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Dynamic Regulation: Conceptual Foundations, Implementation, Effects [*]

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1. Introduction

During the past several years, U.S. telecommunications regulators, partly on their own initiative and partly in response to mandates by the courts, have adopted a pro-competitive stance. Ex ante regulation has been removed or significantly curtailed even in situations that would not have passed muster in the recent past (or would pass the competitive test elsewhere). This shift has several causes, including the new industry environment and new patterns of competition. It also reflects a re-conceptualization of the basic pillars of regulatory practice: the gradual — and often tacit — replacement of a static with a dynamic approach to regulation. We argue that this transformation has been underway for quite some time at the theoretical level but that it has now started to influence practical policy. A critical appraisal of this change sheds light on an important regulatory development and may be useful for other nations as they design their response to the emerging communications environment.

One of the most important challenges faced by communication regulators is the creation of conditions that facilitate the high capital investment required to deploy next-generation networks capable of supporting innovation in new applications and services. This dynamic regulation problem is qualitatively different from orchestrating the transition from past near-monopoly conditions to an open market environment that had occupied regulation since the start of reforms several decades ago. The core network infrastructure during that earlier cycle was in place and many regulators attempted to jump-start competition with forms of structural and conduct regulation at the wholesale level (e.g., divestiture, interconnection, unbundling, wholesale price regulation). In contrast, the deployment of next-generation networks requires significant upgrades and new plant. Conditions for this massive investment are complicated by the turbulent competitive environment. Digitalization allows the market entry of new powerful competitors, even if they initially only serve niche consumers. It also facilitates the migration of content and services across different platforms (Jenkins, 2006). For a new generation of users, mobile phones replace fixed phones. Instant messaging and online communities such as Facebook and MySpace may substitute, at least partially, for mobile and fixed voice communications.

In a broad-brush overview, it is possible to distinguish three distinct approaches to dealing with innovation and investment. In actual regulatory practice, these prototypes often coexisted for different segments of the communications industries. We propose the term *static regulation* for an approach that formulates the policy problem as one of controlling market power subject to technological and economic constraints. What we call *comparative static regulation* allows for technical change and asks how regulatory instruments should be designed in response to such developments. However, investment and innovation continue to be treated in an equilibrium framework. In contrast, *dynamic regulation* recognizes investment and innovation as a core challenge of the design of a regulatory framework. It acknowledges the inherent uncertainty of the new environment and conceptualises investment and particularly innovation as a response by entrepreneurs and firms to market opportunities (and hence as a disequilibrium phenomenon). In contrast to full reliance on antitrust and competition law, dynamic regulation attempts to deliberately shape market rules in ways that are perceived as most conducive to the overarching objectives for the communication industries. In the U.S., practical regulation was predominantly influenced by the static perspective until the 1970s, more strongly affected by the comparative static approach until the late 1990s, and is presently in another transition to a dynamic approach, relegating the other perspectives to a less prominent role.

This paper describes and critically comments on this transformation of the theoretical underpinnings of practical regulation in the U.S. and assesses its relevance for other nations and regions. The next section provides a brief historical review as to how investment and innovation issues were addressed (or neglected) in U.S. regulation. Section three discusses the core bodies of knowledge used in formulating a more dynamic framework. Section four discusses U.S. unbundling policy and section five policies toward next-generation networks, cases that illustrate the transformation toward dynamic regulation. The design of regulatory policy under uncertainty is addressed in section six, followed by some concluding remarks.

2. The evolution of dynamic aspects of regulation

It was not until the 1960s and 1970s that the inter-temporal aspects of regulation became a more central concern of researchers and practitioners. This is not to say that regulation had ignored investment and innovation during preceding periods. In fact, core regulatory policies were designed to balance the need for massive infrastructure roll-out with mitigating undesirable effects of market power. Rate-base rate-of-return (ROR) regulation was introduced to facilitate large-scale investment. Technical change and investment problems are not fully ignored in this approach but they are typically assumed to be slow and/or conducive to long-term planning. Regulatory practice was in essence based on a static model of a competitive market, aiming for second-best solutions (prices equal to average costs) under conditions of natural monopoly. Schumpeter, under whose presidency the Transportation and Public Utilities Group of the American Economic Association was founded, pointed out that the implicit assumption of regulatory theory was either a static or a steady-state economy. He also expressed his view that this was the wrong efficiency standard in the presence of technical change and innovation (Bauer, 1997).

The work of Averch and Johnson (1962) marks the beginning of more explicit attempts to address the investment and later innovation (Bailey, 1974) effects of regulation. At a practical level, U.S. regulation started to circumscribe the realm of regulation more narrowly to stimulate innovation and experimentation in market segments that were not considered in the core of the natural monopoly. Successively, and the history of these reforms is well documented (see, for example, Brock 1981, 1994, 2003), terminal equipment, value-added services, long distance, satellites, mobile service, cable TV, and eventually local services were freed from cumbersome regulation. During the 1980s and 1990s, price cap regulation was promoted as a regulatory instrument that could better than ROR regulation reconcile control of market power with incentives for investment and innovation. The Telecommunications Act of 1996 was designed to facilitate competition in local markets, the last remaining monopoly area. Regulatory measures before the 1990s were largely based on a static or comparative static model of competition. From the late 1990s onward, regulatory measures shifted from retail to wholesale aspects of the business and also become more inspired by dynamic models of competition.

Thus, since the 1960s, U.S. policy had been gradually inspired by creating a regulatory framework that would allow competition to unfold more freely. State and federal regulators, who jointly have jurisdiction over the common carrier segments of the telecommunications industry, pursued a strategy of structural separation. Market segments with economic and technological conditions that presumably allowed effective competition were removed from regulatory oversight. In the remaining regulated areas, the agencies set prices and other conditions attempting to mimic the outcomes of competitive markets.

The reference model guiding regulatory decisions, even if not explicitly admitted, was a perfectly competitive market (see Baumol 2006 for a similar critique). This is visible in the classical texts guiding regulation, such as Glaeser (1927; 1957), Phillips (1965), and Kahn (1970/71), and as well as in the more recent treatises, including Spulber (1989), Train (1991), and Laffont and Tirole (2000). Because conditions of economies of scale or scope were seen as typical for regulated areas, first-best solutions that would equate marginal (incremental) costs with marginal (incremental) revenues would not allow the supplier to break even. Consequently, a second-best solution ─ setting prices at a level that would give a service provider a reasonable chance to break even ─ was chosen. Rate-of-return regulation and since the mid-1990s price cap regulation were the instruments adopted to implement this outcome. With few exceptions, until the 1990s, dynamic considerations were secondary. They were not fully ignored, as rate-of-return regulation, to a certain degree, rewarded service providers for investment. Price cap regulation was also seen as a tool that avoided some of the perceived biases of rate-of-return regulation and would stimulate efficiency. Nonetheless, dynamic effects of regulation were not at the center of public policy debates. This was less critical as the technological basis of the telephone industry was relatively stable. Major innovations at that time occurred predominantly in the unregulated parts of the industry.

When early liberalisation and digitalisation started to accelerate change, the innovation potential in core segments of the infrastructure increased and significant investment needs in next-generation networks arose. It became increasingly clear that the traditional competitive model was a mismatch to the emerging industry environment, which was characterised by higher

degrees of risk and uncertainty. Without proper models to guide the design of regulatory policy in this new environment, traditional regulation was increasingly seen as an impediment to innovation. Even price cap regulation, which had been promoted based on its desirable dynamic efficiency properties, quickly lost its appeal, as unexpected weaknesses were revealed (Sappington and Weisman 1996; Ai and Sappington 2002). Consequently, Section 509 of the Telecommunications Act of 1996 expressed a clear desire to let advanced communication infrastructure develop in an environment "unfettered from state and federal regulation". However, the Act sent mixed signals to regulators and industry, as some of the instruments envisioned to support the transition to local competition invited excessive forms of regulation. Driven by a continued focus on perfect competition, stringent unbundling policies were promulgated for voice services and later for broadband DSL platforms (see the fourth section for a more detailed discussion). The experience with the specific unbundling model adopted in the U.S. revealed its short and long-run effects on facilities investment and innovation in core networks. The lesson from voice unbundling was extrapolated to broadband networks and contributed to a shift in focus on the dynamic effects of unbundling and other regulatory policies (Bauer 2006). As a consequence, the weaknesses of the static approach to regulation were more clearly recognised. Alternative conceptual frameworks that had influenced regulation on the fringe in prior decades were revitalised.

The decade-old notions of workable competition suggested by Clark (1961) and of competition as a "process of creative destruction", coined by Schumpeter (1942), were rejuventated. The common thread uniting these approaches is their emphasis on the tension between the conditions most conducive to static and dynamic efficiency. In a static context, that is, when supply and demand conditions are stable and predictable, the widely known model of perfect competition can serve as a yardstick for the design of policy. In contrast, to stimulate dynamic efficiency, that is, risky investment and innovation, the conditions of static efficiency have to be violated. Obstacles to competition, such as temporary barriers to entry, have a role to play in facilitating long-term efficiency, promoted by entrepreneurs in seeking new and innovative forms of production, goods and services. Schumpeterian analysis provided a powerful new lens to understand entrepreneurship and dynamic competition but did not influence public policy for a while. Schumpeter focused on revolutionary innovations, but other authors emphasized the

equally important role of entrepreneurs in recognizing opportunities for incremental innovation (Kirzner 1973, Shane 2005). In either case entrepreneurs innovate because of disequilibrium situations in a market. Although Weizsäcker (1980) provided a first more eloquent analytical treatment of these issues, no general formal model of competition and entrepreneurship is presently available to guide specific regulatory policy. Recent changes in regulatory policy are therefore based on broader policy visions. However, several more narrowly formulated models have become influential in reshaping antitrust and regulatory policy and will be reviewed in the next section.

3. New models of competition in telecommunications

This section reviews some newer theoretical perspectives which insinuate that the traditional, perfect competition, model may not be useful as a bench mark for regulatory policy. Rather, the new perspectives suggest that market concentration and dominance may be conducive for economic efficiency, provided some side conditions are fulfilled. Of particular interest are the role of sunk costs, the economics of networks and new perspectives on vertical and horizontal relations.

3.1 Sunk cost, pricing, and competition

One important aspect of telecommunications is the high sunk costs of building a network. This includes the traditional sunk costs, that is, the part of the initial expenses that cannot be recovered in case of exit. Furthermore, as the theory of real options has clarified, under conditions of uncertainty, the opportunity cost to an investor of losing the option to wait until more information about the future development of markets becomes available, is an additional sunk cost (Pindyck 2005). In the presence of fixed costs, some of which sunk, firms will need to differentiate their prices and charge prices above incremental costs in order to meet their dynamic break-even constraints. It is important to understand the different implications of this break even constraint for past and future investment. Past investment is already irretrievably sunk. Whereas a firm will attempt to recover these costs, it may be forced by competition to

price its services as low as its incremental costs. However, in the process of planning an investment, a rational firm will only go ahead with a project if it anticipates that the overall revenues during the life-span of the project will be sufficient to recover the sunk costs in addition to other costs. Hence, a firm must be able to charge prices, sometimes significantly above incremental costs, to meet this dynamic break even constraint. If the competitive conditions ex post do not allow such recovery, the firm will likely decide against similar future investment projects. Like Schumpeterian analysis, the theory of real options questions the yardstick proposed by static models of competition to assess the effectiveness of competition (i.e., setting price equal to marginal cost). To the contrary, deviations from incremental cost prices are a precondition to dynamic efficiency. Firms in network markets will use a range of strategies to meet their dynamic break even constraint, including price differentiation and bundling of services. These characteristics require that typical antitrust tests for market power, which are based on measuring the deviation between prices and incremental costs, be modified.

Sunk cost in combination with economies of scale and scope may create a strong tendency toward concentration. For example, local access markets will allow multiple competitors only in sufficiently large markets; the high investment volume needed to upgrade existing or build new next-generation networks is may also contribute to concentration in the supply of network platforms. Analyzing competitive processes in network industries hence requires a clear understanding under which conditions market entry barriers and concentration cause negative effects and when it is unlikely that the incumbent can abuse them. The trade-off between actual market structure and market entry conditions was first pointed out in the 1950s (most prominently by Bain 1956). The notion that potential competition could serve as an effective disciplining force on firms with a high market share was revitalised in the theory of contestable markets, developed during the 1970s (Baumol, Panzar, and Willig, 1982). Although early versions of the theory did not have a noticeable impact due to their highly stylised character, it has regained some influence on regulatory and antitrust decisions under the new conditions in telecommunications markets. Once costs are sunk, they constitute barriers to exit and increase the firm's vulnerability to new competitors, especially if they have cheaper technology available. Under these conditions, the presence of a small competitive fringe might suffice to prevent systematic abuse of market power even in a highly concentrated market. U.S. policy has

presently accepted the notion that a duopoly market structure in next-generation networks (telephone companies, cable companies) with a vibrant competitive fringe (alternative fixed broadband suppliers, wireless broadband, powerline communication) is sufficient for effective competition to prevail, especially in end-user markets. Ex ante regulation has thus been narrowly targeted to a few input market segments.

The theory of contestable markets and other dynamic approaches have moved attention away from actual market structures and market shares, which were the focus of classical antitrust analysis, to the entry and exit conditions of a market. If market entry is very easy ("ultra-free"), market concentration does not matter and even a monopolist could not abuse its power. Since it is the abuse of market power, not its mere existence that is critical in U.S. antitrust cases, the theory has strong potential implications for mergers. Although real world markets rarely meet the criteria necessary for these strong efficiency results to hold, contestability has contributed to a stronger focus on sunk cost and other barriers to entry. There is a widespread presumption that the evolution of telecommunications markets, in particular the emergence of inter-modal competition and the emerging class of access-independent services provided on a next-generation network architecture, has increased the degree of contestability. As a result, high degrees of market concentration are often regarded as benign if accompanied by easy market entry or if merger conditions can be imposed that preserve workable contestability.

3.2 Network economics

A second area of research that has contributed in important ways is the economics of networks and its application to antitrust and competition issues (Shy 2001; Gottinger 2003). This relatively young field of economic research studies the unique economic conditions of network industries. These deviate in several ways from the standard textbook models of industrial organisation (Shapiro and Varian 1999). Most importantly, network industries often operate under increasing rather than diminishing returns to scale and use shared capital to provide their services. Cost concepts such as average cost or incremental costs are difficult to define in networks. Moreover, network industries often are characterised by a combination of high fixed/sunk and low incremental costs. Consequently, traditional optimality conditions, such as equating incremental

costs with incremental revenues cannot be operationalised easily. Other important features of network industries include the existence of network effects and possibly network externalities (Liebowitz and Margolis 2003), the existence of strong complementarities between components of the network (e.g., terminals and services) or between layers of services that need to be combined to offer a final service (e.g., transportation services and content). Networks also are characterised by high sunk and low incremental costs. Network effects, the inability to measure incremental costs are additional features that render traditional efficiency standards that equate incremental costs and incremental revenues inappropriate.

3.3 Vertical and horizontal relations

Central areas of concern in antitrust analysis are the ability of a merged firm to monopolise a market, its ability to foreclose vertically related markets, and its capacity to leverage market power from one market segment to another complementary one. The analytical perspectives on these forms of anticompetitive behavior have changed significantly during the past decades. Of interest are also approaches that have altered the view of foreclosure and leveraging. Modern telecommunication services require the combination of several complementary services, including transportation, routing, applications, and content. Traditional theory assumed that firms with market power in one market segment would have a strong incentive to expand this influence to vertically related and complementary market segments. This view was historically challenged by the Chicago School of economics, which claimed that market power was almost always rooted in superior efficiency.

A modified version of the approach claims that the owner of a network platform does have an interest in the efficient provision of complementary services, such as content and applications. Therefore, unless it can provide these complementary services more efficiently than any other firm, it will not expand and distort complementary markets as this will also reduce profits in the platform segment. For the same reason, even a dominant firm in the platform market will not leverage its market power to a complementary market (Farrell and Weiser 2003). There are many possible objections and exemptions to this general rule. Farrell and Weiser (2003) discuss eight

such exceptions, including regulation of a platform owner, price differentiation, myopic behavior of the incumbent firm, and weak complimentarity.

Another area that has not yet been fully explored is the implications of bundling on the working of this mechanism. Although these caveats may apply in telecommunications, the approach has contributed to a more skeptical view as to when ex ante regulation may be warranted. Most importantly, it has cautioned against the view that concentration in the platform segment is necessarily bad for competition. This stance may be behind the August 2005 policy statement by the FCC to secure open access to the public Internet (see below). Whereas the statement is not very detailed, one must conclude that the agency intends to deal with possible abuses on a case-by-case basis, with a general promulgation of rules only considered if persistent abuse becomes visible.

The new conceptual approaches have decisively shifted the understanding of when such deviations are signs of anticompetitive behavior and have contributed to a more lenient policy towards mergers. These developments have not altered the process of merger review and antitrust scrutiny in principle. However, they have affected the criteria used when analyzing the possible effects of industry consolidation. The next two sections briefly discuss two cases of recent regulatory change: unbundling and next-generation networks.

4. Local loop unbundling

During the past few years, U.S. unbundling policy was substantially reformulated. Policy-makers are now mainly concerned about the longer-term implications of unbundling rules for network investment and innovation. This is a remarkable turnaround from the early years of unbundling policy in the wake of the Telecommunications Act of 1996, which was designed to promote swift market entry. The initial approach built on previous policies crafted during the 1980s, such as Open Network Architecture (ONA and Comparative Efficient Interconnection (CEI). The Act introduced an asymmetric unbundling model, specifying detailed unbundling requirements for incumbent local exchange carriers (ILECs) only). The first set of specific

regulations, adopted in August of 1996, preceded unbundling policies in other nations by several years. In narrowband voice markets, the U.S. rules were much more stringent and detailed than those that would later be promulgated by other countries. These favorable access conditions stimulated rapid growth of competitive local exchange carriers (CLECs), whose market share expanded to 19.1% by 2005.

Initial court challenges by the ILECs, who challenged the rules as regulatory takings were not successful. However, this changed with a better understanding of the unbundling approach on dynamic firm decisions. Moreover, empirical evidence documenting the effects of unbundling rules became gradually available. It became evident that the FCC's rules had provided a stepping stone to enter the market on a service basis and migrate to a facilities-based model only for a few carriers. For many more and in the aggregate they had biased market entry choices in favor of service-based entry. In particular, the availability of full network platforms consisting of loop, port, switching, and local transportation under unbundling rules had given CLECs a low-risk entry opportunity.

Beginning in the late 1990s, some of the FCC's rules were overturned by the courts or were sent back to the agency for reconsideration. During the early 2000s, the attention of the debate shifted from narrowband voice networks to broadband networks. A longer-term perspective was deemed necessary to set the correct incentives for network investment and innovation. There was increasing concern that the past unbundling regime was not very conducive to investment and inter-modal facilities based competition. Over a period of several years, in a continuous interaction between the courts, stakeholders, and the FCC, the rules were reshaped. Broadband unbundling rules that had been introduced in 1999 were phased out in 2003. In December 2004, responding to further court directions, the FCC adopted an Order which also substantially redefined the unbundling obligations of ILECs in the narrowband markets (FCC 2005a).[1] Compared to the initial rules adopted by the FCC in August 1996 and subsequent proceedings, the unbundling obligations of ILECs have been drastically curtailed and the ILECs have gained considerable freedom to price network elements in narrowband markets. Competitive local

[1] The full text of the Order was not released until February 4, 2005 and the Order became effective March 11, 2005. Regulatory and court decisions are referred to by issuing institution and year. Detailed case numbers are provided in the reference section at the end of the article.

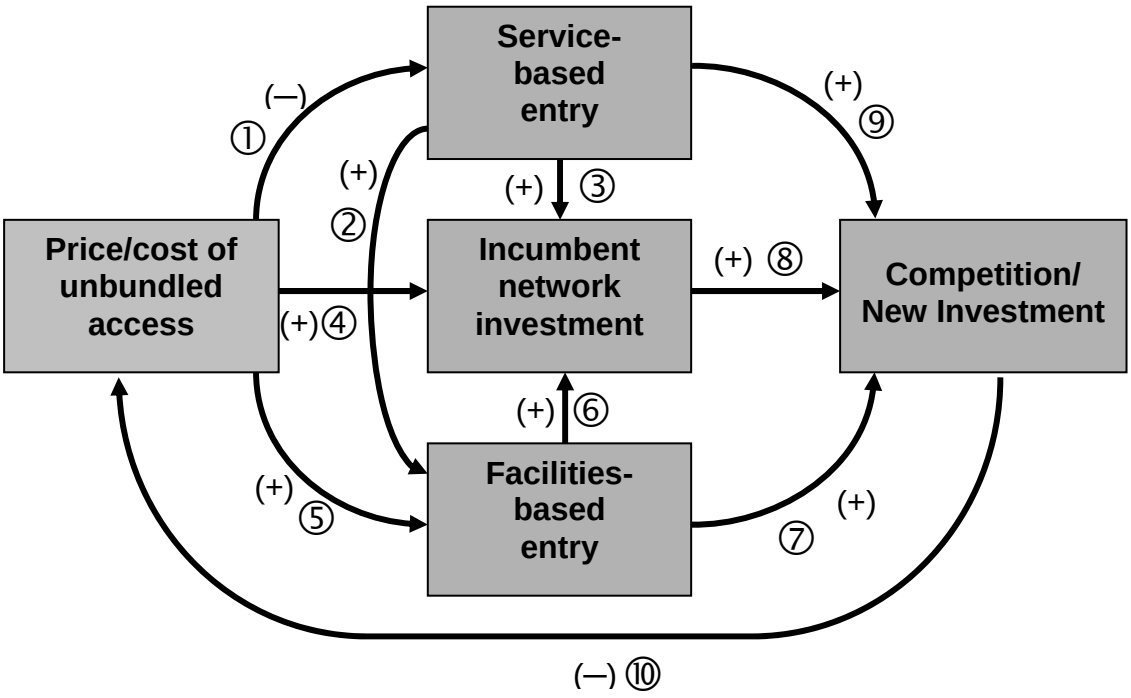
exchange carriers (CLECs) will be able to buy unbundled network elements (UNEs) other than those that continue to be regulated but they will have to pay market prices. The Order confirmed the minimal rules for broadband, solidifying the environment "unfettered by regulation" envisioned by the Telecommunications Act for the Internet and advanced networks.

4.1 Conceptual foundations of unbundling policy

Unbundling intends to ease competitors' access to an incumbent service provider's network. Such a measure requires clear justification, which is typically rooted in some form of essential facilities argument: while access to a network element/functionality is seen as necessary to compete, the specific technological and economic conditions render duplication of the network uneconomic and hence welfare-reducing. In the early 1990s, several incumbent local exchange carriers had attempted to get regulatory and antitrust relief by voluntarily proposing unbundling models. For example, Ameritech, one of the Baby Bells, offered many of the features later prescribed by the Telecommunications Act of 1996 in its unbundling plan (Harris, Rosston, and Teece, 1995). Rochester Telephone had unbundled its local network platform from the provision of services in a similarly structured plan. However, these remained isolated examples until the Telecommunications Act of 1996 established relatively stringent asymmetric unbundling requirements for ILECs.

Unbundling raises many intricate issues, including (1) how far unbundling should go, (2) how to price unbundled network elements, and (3) whether issues in the first two categories should be resolved by private negotiation, regulation, or hybrid approaches. It has complex, often contradictory effects on the incentives of the different stakeholders. Furthermore, unbundling creates multiple trade-offs and feedbacks, for example, between short-term effects on the competitive structure of a market segment and long-term effects on investment and innovation behavior. The most appropriate unbundling regime will be contingent upon the specific policy objectives and the market context. In the U.S., the goals of unbundling have changed over time. Initially designed as a policy to stimulate local competition, it is more recently assessed in light of broadband development (OECD 2003, p. 4).

Figure 4.1: Direct and indirect effects of unbundling



When the most recent unbundling measures were introduced in 1996, these multi-facetted effects of unbundling were only poorly understood. Within a relatively short period of time, research has attempted to close the gap and a more solid knowledge base is now available. While this research has not established a consensus on best-practice unbundling, it has started to illuminate the relevant trade-offs and specified the conditions under which they apply. Figure 4.1 illustrates in a stylised way the direct and indirect effects of unbundling. A (+) sign next to an arrow linking two boxes signifies that the two variables move in the same direction. For example, link ⑤ indicates that a higher (lower) price/cost ratio of unbundled access will ─ other things equal ─ increase (decrease) facilities-based entry. A (─) sign signifies that the two variables move in opposite directions. Therefore, link ① indicates that a higher (lower) price/cost ratio of unbundled access implies ─ other things equal ─ lower (higher) service-based entry.

The overall effect of unbundling depends on the severity of the intervention (e.g., the mandated deviation of prices from the cost of providing unbundled access, the scope of unbundling

requirements), the relative strength of the positive and negative effects linking the variables, and the time lags at which these effects unfold. More stringent unbundling rules (i.e., a lower price cost ratio) will stimulate service-based entry and competition (links ① and ⑨). In turn, service-based entry will stimulate intra- as well as inter-platform facilities-based investment (link ②). Both service-based entry and facilities-based entry will indirectly spur investment by the incumbent (links ③ and ⑥). However, stringent unbundling will also have a direct negative effect on facilities-based investment by the incumbent and new entrants (links ④ and ⑤). To the contrary, less stringent unbundling rules will likely create stronger incentives for long-term investment but reduce short-term market entry opportunities. The overall net effect on competition and new investment will depend on the interaction of these forces (links ⑦,⑧ and ⑨). Lastly, there is also a feedback loop from the resulting state of competition and investment back to the market for access to unbundled network elements (link ⑩).

4.2 Dynamic effects of unbundling

A growing literature has attempted to better understand the dynamic effects of unbundling. A recent survey is provided by Baranes and Bourreau (2005). This body of research clarifies that the appropriate design of unbundling rules depends, first, on whether they are intended to ease access to an already existing network or access to a new network that has yet to be deployed. In the first case, the concerns about the long-run effects on new investment and innovation are probably less important and easier access conditions may be conducive to the overall policy goal. In the case of new infrastructures or innovations that require significant upgrades to existing networks, however, the long-term effects are of primary concern and more stringent unbundling policies could have an overall negative effect. Several empirical studies have produced tentative evidence in support of these differential impacts on short-term and long-term goals. No empirical study has measured the effect of unbundling on investment directly due to the unreliability of investment data. Most studies use market shares of new entrants or diffusion rates as the dependent variable. The evidence does not yield a fully coherent picture. Hazlett and Bazelon (2005) conclude that the specific U.S. unbundling model did not stimulate but depress investment in new facilities. Cave (2006) refers to the U.S. experience as a "reverse ladder of investment" effect. Indeed, by 2005 nearly two thirds of all new access lines were based on

either resale or UNE-P (FCC 2007). Several studies find no or only weak effectsof unbundling on broadband diffusion (Bauer, Kim, and Wildman 2005, Wallsten 2006). One study finds a significant positive effect of unbundling on network diffusion in the European Union (Distaso, Lupi, and Manenti 2006). Similarly, Garcia-Murillo (2005) finds a significant relation between unbundling using a large cross-national sample. However, significance vanishes if only developed nations are included in the analysis.

This evidence does not necessarily imply that unbundling is a poor policy option but it points to the importance of applying the correct price setting method. The TELRIC standard aims at mimicking the competitive long run equilibrium price of an efficient supplier (Sappington 2006). However, these models do not take into account that real world telecommunications markets are characterized by sunk costs and uncertainty. More recent contributions to the research literature take dynamic effects of unbundling rules into account (see, for example, Cave and Vogelsang 2003; Valletti 2003; Mandy and Sharkey 2004; Pindyck 2004, 2005; and Bourreau and Doğan 2005). Hausman (1999) and Pindyck (2004; 2005) argue that under conditions of uncertainty unbundled access creates an option value to a new entrant. As this option value is not reflected in the TELRIC prices, it distorts investment decisions by both incumbents and new entrants. Pindyck (2005) suggests the addition of premium on the implicit rate of return used to calculate unbundled prices. The appropriate premium, dependent on the variability of the market and demand side factors, varies between 1-5 percentage points.

Noam (2001) cautions that in industries with first-mover advantages the insights from real options theory may need to be modified. His concerns point to the importance of taking the competitive situation into consideration. If intra-modal competition is the only relevant option, more stringent unbundling may have stronger and more desirable effects than if there is strong inter-modal competition. Lastly, the effect of unbundling will depend on the overall condition of the industry. If the environment is risky, easier unbundled access will, all other things equal, render service-based entry be a more attractive option than facilities-based competition. In any case, the important lesson is that the stringency of unbundling has important effects on the dynamic incentives of incumbents and new entrants that need to be taken into account explicitly.

4.3 Present U.S. unbundling policy

The latest Orders together with provisions that had survived the multiple earlier court reviews, make up the present unbundling framework.[2] The Triennial Review Remand Order modified the rules governing unbundling in the narrowband mass market and in the enterprise market (FCC 2005a). Rules in broadband markets remained in force from earlier Orders.

4.3.1 The overall unbundling framework

The latest rules refine the framework developed in the Triennial Review Order with regard to impairment (FCC 2003). The appeals court had criticised that the FCC did not specify the level of efficiency of competitors for whom lack of access to a network element poses a barrier or barriers to entry. In response, the FCC clarified that impairment needs to be determined with reference to a hypothetical "reasonably efficient" competitor (FCC 2005a, pp. 15-17). Thus, an entrant could not claim impairment if the business model is only workable contingent upon unbundled network elements. The Commission clarified that impairment can persist with regard to any telecommunications services (and not just in cases of core services offered in direct competition with the incumbent as had previously been the case). Following the direction of the court in USTA II, the Commission decided, however, to prohibit the use of unbundling for exclusive service to competitive markets, specifically mobile wireless services and long distance services (FCC 2005a, pp.17-25). In these market segments, it is reasoned competitors were able to develop working business models without access to unbundled network elements and thus cannot be considered impaired.

In its Triennial Review Remand Order (FCC 2005a), the agency states that Congress did not introduce the unbundling framework to increase profits in competitive market segments. Given the direction of the USTA II court, the FCC had to come up with its own finding of market segments in which impairment existed. In order to facilitate such determination, the Order abandons national unbundling rules in favor of a more differentiated approach.

[2] Court challenges continue, however, as several provisions of the Triennial Review Remand Order, in particular rules concerning high-capacity loops and dark fiber, are presently under review.

4.3.2 Mass market unbundling

In the mass market, comprising residential and small business customers, after a transition period, only local loops (UNE-L) will be available on an unbundled basis. Using the directions provided by the USTA II court, the FCC eliminated its earlier finding of impairment in the (residential and small business) mass market for local circuit switching. As a consequence, the widely used UNE-P platform will no longer be available after the 12 months transition period. Thus, in the future, carriers will either have to deploy their own facilities, lease network elements such as switching from other CLECs, or lease them from ILECs but at non-regulated market prices.

Since March 11, 2005, ILECs are therefore under no obligation to offer unbundled mass market local circuit switching (and thus UNE-P). For existing unbundled switching customers, the FCC adopted a 12-month transition plan. During this period, competitive carriers were not allowed to add new switching UNEs. Furthermore, incumbents received permission to increase UNE-P prices. The FCC declared that "during the transition period, competitive carriers will retain access to the UNE platform (*i.e.*, the combination of an unbundled loop, unbundled local circuit switching, and shared transport) at a rate equal to the higher of (1) the rate at which the requesting carrier leased that combination of elements on June 15, 2004, plus one dollar, or (2) the rate the state public utility commission establishes, if any, between June 16, 2004, and the effective date of this Order, for this combination of elements, plus one dollar" (FCC 2005a). The Commission did not release details to substantiate the magnitude of the price increases other than that it will ease the transition by avoiding a rate shock while protecting the interests of the ILECs where unbundling will be eliminated.

4.3.3 Dedicated interoffice transport market unbundling

Unbundled dedicated interoffice transportation is used by carriers to aggregate end-user traffic both in the mass market and the enterprise market. The FCC differentiated DS1 (24 voice grade

circuits), DS3 (28 DS1 lines) and dark fiber transport. As in the case of mass market circuit switching, a 12-month transition plan was adopted for competing carriers to transition away from the use of DS1- and DS3-capacity dedicated transport where they are not impaired. For dark fiber, an 18-month plan was put into place. According to the FCC, "these transition plans apply only to the embedded customer base, and do not permit competitive LECs to add new dedicated transport UNEs in the absence of impairment. During the transition periods, competitive carriers will retain access to unbundled dedicated transport at a rate equal to the higher of (1) 115% of the rate the requesting carrier paid for the transport element on June 15, 2004, or (2) 115% of the rate the state commission has established or establishes, if any, between June 16, 2004 and the effective date of this Order" (FCC 2005a, pp. 4-5). As in the case of mass market switching, the FCC did not release any specific data to justify the range of allowable price increases.

4.3.4 High-capacity loops

High capacity loops are primarily used to serve business customers. Based on the directions provided by the USTA II court, the FCC examined whether such loops could be procured from third parties or self-provided. Based on the Commission's analysis, it determined that DS3 loops needed to be unbundled to locations within a wire center serving fewer than 38,000 business lines or in which fewer than four fiber-based collocators were present (FCC 2005a, p 98-100). For DS1 loops, the FCC recognised that stand-along provision was economically rarely viable. Thus, it assumed that DS1 loops were only available on a competitive basis where sufficient DS3 capacity was present that could be leased at the DS1 level. For that reason, it ruled that DS1 loops would need to be unbundled in wire centers containing fewer than 60,000 business lines or fewer than four fiber-based collocators. Thus, in both cases, unlike in the case of dedicated transport, the failure to meet one of the two indicators triggers an obligation to unbundle. The agency found that CLECs were not impaired without access to fiber loops in any instance.

5. Next-generation networks

U.S. law and regulation do not use the concept of "next-generation networks." Nonetheless, several recent policies affect the development of the infrastructures commonly discussed under this heading. The Telecommunications Act of 1996 speaks of "advanced networks and services". Because the default framework for these services is the absence of regulation, many complicated problems phased by regulatory agencies elsewhere do not arise. Unbundling provisions in broadband markets were not directly affected by the Triennial Review Remand Order (FCC 2005a) but had already been vacated by the USTA I decision and/or phased out in the Triennial Review Order (FCC 2003). Line sharing had been added as a separate unbundled network element in 1999. In USTA I, the D.C. Court of Appeals vacated the line sharing rules with the argument that the FCC had not considered the market leadership of cable and the potential disincentives for ILECs and CLECs to innovate. In response, the Triennial Review Order established a three-year time table to phase out line sharing. Thus, between 2003 and 2006, ILECs had to allow line sharing, but were allowed to charge higher prices than in the past. According to the Order, prices could increase to 25% of the full copper loop price in year 1, 50% in year 2, and 75% in year 3. Under the transition plan, new customers could only be added during year 1. Furthermore, ILECs will have to allow line splitting, a scenario in which a CLEC acquires a local loop but only uses the high-frequency circuit and leases the voice channel to another CLEC.

The Triennial Review Order also had eliminated unbundling requirements for fiber deployment to the premises (FTTP) in new developments ("greenfield" projects) to stimulate investment in these next generation platforms. Responding to a request for reconsideration by Bell South and other ILECs, in October 2004 the Commission clarified that this exemption would also apply to fiber-to-the-curb (FTTC) projects, in which fiber extends to within 500 feet of all the customers served by that loop (FCC 2004). If an ILEC were to overbuild copper loops, it would either have to keep the copper loop in service or make a narrowband channel available on an unbundled basis if the copper loop is retired. More specifically, ILECs must provide access to a voice grade channel via time division multiplexing (TDM) technology or, if no TDM is available, make a 64kbps channel available. In the Triennial Review Order, the FCC had also eliminated the

broadband sharing requirement for hybrid loops. In hybrid networks fiber is deployed to points that do not qualify as FTTP or FTTC. In such cases, CLECs may deploy their own networks to the fiber termination point of the ILEC ("remote terminal") and then lease the remaining copper loop (called "subloop"). Overall, interpreting the instruction in the Telecommunications Act to facilitate the deployment of advanced communications infrastructure and services, unbundling obligations in next-generation network markets have been essentially eliminated.[3]

6. A flexible approach to regulatory uncertainty

The key features of the US approach can be further clarified from a decision making under uncertainty perspective. In dynamic market environments, the present regulatory framework is not only contingent upon past and present but also the expected future state of competition. In the U.S., regulatory choices with regard to broadband unbundling suggest an explicit forward-looking view and a strong trust that the emerging market structure will be characterised by robust workable competition. The U.S. model does not adopt a leap-of-faith attitude, assuming that future markets will per se be workably competitive. Rather it can be seen as a response to the risk of regulatory error.

A framework to take the repercussions of uncertainty on regulatory choices more systematically into account illustrates these differences. Two principal options exist: if the future state of competition is exogenous to regulatory decisions, the decision could be modeled as a "game against nature," using traditional tools of decision-making under uncertainty, such as the minimax method. The assumption that the future state of competition is independent of preceding regulatory decisions is too limiting, however. Future market conditions are influenced by the present and expected future regulatory framework as these rules shape the incentives of incumbent service providers and potential new entrants. Therefore, in contrast to the established view of regulation, which models regulation contingent upon existing market conditions and rarely takes the effect of regulation on competition into account, future market structures are

[3] Unbundled local loops, interoffice transportation, and high-capacity loops may be used as components in next-generation networks and remain subject to unbundling, as discussed in section 4.

often endogenous to regulation as well. If this endogeneity is relevant, the game against nature approach cannot be utilised. It is, however, possible to use an alternative method based on an examination of the possible errors of present regulatory decisions.

This framework has been used in antitrust and regulatory cases (McChesney 2003). Weisman (2005) has applied it to develop criteria for regulatory forbearance. Bauer (2005) points out that the framework is more appealing for new and emerging rather than existing markets. In the simplest case, two future competitive states (workable competition, non-workable competition) and two regulatory approaches (no regulation, regulation) can be distinguished. In a more differentiated approach, more future competitive states and regulatory approaches. The main principles of the framework can be illustrated using the simplified two-by-two scenario (see table 1).

Table 1: Possible errors of forward-looking regulation

$Regulation_t$	True market $structure_{t+1}$	
	Workable competition	Non-workable competition
No ex ante regulation, full reliance on antitrust oversight	Correct	Type II error
Ex ante regulation (e.g., control of wholesale and/or retail prices)	Type I error	Correct

A correct decision in period t requires that the regulatory model adopted matches the true competitive situation in period t+1. This is quite different from much of current regulation, which often tacitly adopts a "rear-view mirror" perspective in that if is strongly based on the existing market structure. If ex ante regulation was retained in period t in anticipation of a non-competitive market structure in period t+1, but the underlying structure is a workably competitive market, a Type I error (false positive) was committed. If ex ante regulation was eliminated in period t in anticipation of a workably competitive market structure in period t+1 but the emerging true market structure does not support workable competition, a Type II error

(false negative) was committed. Ideally, the choice of a regulatory approach will minimise the cost of errors. McChesney (2003) argues that in antitrust Type II errors (the failure to punish firms violating fair competition principles) are systematically less costly than Type I errors. As long as competitors may enter the market, a self-correcting mechanism exists. In the second case, i.e. in a situation where behavior that is compatible with fair competition is punished, there is no such corrective process. In antitrust law, which deals with cases in industries that are presumed to allow workable competition, this analysis is compelling.

Weisman (2005), in his analysis of forbearance for local exchange services, extends the argument to industries that were historically subject to regulation. However, the antitrust analogy does not automatically apply to markets that may be characterised by significant market power. Consequently, a general claim that Type II errors are less harmful cannot be sustained without some qualifications. If the true market structure is indeed workably competitive, continued regulation (a Type I error) may delay its emergence. One reason is that regulation constrains supernormal profits, which is one of the forces attracting new competition in a dynamic market. Another reason is that the weaknesses in the regulation of inputs, discussed above, may retard facilities-based entry. Consequently, a workably competitive market structure will only emerge slowly. On the other hand, the remedy for Type II errors is not competition but antitrust and regulatory measures. Whereas these measures are not costless, they may provide effective solutions. Therefore, if a market does not develop a workably competitive structure corrective action will be possible. Moreover, an initial approach without regulation will trigger a different learning and experimentation process than one that prolongs regulation. Given the conditions of dynamic telecommunications technology, these arguments suggest that in new markets the potential costs of Type I errors outweigh the potential costs of Type II errors.

Although it was not explicitly invoked in policy debate, the U.S. approach to broadband unbundling follows the logic of this method. When the new regime was put into place, the anticipated future market structure was one of workable competition. The FCC's policy statement of August 2005 indicated that the agency would be willing to promulgate new measures to safeguard openness of Internet access if evidence of abuse would accumulate. Other models are being discussed that attempt to achieve similar goals, most prominently the notion of

a “regulatory holiday”. Several differences exist between the U.S. model and this proposal. First, the U.S. model is based on the expectation that workable competition will prevail and hence no schedule to re-introduce regulation at a future point in time exists. This overcomes the potential time-inconsistency problem inherent in the regulatory holiday model. Second, as it has not been tried out before, no empirical evidence is available that a regulatory holiday will accelerate facilities investment is available. On the other hand, there is considerable evidence, in telecommunications and in other industries, that markets stimulate investment. Third, the notion of a regulatory holiday has been compared to patent law. This analogy is incomplete at best. Whereas patent law grants a limited exclusive period during which an inventor may exploit a patent, it also obliges the holder to completely disclose the invention to stimulate subsequent innovation. The regulatory holiday model does not define such an obligation whereas the FCC’s intention to promulgate openness rules in case of abuse amounts to a similar provision.

Under conditions of uncertainty, regulatory decisions will be dependent on the degree of risk aversion, the trust in the effectiveness of antitrust and regulatory institutions to deal with Type II errors, assessments as to the potential costs of Type I errors, and other regulatory and policy attitudes. The framework also allows an argument in favor of allowing more regulatory differentiation, be it at the state or national level. Under conditions of uncertainty some degree of institutional diversity can be a more rational policy overall. It may allow institutional learning, that is a better understanding of the effects of different institutional arrangements on sector performance.

7. Conclusions

Since the 1970s, researchers and policy makers have developed an increasing interest in learning from the practices and experience in other nations and regions. Emulation of regulatory and policy innovations has become of the sources of improved governance of information and communication industries. This paper describes and critically comments on this transformation of the theoretical underpinnings of practical regulation in the U.S.

We suggest that the U.S. regulatory framework has evolved in three phases:

1. static regulation (pre 1970s)
2. comparative static regulation (1970s and fading out)
3. dynamic regulation. (evolving phase)

The current phase recognizes increasingly investment and innovation as a core challenge of the design of a regulatory framework. It acknowledges the inherent uncertainty of the new environment and views investment and particularly innovation as a disequilibrium problem. In contrast to full reliance on antitrust and competition law, dynamic regulation attempts to deliberately shape rules of market interaction in ways that are perceived as most conducive to the overarching objectives for the communication industries. In the U.S., practical regulation was predominantly shaped by the static perspective until the 1970s, more strongly influenced by the comparative static approach until the late 1990s, and is presently in another transition to a dynamic approach, relegating the other perspectives to a less prominent role.

The current phase trend is particularly visible in the area of broadband unbundling, where the existing unbundling obligations of incumbent local exchange carriers were eliminated to create a symmetric legal and regulatory framework for cable and telephone companies. The new approach trusts that competition the two dominant suppliers, the cable and telephone companies, is intensified by the competitive fringe of smaller service providers. Overall, competition is seen as sufficiently robust and workable to warrant elimination of unbundling obligations and to allow industry consolidation. Moreover, the new policy rests on a strong belief that deregulation will facilitate facilities-based competition and thus a more robust competitive situation in the medium and long term.

The empirical evidence of the evolution of narrowband and broadband markets in the U.S. is consistent with the dynamic theory of investment and the anticipated effects of the regulatory changes. Due to the short observation period and the multiple additional factors involved, caution is required when interpreting these positive and possible negative outcomes as causal effects of the new regulatory framework. In narrowband markets, where the FCC eliminated switching as an unbundled network element (and thus UNE-P), competitors have reacted with

accelerated deployment of their own loops and a stronger interest in simple resale. In broadband access markets, the growth rate of DSL has increased and consistently been above that of cable. Moreover, deployment of fiber and wireless broadband is growing at a high rate (with the caveat that FCC data revisions limit the comparability of fiber data). A trade off may exist between short term costs and the longer term benefits associated with facilities based competition. For example, in the second half of 2005 the total number of access lines provided by CLECs declined and the elimination of unbundling rules probably has complicated market conditions for competitors building their business model on wholesale access. However, as evidence from mobile and broadband markets indicates, facilities-based competition has considerable longer term benefits.

We suggest that the key feature of the US approach can be understood from a perspective of decision making under uncertainty. Under conditions of uncertainty it can be a more rational policy to allow some degree of institutional diversity, and a trial-and error approach. Such an approach seeks to avoid Type I errors, at the price of increasing the risk for Type II errors (ex ante regulation under conditions of workable competition vs. no ex-ante under conditions of dominance). Such diversity is a precondition for institutional learning in the form of a better understanding of the effects of different institutional arrangements on sector performance. In the U.S., regulatory choices with regard to broadband unbundling suggest a strong trust that the emerging market structure will be characterised by robust workable competition.

Given the different institutional frameworks, the U.S. does not necessarily offer a blueprint as to the overall evolution of the information and communication sectors. However, the new U.S. approach with its strong reliance on dynamic competitive thinking is relevant example for developing conceptual frameworks used to support specific regulatory decisions.

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