favorable terms.[73] The government may be susceptible to renegotiation demands in order to avoid the appearance of failure in the procurement process or to avoid substantial transaction costs associated with reauctioning the franchise.[74]

Franchise bidding also can fail to provide ideal incentives for investment. If the duration of the franchise contract is short relative to the useful life of a desirable sunk investment, the chosen supplier may be reluctant to undertake the investment if the firm's tenure as the monopoly supplier is likely to

[70] This possibility is known as the "winner's curse." See Vijay Krishna (2002, pp. 84–85), for example.

[71] The terms of the franchise contract can be altered to counteract the problems that arise when bidders have limited financial resources. For example, rather than bid on a lump-sum franchise fee, potential operators might bid on the fraction of realized profit (or revenue) that they are willing to share with their customers. See Tracy R. Lewis and Sappington (2000) for details. Che and Ian Gale (1998, 2000) provide related analyses.

[72] A decision to exclude foreign investors from the bidding process (to promote nationalism or to further national security, for example) can limit substantially the intensity of franchise bidding. Such exclusion also can reduce the value of the franchise since the skills and expertise of the successful bidder affect the profit the enterprise can generate. Roman Frydman, Cheryl Gray, Marek Hessel, and Andrzej Rapaczynski (1999) report that enterprise revenues increase substantially when an SOE is sold to outside managers, but not when it is sold to individuals who managed the SOE before its privatization.

[73] Guasch (2004) analyzes more than 1,000 franchise auctions in Latin America and the Caribbean between 1985 and 2000. He finds that more than 50 percent of electricity franchise contracts and 75 percent of water franchise contracts were renegotiated. The average time between franchise award and renegotiation was approximately two years. Renegotiation was initiated by the chosen operator more often than it was initiated by the government.

[74] When all relevant dimensions of performance are not specified clearly in a regulatory contract, a potential supplier may be able to bid the highest franchise fee, not because it is the least-cost supplier of the services in question, but because it will deliver the least on all of the performance dimensions that are not specified in the regulatory contract. Alejandro M. Manelli and Daniel R. Vincent (1995) identify conditions under which considerations of this sort render it optimal for a regulator to negotiate a contract with a single selected supplier rather than to award the franchise to the firm that bids the most to operate under a contract that does not specify fully all relevant dimensions of performance.

end before it can fully recover the cost of the investment. Consequently, the chosen supplier may adopt an inefficient production technology (one that employs an unduly small level of sunk costs) and all potential suppliers may reduce their bids for the right to serve as the monopolist.

Although long-term contracts can, in principle, help to overcome this problem, long-term contracts seldom are a panacea. In practice, it typically is impossible to delineate all relevant contingencies in a contract.[75] Furthermore, rigid contracts can preclude valuable adaptations to changing industry conditions. In addition, even the most carefully crafted long-term contracts may not be enforced if the prevailing legal institutions are weak. For all these reasons, even long-term contracts typically are unable to deliver ideal investment incentives. In some settings, it may be possible to adjust franchise bidding policies to counteract some of these problems.[76] For example, auction rules that favor the incumbent supplier can enhance the incumbent's incentive to undertake sunk investments in the presence of short-term contracts.[77]

In summary, auctions for the right to be the sole supplier can help to limit monopoly rents and to select the most efficient industry supplier. However, franchise auctions seldom eliminate the need for regulation. Moreover, the same strong regulatory institutions that are necessary for effective monopoly regulation are required for the success of franchise bidding contracts. When these institutions are present, though, franchise bidding can constitute a useful additional instrument that regulators can employ to select and discipline sole providers in network industries.[78]

In concluding this section, we note that yardstick competition can secure many of the same benefits as franchise bidding in settings where different monopolists operate in distinct geographic markets. (For example, different water distribution companies often serve different regions of a country.) In such settings, each monopolist might be compensated on the basis of how its performance compares to the performance of other monopolists. For example, the compensation delivered to each firm might be set equal to an index of the realized costs of the other firms, rather than its own costs. This and other forms of yardstick competition can provide strong incentives for efficient performance by all monopolists when they are known to operate in similar settings. When the firms operate in environments that differ substantially (in geographic area, terrain, weather, or population density, for example), explicit corrections for relevant differences can be important. Such corrections typically will be necessary to avoid compensation that is unduly generous for some firms and unduly meager for others. Appropriate handicapping can be difficult in the presence of limited information about the precise nature of the variation in the firms' operating conditions. However, some relative performance comparisons generally can

[75] See Williamson (1976), for example.

[76] Robin A. Prager (1989), Mark A. Zupan (1989a, 1989b), and Yasuji Otsuka (1997) present evidence which suggests that these difficulties with franchise competition are not always insurmountable in practice.

[77] See Laffont and Tirole (1988). Investment also might be encouraged by adopting technologies that employ more fungible physical assets (e.g., wireless rather than wireline facilities in the telecommunications industry).

[78] Regulators can sometimes benefit by ensuring that alternative suppliers are available to replace the incumbent supplier as needed. Although it can be costly to maintain a second source of production, the ability to readily shift some or all production to the second source can impose useful discipline on a monopoly supplier. See, for example, Rafael Rob (1986), Anton and Yao (1987), Demski, Sappington, and Speller (1987), Riordan (1996), Riordan and Sappington (1989), James D. Dana, Jr. and Kathryn E. Spier (1994), and Anton and Paul J. Gertler (2004).

help to discipline and motivate monopoly suppliers.[79]

6. *Entry Assistance and Anti-Competitive Liberalization Policies*

The foregoing discussion suggests the greatest potential gains from competition will tend to arise when: (1) industry scale economies are limited relative to consumer demand; (2) the industry regulator has limited information, limited resources, and limited instruments with which to craft policy; (3) the regulator's commitment powers are limited; and (4) subsidization of the consumption of some of the dominant supplier's services is either not critical or can be achieved by means other than regulating the supplier's price structure.

The design of liberalization policy is of paramount importance in settings where competition is deemed to be a superior alternative to a prevailing monopoly regime. The purpose of this third segment of the present essay is to discuss the principles that underlie the design of sound liberalization policy.[80] After considering the subtle issue of explicit entry assistance, this section focuses on liberalization policies that can hinder (rather than promote) vibrant, long-term industry competition. Section 7 reviews preferable competition-enhancing liberalization policies.

It is important to emphasize at the outset that the discussion in both this section and the next necessarily entails some subjective judgments. Furthermore, even though the policies considered in this section generally are not recommended, some of the policies can, in theory, enhance welfare in certain settings if the regulator is particularly well informed. Therefore, definitive, unequivocal conclusions about liberalization policies are difficult to draw. The ensuing discussion is intended to provide general guiding principles (to the extent possible) rather than precise, comprehensive prescriptions and definitive conclusions.

Successful liberalization is seldom as simple as removing all legal restrictions on entry into the regulated industry. Entrants face myriad economic barriers to entry, even when legal barriers are removed. These entry barriers include (1) customer inertia due to switching costs or ignorance, for example; (2) incumbent control of key inputs that entrants require for profitable operation; and (3) the prospect of aggressive pricing by incumbent suppliers. Policies that reduce or limit the effects of entry barriers constitute vital components of a successful liberalization plan, as explained in section 7. However, is the reduction of entry barriers sufficient, or should liberalization efforts include additional policies that provide explicit assistance to competitors?

Although such direct assistance has many important drawbacks (as explained further below), it can in principle increase total welfare under some conditions. To illustrate, suppose competition would drive prices close to the entrant's marginal cost of production, as it would, for example, in the setting of section 3.2 when the competitors' costs are highly correlated. In such a setting, an entrant will anticipate limited variable profit from industry operations. Consequently, if the entrant must incur a substantial sunk cost in order to enter the industry, the potential competitor will decline to enter, even if it faces no legal restrictions on entry. Therefore, entry may be least likely to occur without assistance

[79] See Andrei Shleifer (1985), Joel Sobel (1999), Roger Carrington, Tim Coelli, and Eric Groom (2002), and Mehdi Farsi, Massimo Filippino, and William Greene (2005), for example. Armstrong and Sappington (forthcoming, section 4.1) provide further discussion and references. Notice that the entire benefit of yardstick competition arises from the rent-reducing impact of operation by multiple firms. Yardstick competition does not admit a sampling benefit because the firm that supplies a given market is fixed exogenously.

[80] This discussion draws in part from Armstrong, Cowan, and Vickers (1994, chapter 4).

precisely when, due to its intensity, competition is most effective relative to regulation.[81] In such settings, entry assistance (perhaps in the form of a subsidy financed by public funds to cover the sunk entry cost, for example) could increase social welfare in theory. However, the appropriate magnitude of such entry assistance can be difficult to determine in practice. Furthermore, such assistance can promote regulatory capture and unproductive use of public funds.

The general merits of entry assistance depend in part on the external effects of entry. External effects refer to the effects of entry on consumer surplus and the profits of incumbent producers. External effects may cause entry to be unprofitable for an individual firm even though entry would increase consumer surplus and total welfare, as in the setting just described. External effects also may cause entry to be profitable for an individual firm even though entry would reduce total welfare. Such a setting (in which it can be more appropriate to discourage entry than to assist entry) arises naturally when the profit an entrant anticipates from industry participation is derived in part from profit that would otherwise accrue to incumbent producers.[82]

Because the most appropriate level of direct entry assistance can be difficult to determine and because such entry assistance can have undesirable consequences,[83] it generally is not recommended. The following liberalization policies (some of which entail entry assistance and some of which fail to reduce entry barriers adequately) also generally are not recommended.

6.1 *Provide a Temporary Monopoly or Oligopoly*

A common form of liberalization is to announce a future (sometimes distant) date at which competition will be admitted, but explicitly preclude widespread competition before that date.[84] A temporary monopoly (or oligopoly) policy of this sort often is adopted in part to secure the incumbent supplier's support for liberalization. Such support may be important, for example, when the incumbent supplier is a state-owned enterprise with substantial authority to set industry policy or when the incumbent supplier employs a large labor force and so has substantial political power.

In principle, a temporary monopoly policy can have some merit. Intense competition can increase the risk of and limit the return from investment, and thereby reduce the investment of the incumbent supplier. Therefore, in principle, a temporary monopoly could increase the incumbent supplier's investment, to the benefit of consumers.

However, the temporary monopoly also postpones investment by new suppliers, and so may reduce aggregate investment in both the short run and the long run. Furthermore, investment by new entrants may spur retaliatory or defensive effort by the incumbent supplier.[85] This added impetus for investment by an incumbent supplier is eliminated in the short run by a temporary monopoly policy, and potentially reduced by a temporary oligopoly policy. A temporary oligopoly policy also can limit entry to a few selected competitors. Such selection runs the risk of allowing less efficient suppliers to

[81] Entrants may require little assistance when they are competing against an inefficient incumbent supplier that has historically delivered poor service quality to consumers. Consumers often will be anxious to secure service from an alternative supplier under such conditions.

[82] Unassisted entry by the first firm in a market generates positive external effects in that market. The first producer causes consumer surplus to increase and does not affect the profits of other producers.

[83] The information required to assess the magnitude of relevant external effects includes the details of consumer demand, the extent and nature of product heterogeneity, and the production technologies of actual and potential producers. See N. Gregory Mankiw and Michael D. Whinston (1986) for additional analysis of this issue.

[84] Recall that British Gas was permitted to retain its monopoly status (albeit in continually shrinking market segments) during the initial stages of liberalization.

[85] See Woroch (2000) for evidence of this effect.

compete, while excluding the most efficient suppliers from the market. A priori restrictions on the number of competitors also can limit product innovation, facilitate collusion among the selected incumbent producers, and limit industry pressure to reduce operating costs and prices.

A temporary duopoly is sometimes suggested as a means to assist at least one additional industry participant on the grounds that no entry would occur if an entrant were not promised the security of a temporary duopoly. This rationale is not entirely compelling. If a second entrant would render the first entrant unprofitable, the second entrant seems unlikely to enter unless it is more efficient than the first entrant. Furthermore, an incumbent producer may benefit greatly from entry assistance of this type, which suggests such assistance may be poorly targeted.

An additional potential drawback to a temporary monopoly is that it may provide ample time for an incumbent supplier to devise ways to limit the likely success of future competitors. In addition, "temporary" monopolies can become permanent or semipermanent monopolies in settings where the incumbent supplier has substantial political power and where the regulator's commitment powers are limited.

The welfare losses from temporary monopolies and oligopolies can be substantial. In the United States, for example, service quality increased and prices for wireless telecommunications services declined substantially once the relevant markets were opened to more than two providers.[86] During the mandated duopoly period, however, industry prices remained close to their monopoly levels.[87] Similarly, the prices of wireline telecommunications services did not decline substantially in Australia during its mandated duopoly period. In contrast, prices dropped significantly in countries (like Chile and Guatemala, for example) that did not adopt duopoly policies.[88]

6.2 *Exclude Foreign Investors*

Feelings of nationalism and concerns with national security can lead to the imposition of limits on foreign participation in key domestic industries.[89] Although such limits can reduce foreign control of domestic industry, they can impose significant costs on the domestic economy. Limits on foreign ownership can reduce the flow of much-needed capital to the domestic industry. The limits can also serve to exclude the most knowledgeable and experienced operators from the industry, and thereby reduce industry performance. In cases where operating licenses are sold by a domestic government, limits on foreign participation can also reduce the license revenue that accrues to the domestic government.

6.3 *Specify Market Share Targets*

In an attempt to ensure adequate competitive pressure in a liberalized industry, regulators sometimes specify the market share they would like to see competitors achieve.[90] Such a policy suffers from at least two major drawbacks. First, market share is not necessarily a good measure of market power. In particular, an incumbent supplier may have substantial ability to raise the prices it charges for its services even when competitors presently serve a significant portion of customers. This ability to raise prices profitably may stem from the incumbent's superior products or control over key inputs, for example. Consequently, the specification of a target market share for competitors may

[86] See Federal Communications Commission (2003).

[87] See Philip M. Parker and Lars-Hendrik Röller (1997).

[88] See Spiller and Cardilli (1997), for example. The United Kingdom adopted a seven year duopoly policy in its telecommunications industry. Newbery (1999, table 7.4) reports that the productivity of the incumbent producer in the United Kingdom improved significantly only when the duopoly policy was relaxed.

[89] These concerns may be particularly strong in countries where colonial rule has only recently ended.

[90] Recall that target market shares were specified in the U.K. natural gas industry.

not ensure that substantial discipline is imposed on the incumbent supplier.[91]

Second, the specification of market share targets can reduce the intensity of market competition. An incumbent supplier may choose not to compete aggressively against a rival in order to ensure that the rival achieves its market share target. When market share targets are specified, the incumbent may rationally refrain from aggressive competition, recognizing that it may cause the regulator to impose more stringent regulations on the incumbent when competitors fail to achieve their market share targets. The resulting diminution in competitive intensity can result in higher prices and lower service quality for customers and can enable competitors to survive in the marketplace even though they have higher costs than the incumbent supplier.

6.4 *Implement Vague or Excessively Generous Network Access Policies*

Many network industries entail a vertical structure that contains a massive network infrastructure segment (e.g., a basic telecommunications network or a gas or electricity transmission system). The incumbent supplier of retail services often owns or operates the infrastructure segment. Given the prohibitive cost of constructing multiple infrastructures, rival retail operators often are compelled to procure key inputs (e.g., network access) from the incumbent, vertically integrated supplier. The appropriate design of the terms that govern competitors' access to the incumbent's network poses a formidable challenge for regulators. Some undesirable (but not uncommon) elements of network access policy are mentioned here. More desirable elements of network access policy are reviewed in section 7.

One inappropriate element of network access policy is a vague or incomplete statement of the incumbent producer's obligations to supply access to rivals during the liberalization process. If, for example, an incumbent producer is afforded substantial latitude in setting the terms and conditions of network access, the incumbent should be expected to employ this latitude to disadvantage retail rivals. For example, the incumbent should be expected to set high access prices, limit the quality of the inputs delivered to rivals, and delay the provision of access.[92]

A second inappropriate element of network access policy is the failure to establish a timely, functional dispute resolution process. When they operate as rivals at the retail stage of production, the incumbent producer and retail competitors naturally will have divergent interests regarding the terms and conditions of access. These divergent interests often will lead to disputes, even when the incumbent's obligations are reasonably well specified. Prompt resolution of these disputes is necessary to ensure the timely implementation of the liberalization process. By specifying clearly the details of a rapid dispute resolution mechanism, a regulator can help to ensure that an incumbent producer does not disadvantage competitors

[91] It is also possible that an incumbent's market share might overstate the firm's market power. For instance, consider Bertrand price competition in a setting where one firm has slightly lower unit cost than its rivals. In equilibrium, this firm will have a 100 percent market share even though it has limited ability to raise the market price.

[92] Recall that competing suppliers of natural gas enjoyed little success until the terms of access to British Gas's infrastructure were explicitly regulated. Weisman (1995), Nicholas Economides (1998), David Reiffen (1998), David M. Mandy (2000), T. Randolph Beard, David L. Kaserman, and John W. Mayo (2001), and Mandy and Sappington (forthcoming), among others, analyze the incentives of a vertically integrated supplier to disadvantage retail competitors. Of course, a vertically integrated incumbent supplier may not wish to disadvantage a retail competitor if the competitor is substantially more efficient than the incumbent and if the incumbent can secure sufficiently high profit margins on the inputs it sells to the retail competitor. See, for example, Sibley and Weisman (1998) and Rey and Tirole (forthcoming).

by delaying unduly their access to key network infrastructure.[93]

A third inappropriate element of network access policy is the implementation of terms of access that are unduly generous for entrants. To reduce the costs that new suppliers incur when entering a market, regulators may afford new suppliers access to essential infrastructure at prices that are below the incumbent's costs of supplying the access. Short-term subsidies of this nature can reduce the costs that new suppliers incur as they begin to provide service in a formerly monopolized industry. In doing so, such subsidies may help to attract new competitors to the industry and thereby "jump start" competition.[94]

While short-term subsidies could, in principle, prove beneficial in this regard, subsidies that are intended to be in effect for only a short period of time often remain in effect far longer. Long-term subsidies of this sort introduce at least two important problems. First, the subsidies may permit inefficient firms to operate profitably in the industry, thereby increasing industry costs and reducing industry welfare. Second, subsidized access to infrastructure can induce competitors to employ inefficient operating technologies. In particular, a competitor may decide to employ the subsidized access to the incumbent's infrastructure even though the competitor would employ fewer social resources if it built and employed its own infrastructure. Thus, by distorting the technological choices of competitors, subsidized infrastructure access can increase industry operating costs. It can also reduce product and process innovation in the industry by limiting the extent to which competitors construct their own infrastructures.[95]

6.5 *Restrict the Incumbent Asymmetrically*

Stringent, asymmetric regulation of an incumbent supplier that limits the incumbent's ability to compete against entrants can help to attract entry. However, even when entry is desirable, the costs of asymmetric regulation often outweigh its benefits.

To illustrate this more general principle, consider a policy that embeds cross subsidies in the incumbent supplier's pricing structure and prohibits the incumbent from reducing any of its prices in response to competitive pressures (even prices that exceed production costs by a substantial margin). Such a policy has at least four potential drawbacks. First, the cream-skimming induced by cross-subsidies can jeopardize the financial integrity of the incumbent supplier. It can do so by reducing the incumbent's sales of the profitable services targeted by competitors without any offsetting reduction in the sales of the unprofitable, subsidized services. Second, the cross subsidies can increase industry costs by allowing inefficient suppliers to serve customers. Third, when competitors focus their efforts on selling the most profitable services, customers of unprofitable, subsidized services are denied the benefits of competition.[96] Fourth, as explained more fully in section 7.7 below, the design of appropriate access charges can be complicated considerably when the incumbent supplier's retail tariffs do not reflect the supplier's costs.

[93] Recall that few interconnection agreements were negotiated in Chile until after strict mandates for timely negotiation and an effective dispute resolution mechanism were implemented. Spiller and Cardilli (1997) explain how final-offer arbitration of the type implemented in Guatemala's telecommunications industry can facilitate timely negotiation of interconnection agreements.

[94] See Joshua S. Gans and Stephen P. King (2004) for an analysis of this issue. Of course, if access prices are unduly high, competitors may build their own infrastructure even though short-term and long-term industry costs would be minimized if the competitors employed the incumbent's infrastructure.

[95] See, for example, Hausman (1997), Hausman and J. Gregory Sidak (1999, 2005), Gregory Rosston and Noll (2002), and the discussion in section 7.7 below.

[96] Recall that uniform retail prices and distance-based access charges to British Gas's transport pipeline may encourage competitors to serve customers located close to gas landing points.

As one further illustration, consider an asymmetric policy that precludes an incumbent supplier from expanding its product line (e.g., an incumbent supplier of telephone service might be precluded from providing cable television service). It is apparent that such regulations can lead to higher prices, reduced product variety, and lower product quality. When a strong, viable competitor is precluded from a market, the remaining operators may not be compelled to compete as aggressively as they otherwise might. Consequently, prices may rise, superior products may be introduced less frequently, and the quality of existing products may decline.[97] Consumers are harmed by each of these outcomes.

In summary, although restrictions on the scope of an incumbent supplier's operations do not necessarily reduce welfare (see section 7.6 below), they have substantial potential to do so if they are not applied judiciously. Similarly, many of the other types of liberalization considered in this section can, in principle, increase welfare under some conditions. However, these liberalization policies generally are not the best way to promote vigorous, long-term industry competition. Preferable policies are considered next.

7. *Pro-Competitive Liberalization Policies*

The purpose of this section is to describe liberalization policies that generally can help to foster vigorous long-term industry competition while avoiding many of the potential drawbacks discussed in section 6. The liberalization policies discussed in this section focus more on removing entry barriers and unleashing the full force of competition rather than on handicapping or favoring certain competitors. Such policies provide increased potential for ultimately relying on market forces rather than on ongoing detailed regulatory oversight to ensure that consumers are well served.

7.1 *Reduce Customer Switching and Search Costs*

Competition can compel providers to deliver high-quality products to consumers at low prices if consumers are able to easily identify and secure service from the firms that offer the best products at the lowest prices.[98] Therefore, liberalization policies that help to ensure consumers are well informed and are able to switch their service provider easily can stimulate vibrant, enduring competition that may ultimately substitute for regulatory oversight.[99] Specific policies that can be helpful in this regard include the following three.

First, consumers might be afforded ready access to information about the services that competitors offer. Relevant information includes both price and (objective, verifiable) quality information. If consumers generally have access to the Internet, relevant information might be made available at a government (or government accredited) web site. The web site address might be printed on the bills that customers receive from the incumbent supplier. Price comparisons will be most transparent when the services the firms supply are fairly homogenous (such as gas and electricity). Price comparisons can be less meaningful when

[97] Service quality may also decline when universal service obligations require incumbent suppliers to offer service at uneconomic rates. Reductions in service quality can both reduce the cost of supplying the uneconomic service and reduce customer demand for the service. Both effects increase the profit of an incumbent supplier that is saddled with uneconomic universal service obligations.

[98] See Asher Wolinsky (1997) for a model in which a regulator often allows firms to compete directly for customers rather than specifying market boundaries because customers can better discern service quality than the regulator.

[99] Recall that many consumers continue to purchase natural gas from British Gas, even though it tends to charge more for gas than its competitors. This behavior may be explained in part by consumer ignorance regarding the prices charged by competitors.

industry suppliers offer heterogeneous services (e.g., certain types of telecommunications services). Even when it is impractical to provide comparative information, though, basic information about how to contact competing suppliers can increase consumer awareness of competitive alternatives and thereby enhance industry competition.[100]

Second, steps might be taken to reduce the costs that customers incur when they switch suppliers.[101] For example, providers of local telephone service might be required to install technologies that allow a customer to retain the same telephone number regardless of the supplier from which the customer secures service. Absent such "number portability," a consumer might be reluctant to switch suppliers because the switch would require the consumer to inform all friends and associates of her new number or reprint business cards and stationery on which the number appears, for example.[102]

Third, policies might be implemented to reduce asymmetries in the costs that consumers incur when they choose different suppliers. For example, carrier preselection policies in the telecommunications industry allow customers to designate in advance the long-distance carrier that they would like to complete all of their long-distance telephone calls. When a carrier preselection policy is in place, customers do not need to dial additional numbers or otherwise undertake costly or time-consuming activities in order to direct their long-distance telephone business to their preferred carrier. Consequently, new carriers do not need to convince customers to incur substantial costs in order to win their loyalty. The new carriers need only provide higher quality and/or lower prices than incumbent carriers.[103]

More generally, liberalization policies that provide objective information to consumers about the options available to them, reduce customer switching costs, and limit any differential costs that consumers must incur to obtain service from their preferred supplier can foster vibrant, long-term industry competition.

7.2 *Ensure Adequate Monitoring and Data Reporting*

Accurate information about the activities and capabilities of both incumbent suppliers and new operators is of great value when designing regulatory and liberalization policies. This information is essential in assessing the nature and intensity of industry competition and, thus, the extent to which stringent regulatory controls can be relaxed.

Accurate information about the services that competitors supply is important in order to identify the services on which the incumbent supplier might reasonably be afforded more substantial pricing flexibility. Market concentration (as measured by the Herfindahl Index, for example) can sometimes serve as an imperfect indicator of the intensity of market competition. Information about the installed capacity of competitors can be of greater value in assessing both the current and likely future intensity of market

[100] Models of unregulated oligopoly (e.g., Hal R. Varian 1980) often predict that the average equilibrium price in an industry declines as more consumers become informed about the prices competitors charge. Thus, policies that make some consumers more aware of prevailing prices can benefit all consumers.

[101] See Joseph Farrell and Paul Klemperer (forthcoming) for an overview of the economics of switching costs.

[102] Of course, the benefits of policies like number portability must be weighed carefully against the associated costs (e.g., the costs of designing and installing the requisite technology).

[103] Michael Waterson (2003) discusses the potential merits of requiring customers to choose their supplier annually, along the lines of annual policy renewals that are common in the insurance industry. While such a requirement can reduce the differential costs that customers incur in choosing to receive service from a new entrant rather than continuing to receive service from the incumbent supplier, the policy increases transactions costs for all consumers, not only for those who switch suppliers. The same is true of Chile's equal access policy, which, recall, requires callers to specify their preferred carrier every time they place a long distance call.

competition, as can detailed knowledge of the entry barriers that competitors face.

To ensure the timely availability of the information required to formulate appropriate liberalization policies, it is important to establish data reporting requirements. The requirements should specify clearly what data must be reported, how often it must be reported, and which entities must report the data. The data reporting requirements should be changed as infrequently as possible, so as to limit the costs imposed on the reporting entities (and to provide a consistent time series of data).[104]

7.3 *Privatize State-Owned Enterprises*

When the incumbent supplier is owned (wholly or primarily) by the government rather than by private investors, privatization of the state-owned enterprise (SOE) can be an important element of a successful liberalization policy. By hardening soft budget constraints and promoting profit maximization, privatization of an SOE (i.e., selling the firm to private investors) can (1) serve to focus the firm's efforts on reducing its operating costs and delivering high-quality services to consumers and (2) reduce a firm's incentive and ability to engage in below-cost pricing which can preclude the efficient operation of more efficient competitors.[105]

In settings where a government's commitment powers are limited, partial privatization of an SOE may be preferable to full privatization. When the government retains an ownership stake in the firm, the government, like private investors, will suffer financially if it implements policies that reduce the firm's earnings. Consequently, a promise by the government not to expropriate private investors may be more credible when the firm is partially privatized than when it is fully privatized.[106] Widespread domestic distribution of the privately held shares of the (partially) privatized firm can have a similar effect. In the presence of such widespread domestic ownership of the privatized firm, any policy the government might implement that seriously erodes the earnings of the firm would likely evoke widespread, popular opposition. Fearful of the political ramifications of any such widespread opposition, the government will be reluctant to expropriate the privatized firm.[107]

7.4 *Rebalance Retail Tariffs to Better Reflect Costs*

Vibrant long-term industry competition can also be fostered by rebalancing the prices the incumbent supplier charges for its services. Rate rebalancing occurs when prices are aligned more closely with incremental production costs. Ideally, the desired rate rebalancing should be completed at the outset of the liberalization process in order to provide appropriate signals to potential competitors about their likely returns from long-term industry operation. Although prices that diverge from cost can help to achieve desired income distribution, pricing structures that embed cross-subsidies are inappropriate when industry liberalization is under way because they introduce the problems identified in section 6.5.

To avoid these problems, the price charged for each of an incumbent's services should be set at or above the firm's incremental cost of providing the service.[108] Such

[104] Regulators may rationally choose to keep some of the reported data confidential. Confidentiality can protect proprietary business plans and limit undesired information sharing among industry participants.

[105] Sappington and Sidak (2003) note that an SOE's reduced focus on profit can increase its incentives to engage in anticompetitive activities. If, for example, an SOE is more concerned with market share than profit, the SOE may be more willing than a profit-maximizing firm to implement below-cost pricing for an extended period of time.

[106] See, for example, Enrico C. Perotti and Serhat E. Guney (1993), Perotti (1995), and Germa Bel (2003).

[107] See Armstrong, Cowan, and Vickers (1994), Bruno Biais and Perotti (2002), and Bel (2003).

[108] In the presence of scale and scope economies, it may not be possible to set tariffs that reflect marginal production costs without inflicting a financial deficit on the incumbent supplier.

rate rebalancing helps to direct the forces of competition to those services that competitors can supply more efficiently than the incumbent supplier and allow the incumbent supplier to deliver the services that it can supply more efficiently than its rivals.

In settings where rate rebalancing would require dramatic increases in the prices of certain essential services, strong opposition to the rebalancing may arise. To ameliorate this opposition, rates might be rebalanced gradually over time, even though complete rebalancing at the outset of liberalization is preferable, when it is feasible. Alternatively, or in addition, financial support might be provided directly to the customers that would find the price increases to be most burdensome. Such a policy can replace implicit subsidies to all consumers with explicit subsidies to those with the greatest need for financial assistance.[109] If the country's tax system is relatively efficient, general tax revenue can be the best source of funds for the explicit, targeted subsidies in the regulated industry.[110] If the subsidies must be funded entirely within the regulated industry, taxes can be imposed on services that are deemed to be less essential (e.g., the services whose prices were set well above the incumbent's costs prior to liberalization). Any such commodity taxes should apply symmetrically to all suppliers, so as not to distort the competitive process.[111]

7.5 *Allow Adequate, But Not Unlimited, Pricing Flexibility*

If it has no freedom to change the prices it charges for its services, the incumbent supplier will have limited ability to respond to the challenges presented by competitors. Consequently, competitors may survive in the market even if they are less efficient than the incumbent supplier.[112]

Price cap regulation can provide incumbent suppliers some pricing flexibility while limiting undue exercise of market power. Price cap regulation plans typically constrain the rate at which the regulated firm's prices can rise on average, without specifying the exact price that must be charged for any particular service. The application of distinct price cap constraints to distinct groups of services can afford the incumbent supplier some flexibility to respond to competitive challenges without allowing the firm to abuse its market power. To illustrate, the firm might be permitted to increase by five percent annually the average of the prices it charges for services that are supplied by competitors. The firm might also be allowed to increase by one percent annually the average of the prices it charges for services that generally are not supplied by competitors. Pricing restrictions like these that impose different and separate constraints on different groups of services can provide adequate protection for customers who have no competitive alternatives while affording the incumbent supplier a reasonable opportunity to respond to emerging competitive challenges.[113]

In addition, incumbents should generally be precluded from pricing an established service below the incremental cost of providing the service (unless they are required to do so as part of a universal service obligation). As explained above, below-cost pricing

[109] Recall that Chile implemented a program to subsidize the purchase of basic telephone service by citizens in rural regions and low-income urban areas (Laffont 2005, p. 216).

[110] See Atkinson and Stiglitz (1976) and Laffont and Tirole (2000, chapter 6).

[111] Armstrong (2002, section 2.1) discusses the design and implementation of such taxes.

[112] Recall that some observers believe the success enjoyed by new suppliers of local telecommunications services in Chile may be due in part to the limits placed on CTC's ability to reduce prices selectively in response to competitors' prices (Paredes 2005).

[113] Armstrong, Cowan, and Vickers (1994, section 7.5.4) describe how British Telecom used the pricing flexibility it was afforded by price cap regulation to reduce prices substantially on long distance telephone calls (that were also supplied by competitors) while raising prices for local telephone calls (for which there were essentially no other suppliers).

can preclude the operation of more efficient suppliers, and thereby raise industry costs.[114] Below-cost pricing also encourages excessive consumption (i.e., consumption beyond the point at which the marginal benefit of consumption is equal to the marginal cost of production).

It is particularly important to monitor and implement procedures to preclude below-cost pricing by a firm that operates under price cap regulation. This is because such a firm can have a particularly strong incentive to price below cost the services on which it faces particularly intense competition. Under a price cap plan that restricts the rate at which all of the firm's prices can increase on average, a substantial reduction in the price of one service can authorize a pronounced increase in the price of another service. By permitting increases in net revenue on some services that offset corresponding reductions from below-cost pricing on other services, price cap regulation plans can enhance the incentives of an incumbent regulated firm to set predatory prices that can serve to drive its rivals from the market.[115] Therefore, safeguards against below-cost pricing are an important component of price cap regulation plans.

[114] In settings where an incumbent, vertically integrated producer (VIP) otherwise has considerable pricing flexibility, the relevant price floor can include an "imputation" requirement in order to prevent a price squeeze. A price squeeze occurs when a VIP sets a price for a key input that exceeds the price of the VIP's relevant retail service. An imputation requirement obligates the VIP to price its retail service above the sum of the VIP's (downstream) unit cost of producing the retail service and the unit price the VIP charges its retails competitors for the key input. Thus, the lower bound on the price of the VIP's retail product is the usual incremental cost floor, with one exception. The VIP's cost of producing the key input is imputed as the input cost that the VIP imposes on its retail competitors. This price floor is thus the incremental cost the VIP would incur if it faced the same input cost as its rivals. This imputation procedure avoids price squeezes, and thereby helps to ensure that the most efficient providers supply the retail service.

[115] See Armstrong and Vickers (1993).

7.6 *Prevent Disadvantaging of Downstream Competitors*

Vertically integrated producers (VIPs) that both sell essential inputs to retail producers and supply the retail service themselves can disadvantage their rivals through anticompetitive actions other than predatory pricing. For example, consider a setting where a VIP operates under price cap regulation. Suppose the price cap regulation plan imposes a single overarching restriction on the prices of all of the VIP's services, both retail and wholesale services. Under such a restriction, price reductions on retail services effectively authorize price increases on wholesale services. Both price changes are disadvantageous for retail competitors who must purchase the VIP's wholesale services. To limit such disadvantaging of rivals, it generally is advisable to place separate restrictions on the rate at which a VIP's wholesale service prices can rise and on the rate at which its retail service prices can rise.[116]

VIPs can disadvantage retail competitors through means other than strategic pricing. For example, as indicated in section 6.4, a VIP could intentionally reduce the quality of the inputs it delivers to its downstream competitors and thereby limit the competitors' ability to deliver high quality services to their customers.[117] To limit undesirable strategic disadvantaging of rivals, careful monitoring of the quality of the inputs that a VIP delivers to its downstream rivals can be advisable, as can an explicit schedule of penalties for unduly low service quality and, perhaps, rewards for exceptionally high levels of service quality.[118] Structural separation of the

[116] Laffont and Tirole (1996) note that when wholesale and retail services are treated as separate baskets of services in this manner, a VIP's ability and incentive to implement Ramsey prices may be reduced.

[117] Reiffen, Laurence Schumann, and Michael R. Ward (2000) and Paul R. Zimmerman (2003) provide some evidence of this effect.

[118] Lisa V. Wood and Sappington (2004) discuss the design of such reward structures.

VIP's wholesale and retail operations can facilitate accurate monitoring of the relative prices and qualities of the inputs that the VIP supplies to its own retail affiliates and to competing retailers.[119] In assessing the merits of structural separation, this potential benefit should be weighed against any associated costs, including foregone economies of scope.

A more radical alternative to structural separation is ownership separation. Under structural separation, wholesale and retail operations are physically separated but common ownership and control of both operations is permitted. In contrast, ownership separation precludes common ownership and control of wholesale and retail operations. While structural separation can help to limit the ability of a VIP to disadvantage its retail competitors, ownership separation can serve to reduce the incentive a producer of key wholesale services might have to disadvantage the (retail) firms that purchase the wholesale services. When it does not provide retail services, the wholesale provider does not secure any direct gains in the retail market from disadvantaging retail producers. In fact, a reduction in the quality of the inputs it sells generally will reduce the demand for these inputs and thereby reduce the revenues of the wholesale producer. Consequently, by eliminating the key source of potential gains from disadvantaging downstream operators, ownership separation can substantially reduce, if not eliminate, incentives for such disadvantaging.[120]

Of course, the costs of ownership separation must be weighed carefully against its potential benefits. Ownership separation, like structural separation, may sacrifice substantial economies of scope and economies associated with integrated planning of wholesale and retail operations. Ownership separation may also preclude a particularly efficient competitor (the producer of wholesale services) from participating in the retail market and thereby raise industry costs and retail prices. Ownership separation also can entail substantial divestiture costs in cases where a VIP is already providing both wholesale and retail services when ownership separation is considered.[121] The merits of ownership separation also can depend on the prevailing regulatory institutions. A regulator with ample resources, considerable experience, and substantial authority to collect relevant data may be able to prevent a VIP from disadvantaging its rivals. In contrast, a regulator with limited resources, limited experience, and limited information might be unable to do so, rendering vertical separation the best (albeit a costly) way to promote effective competition.

7.7 *Establish Appropriate Access Prices*

The prices that retail competitors must pay to access the infrastructure of an incumbent VIP can have a substantial impact on welfare. A comprehensive assessment of the effects of access prices on welfare is complex. However, some of the key effects can be illustrated in the following simple setting.[122]

Suppose an incumbent VIP incurs marginal cost c_1 in supplying a retail service and

[119] Hausman and Sidak (2005) review the form of structural separation currently required by Ofcom, the U.K. communications regulator. The separation includes the creation of a separate division of British Telecom to supply wholesale services on the same terms and conditions to all retail competitors and an "equality of access" board to oversee the operations of this division.

[120] Vertical divestiture of the incumbent also can simplify the design of access charges by eliminating the effects of access charges on the incentives of a VIP to disadvantage retail competitors. Beard, Kaserman, and Mayo (2001), among others, consider how access charges affect the incentives of a VIP to disadvantage rivals.

[121] See Vickers (1995), Paul J. Hinton, J. Douglas Zona, Schmalensee, and William Taylor (1998), Sand Hyup Lee and Jonathan H. Hamilton (1999), Robert Crandall and Sidak (2002), Stefan Beuhler, Dennis Gärtner, and Daniel Halbheer (2005), and Crew, Kleindorfer, and John Sumpter (2005), for example, for analyses of these and related considerations.

[122] See Armstrong (2002) and Vogelsang (2003) for more detailed surveys of this topic.

marginal cost c_2 in supplying a network input to a single retail competitor. This competitor, the entrant, incurs constant unit cost c in converting one unit of the access service into one unit of its own retail service. (The production technology is fixed proportions, so exactly one unit of the access service is required to produce each unit of the retail service.) The retail services of the incumbent and the entrant are homogeneous, and consumers purchase the product from the firm that sets the lowest retail price.

Suppose the regulator sets retail price p and access price a for the incumbent's services in this setting. Then the entrant will find it profitable to operate if the highest price (p) it can charge for its retail service exceeds its unit cost ($a + c$) of producing the service. Industry production costs are minimized when the least-cost supplier serves all retail customers. The entrant is the least-cost supplier in this setting when ($c_2 + c$) is less than c_1. Therefore, for fixed regulated retail price p, the following access price ensures the entrant will operate when and only when it is least-cost industry supplier:[123]

$$a = c_2 + [p - c_1]. \tag{10}$$

The access price in equation (10) reflects the efficient component pricing rule (ECPR), which states that the access charge should be set equal to the sum of the incumbent VIP's cost of supplying access (c_2) and the opportunity cost (or lost profit, $p - c_1$) the VIP incurs when it loses a unit of business to the entrant.[124] The ECPR implies that when the VIP's regulated retail price exceeds its cost of supplying the retail service (so $p > c_1$), the access charge should exceed the VIP's cost of providing access. This increase in the access charge serves to limit the operation of inefficient entrants. To see why, notice that, if a VIP is obligated to both supply network access at cost and set the price of its retail service above cost ($p > c_1$), an inefficient entrant (i.e., one for which $c_2 + c > c_1$) might find it profitable to enter the market, raising industry production costs. This inefficient entry can be precluded by raising the access charge above cost by the same amount the retail tariff is held above cost ($p - c_1$).[125] Similarly, if the VIP is required to offer a retail service at a price below cost ($p < c_1$), network access can be subsidized accordingly to encourage efficient entry into the subsidized retail market.[126]

Intuitively, one might view the VIP as paying a unit tax of $p - c_1$ when it is required to supply the retail service to consumers at unit price p. To ensure profitable entry only by competitors that are more efficient than the VIP, entrants must pay the same tax the VIP pays. The ECPR implements this tax by raising the access charge above the VIP's cost of supplying access by $p - c_1$.

This simple analysis requires modification in richer settings. Suppose, for example, the retail services of the entrant and the VIP are not homogeneous. In this case, one unit of supply by the entrant does not necessarily reduce the VIP's retail output by exactly one unit, and so the ECPR must be adjusted accordingly.[127] Alternatively, suppose the VIP's retail price is not immutable (perhaps because the VIP operates under a price cap regulation plan that affords the firm some discretion in setting retail prices). In this case, the established access charge will affect

[123] Notice that this discussion takes the incumbent's retail tariff as given. Ideally, wholesale and retail prices should be set simultaneously to achieve social goals, following standard Ramsey principles (Laffont and Tirole 1994).

[124] See Robert Willig (1979) and William J. Baumol (1983) for early discussions of this rule.

[125] This increase in the access charge above the cost of supplying access can help to mitigate the cream-skimming problem discussed in section 7.4 above.

[126] When access charges reflect the ECPR, a VIP is compensated for the profit reduction it incurs when it loses a retail customer to a rival supplier. Consequently, access prices that reflect the ECPR can limit a VIP's incentive to disadvantage retail rivals.

[127] Armstrong, Chris Doyle, and Vickers (1996) provide the details of this and other extensions of the ECPR, along with a more general characterization of optimal access prices.

the VIP's choice of retail tariff. The ECPR requires additional modification to reflect this interaction.[128]

The design of access prices becomes more complicated if an entrant can supply the input itself, by investing in its own infrastructure, for instance. In such a setting, care must be taken to ensure that access charges provide the entrant with appropriate ("make-or-buy") incentives to supply inputs itself rather than purchase them from the incumbent VIP. Two distinct regulatory instruments would be ideal in such a setting. To deliver appropriate make-or-buy incentives to entrants, the VIP's access charge should be set equal to the VIP's cost (c_2) of providing the input. This policy ensures an efficient pattern of production given that entry takes place. Such cost-based access pricing may not ensure industry cost minimization, though, because inefficient retail competitors may find entry profitable or efficient competitors may find entry unprofitable when retail prices diverge from the VIP's production costs ($p \neq c_1$). To ensure efficient entry decisions, cost-based access charges should be accompanied by a tax on the outputs of entrants that reflects the deviation of the VIP's retail price from its cost ($p - c_1$).[129] When the regulator is unable to implement output taxes, the access charge is forced to perform the dual task of providing efficient make-or-buy decisions and efficient entry decisions.[130] Typically, a single instrument cannot achieve two goals, making some compromise inevitable.[131]

In summary, the appropriate design of access charges can require considerable information. Furthermore, the delivery of appropriate incentives for efficient make-or-buy and industry participation decisions can require an extensive set of regulatory instruments (e.g., access prices and output taxes). In settings where a regulator has limited information and limited powers, the design of access charges can present extremely challenging problems. However, these problems can be mitigated if the incumbent VIP's retail tariffs reflect its production costs, as proposed in section 7.4 above. When retail rates reflect costs (so $p = c_1$) in the simple setting considered here, the ECPR in equation (10) collapses to a particularly simple rule: the access charge should be set equal to the VIP's cost of providing access. As noted above, this rule also provides appropriate make-or-buy incentives. Notice that this policy can require little knowledge of consumer demand, and does not require the regulator to be able to control the activities of entrants. In sum, an effective rebalancing of the incumbent VIP's retail tariff greatly simplifies the regulator's task of setting appropriate access charges, and allows access charges to focus on the single task of ensuring appropriate make-or-buy decisions.

Access prices also can affect incentives for network innovation and cost reduction. For example, access prices that provide profit margins on access services that vary inversely with the incumbent VIP's realized access costs can create incentives for the VIP to reduce its costs of supplying access.[132] Clearly, the appropriate design of access charges becomes more complex when access charges serve to motivate cost reduction in addition to securing industry cost minimization and inducing efficient make-or-buy decisions.

[128] See Armstrong (2002, section 2.6) for further discussion of this issue.

[129] See Armstrong (2002, section 2.4) for further discussion of this point.

[130] Sappington (2005b) notes that if retail prices are not regulated, efficient make-or-buy decisions may arise even when access charges do not reflect the incumbent's production costs.

[131] Hausman (1997) and Hausman and Sidak (1999, 2005), among others, note that competitors will rely unduly on an incumbent supplier's infrastructure if access prices are set below the full cost of supplying access. This full cost includes a capital cost that reflects prevailing technological and market risks.

[132] Access prices in the U.S. telecommunications industry reflect estimates of an efficient incumbent supplier would incur in supplying access, which can differ from the actual costs of the incumbent supplier. (See Rosston and Noll 2002, for example.) This pricing policy is intended to induce incumbent suppliers to operate efficiently.

Conceivably, access prices might be set at relatively high levels to systematically encourage entrants to construct their own infrastructure. One reason for doing so (despite the duplicative infrastructure costs such a policy can promote) would be to promote competition among multiple producers in hopes of fostering industry innovation and eliminating the need for long-term regulation of a monopoly supplier of key inputs.[133] However, competition among facilities-based networks will not necessarily eliminate the need for long-term regulation. Even if all operators in the telecommunications industry employ their own infrastructure, each operator must still interconnect with other operators in order to complete calls intended for the customers of other operators. It is conceivable that unregulated negotiations among similarly situated network operators could produce intercarrier compensation arrangements that are broadly consistent with social goals. However, this need not be the case. Firms might negotiate compensation arrangements that inhibit competition or limit new entry, for example.[134]

7.8 *Limit Cost Shifting*

In settings where regulatory controls are relaxed on some, but not all, of the incumbent supplier's operations, it can be important to limit the supplier's ability to engage in cost shifting. Cost shifting occurs when costs that actually are incurred in the production of one set of services (e.g., competitive services) are recorded as costs incurred in the production of a different set of services (e.g., monopoly services). An incumbent supplier may benefit from cost shifting when, for example, its competitive operations are not regulated but the prices it can charge for its monopoly services are linked directly to its measured operating costs. In this situation, the incumbent supplier can secure higher regulated prices without affecting its (pretax) earnings on competitive services by shifting costs from its unregulated to its regulated operations.

The incumbent supplier's ability to undertake such cost shifting can be limited by requiring separate books of account for its regulated and unregulated operations, for example. The firm's incentive to engage in cost shifting can be limited by reducing the extent to which regulated prices are linked to measured operating costs. In particular, price cap regulation can reduce incentives for cost shifting relative to rate of return regulation and other forms of cost-plus regulation.[135]

7.9 *Ensure the Integrated Operation of All Elements of Industry Policy*

It is important to review industry policy in its entirety whenever a major component of industry policy (e.g., liberalization policy) is altered substantially. The review should be designed to ensure the ongoing, effective, integrated operation of all components of industry policy.

The experience in California's electricity industry illustrates the importance of such a comprehensive review. The deregulation of wholesale electricity prices can benefit consumers when a competitive wholesale supply of electricity is available. Encouraging major buyers and suppliers of wholesale electricity to participate in a common exchange system also can provide widespread benefits. Furthermore, a capped retail price for electricity can be a component of a sensible

[133] See Woroch (2002). David Boles de Boer, Christina Enright, and Lewis Evans (2000) note that New Zealand encouraged facilities-based competition among Internet service providers while Australia relied more on regulation to protect consumers. The authors report lower prices in New Zealand than in Australia.

[134] Armstrong (1998) and Laffont, Rey, and Tirole (1998) demonstrate these possibilities formally. Patrick DeGraba (2004) and Sharkey (2004), among others, analyze the effects of different intercarrier compensation arrangements.

[135] Braeutigam and John C. Panzar (1989), Timothy J. Brennan (1990), and Weisman (1993), among others, provide formal analyses of this issue.

regulatory policy. However, even though each of these policies can have individual merit, the combination of these policies can lead to highly undesirable outcomes. As in California, volatile wholesale prices coupled with capped retail prices can jeopardize the financial integrity of retail suppliers of electricity. The problem can become particularly acute when the volatility of wholesale prices is increased by limiting the ability of retail suppliers to negotiate long term contracts for electricity.

Several of the policies cited above can be viewed as corollaries of the general principle that effective, integrated operation of all components of industry policy merit careful examination whenever liberalization is considered. For example, the need to rebalance retail prices and to afford incumbent suppliers appropriate pricing flexibility reflect prudent changes in certain elements of industry policy as other elements change.

7.10 *Increase Antitrust Scrutiny and Enforcement*

A central long-term goal of liberalization is to replace regulatory oversight and control with the disciplining forces of competition. Liberalization might be viewed as a process by which competitive forces are fostered and strengthened to the point where they, alone, can impose effective discipline on some or all of the incumbent supplier's operations. The more pronounced the disciplinary role played by competition, the more important it is to protect competition and ensure it is not subverted by powerful industry participants. This is generally the role of antitrust policy.

Antitrust policy and regulatory policy differ in at least three fundamental respects. First, antitrust policy typically sets guidelines that describe in broad terms acceptable behavior and outcomes. In contrast, regulatory policy often specifies detailed rules (often that apply to particular firms) that define fairly precisely the limits on acceptable behavior and outcomes. Second, having specified ex ante guidelines, antitrust policy typically entails ex post investigations of possible violations of the specified guidelines. Regulation, in contrast, often couples ex ante rules with ongoing industry oversight, rule refinement, and rule enforcement. Third, antitrust policy typically relies on edicts to discontinue anticompetitive behavior and associated fines (often in the form of damage payments to injured parties), while regulation often proscribes specific types of conduct (e.g., price discrimination or expansion into particular markets) and establishes detailed performance requirements and associated reward and penalty structures.[136]

Antitrust and regulatory policy can play vital and complementary roles in the liberalization process. Indeed, it may be important to increase both regulatory oversight and antitrust enforcement as competition develops in the liberalized industry. Thus, the road to deregulation of an industry may not be a straight one. Increased antitrust enforcement and regulatory oversight may both be necessary temporarily to ensure that competition has the opportunity to develop to the point where it can eventually replace regulation as the key source of discipline on the incumbent firm.[137]

In the 1990s, New Zealand decided to rely solely on general competition laws enforced by the courts and by a non-specialized competition authority to govern activities in the telecommunications and electricity sectors. This novel approach was not an immediate failure. However, problems emerged over time, leading the government to realize the need for more orthodox regulatory control. The problems included a heavy case load for the courts and substantial difficulty in proving

[136] See, for example, Marc Bourreau and Pinar Dogan (2001), Sidak (2003), Martin Cave (2004), and Damien Gerardin and Sidak (2005). Dennis Carlton and Randal Picker (2005) note that regulation can allow interested parties greater ongoing intervention in the control process than antitrust.

[137] Ultimately, explicit regulatory control may be replaced in some settings simply by the specter of regulatory intervention. See Amihai Glazer and Henry McMillan (1992), for example.

an incumbent supplier had abused its dominant position. Moreover, legal proceedings proved to move slowly at times when quick decisions were required to keep pace with rapid technological advance. The New Zealand experience suggests that exclusive reliance on competition law may not be sufficient in network industries with emerging competition, even in countries with well-developed case law, strong legal institutions, and substantial judicial resources.[138]

8. *Conclusions*

The foregoing discussion has produced two broad conclusions. First, even the apparently simple choice between regulated monopoly and unregulated competition is not always straightforward in practice. The appropriate choice between these regimes can vary with the relevant technological and demand conditions, with the regulator's skills and resources, with the efficiency of tax systems and capital markets, and with the strength of other prevailing institutions. Second, in settings where competition is preferable to regulated monopoly, the road from monopoly to competition can be a particularly long and winding road. There is no single ideal path from monopoly to competition. The most appropriate liberalization policy depends upon a wide variety of factors, including those relevant to the choice between monopoly and regulation.

The foregoing discussion also has emphasized that, although there is no single liberalization policy that is ideal in all settings, some policies typically are superior to others. Liberalization policies that primarily aid some competitors and handicap others on an ongoing basis can hinder the development of vigorous long-term competition. Therefore, policies such as establishing temporary monopolies or oligopolies, excluding foreign investors, specifying market share targets for industry suppliers, providing entrants with long-term subsidized access to the incumbent's infrastructure, restricting unduly the incumbent supplier's pricing flexibility, and imposing unfunded carrier-of-last-resort obligations exclusively on incumbent suppliers generally are not recommended.

In contrast, liberalization policies that remove barriers to entry and empower consumers to discipline industry suppliers typically are better methods for fostering vigorous long-term industry competition. In particular, policies like reducing customer switching costs, rebalancing the incumbent supplier's prices to better reflect its operating costs, privatizing state-owned enterprises, prohibiting below-cost pricing, and establishing appropriate (access) prices for the use of critical infrastructure generally are recommended.

In addition, careful monitoring of industry operations can be of critical importance during the liberalization process. Accurate, timely data about the nature and intensity of industry competition will allow regulatory policy to adjust quickly to changes in industry conditions. Consequently, although liberalization should ultimately lead to reduced regulatory oversight and control, more pronounced regulatory and antitrust oversight may be required on an interim basis to ensure that regulatory policy is tailored appropriately to the evolving level of competition and that competition is protected.

The road from monopoly to competition is seldom straight and smooth. Detours (e.g., increased regulatory and antitrust scrutiny) may be necessary to ensure safe passage to the intended destination. Bumps in the road (e.g., widespread opposition to rate rebalancing or privatization of state-owned enterprises) should be anticipated in order to facilitate their navigation in as smooth a manner as possible. Thus, the liberalization process can constitute a challenging journey and one that entails considerable uncertainty. Detailed road maps can be of enormous value on such journeys. Unfortunately, though, because every setting in which liberalization might be

[138] Spiller and Cardilli (1997) and Laffont (2005, pp. 200–202).

contemplated is different, road maps that provide sufficient granularity and specificity in every relevant setting are not available. Therefore, one generally must embark on the road to competition armed only with the coarse route markers on which the foregoing discussion has focused.

As emphasized in section 4, the most appropriate liberalization policy can vary considerably according to the institutional setting in which it is being implemented. Therefore, an important role for future research is to develop detailed maps of the best route to competition, i.e., to specify the precise details of liberalization policies that will work well in specific institutional settings. Two approaches to this task seem particularly fruitful. First, the broad principles reviewed in this paper can be translated into precise policy recommendations. (For example, precisely how rapidly should rates be rebalanced, given the prevailing prices, customer wealth, and the operating technologies of the incumbent suppliers and entrants? Alternatively, at precisely what level should access prices be set given the prevailing industry costs structure and retail prices?) Second, case studies and comprehensive empirical work can be undertaken to assess the success and failure of particular liberalization policies in different institutional settings. Together, these two approaches can expand our knowledge of the liberalization policies that will best harness the powers of competition to provide critical industry discipline and perhaps ultimately replace the costly, imperfect discipline that regulatory oversight and control provide.

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