

## 4 Competition and access

This part and the two that follow it review the core policies and practices of other countries, and evaluate whether we can conclude that one or another policy intervention contributed to a country's broadband performance. These policies and practices fall into the two major categories of government action: regulation and public spending. They are focused on improving either the supply of, or the demand for, ubiquitous connectivity, or on assuring equitable access to the technological capabilities of the digitally networked environment. On the supply side, governments spend and invest in infrastructure or tailor their regulatory action so as to improve competition in telecommunications markets while preserving investment incentives. On the demand side, governments mostly spend improve skills, subsidize equipment and services, or act as buyers.

In our review, we found that a central aspect of policy has been the effort to foster competition in an imperfect and difficult market. This was true of the first broadband transition, and is at the center of many planning efforts for the next generation transition. Fostering competition entailed a shift from older-style regulated monopoly structures to a system that deploys its regulatory power to lower entry barriers by requiring open access to hard-to-replicate infrastructure elements. Both the degree to which national regulators were engaged and effective relative to usually recalcitrant incumbents, and the degree to which regulators emphasized protecting entrants appear to have been important. In wireless markets, the lessons are murkier. There are countries that have done well with policies that “should” not have worked—beauty contests or small numbers of allocations—and countries that have done poorly even though they acted early and auctioned four or five dedicated 3G licenses with adequate spectrum. There were also countries that had the inverse results. We review these in Part 5, but mostly suggest that this is an area that needs further study. In our review of investment policies, we found that major spending on infrastructure, either directly, as in South Korea and Sweden; through subsidies, subsidized loans, and tax breaks, as in South Korea and Japan; or through municipal-level requisitioning and public private partnerships, as in Sweden and the Netherlands, played a role. In Part 6 we review those general strategic investments, stimulus-specific investments, and municipal approaches, paying particular attention to the new European Commission guidelines aimed at considering the risk that government investments will crowd out market investments. We also review several innovative programs on the demand side in terms of skills training and subsidies to poorer users and higher cost areas.

### 4.1 Competition and access: Highlights

The most surprising finding in our analysis is that open access policies contributed to the success of many of the highest performers during the first broadband transition, and as a result are now at the core of future planning processes in Europe and Japan. Contrary to perceptions in the United States, there is extensive evidence to support the position, adopted almost universally by other advanced economies, that open access policies, where undertaken with serious regulatory engagement, contributed to broadband penetration, capacity, and affordability in the first generation of broadband. We review the evidence here at length. We begin our study with an extensive review of the literature on open access policy, both quantitative and qualitative. Our review shows that the econometrics literature that depends on cross-country studies is generally weak; its results are substantially more evenly distributed between studies that suggest that open access policies fail or harm penetration or investment and those that suggest that open access policies support those outcomes. We also find that the econometrics literature is heavily influenced by work sponsored by interested industry parties, which requires added caution. Qualitative work we review here tends to support the beneficial effects of open access more substantially than it supports the opposite claim, and tends to have less corporate sponsored elements. We follow the

literature review with our own extensive set of qualitative case studies. We consider the qualitative method we use throughout most of this part more appropriate for the complex underlying phenomena than purely econometric techniques, given the small number of countries and observation points.

Countries whose performance makes them valuable learning models are transposing what they learned about access from the first generation broadband transition to next-generation connectivity. They present several interesting models of observation regarding how to implement such open access policies in various next generation topologies. We see models of active and passive component-sharing; we see models of required sharing of the last drop; and we see competition policy adjusted to allow competitors, both incumbents and entrants, to cooperate in deploying new fiber plant. We also see a substantial recent move to adopt or consider adoption of the United Kingdom's imposition of functional separation between retail and wholesale divisions of incumbents, in order to facilitate competition based on open access to network components. We emphasize here to avoid misunderstanding: Recognition that access-based competition played an important role in the first broadband transition does not translate into a commitment to re-enact precisely those policies tailored to sharing of the already-sunk and existing copper infrastructure that typified the first broadband transition. Throughout the countries we reviewed, those lessons are being transposed to a new reality, where new investments in fiber to the home plant create different challenges. The core lesson retained, however, is that shared use of certain high-cost, slow-moving facilities lowers the entry barriers to the market in high-speed connectivity to the home. By finding a way to allow service- and electronics-level competitors to enter the market without fully replicating a redundant, expensive, labor- and capital-intensive physical infrastructure of trenches, ducts, and holes in walls, countries we observed are trying to introduce competition into markets that otherwise could sustain one, and in any case no more than two, competitors per market.

Table 4.1 summarizes the core lessons, and focuses on which of the case studies or sections is most pertinent to that lesson. The core lessons are also highlighted at the end of each discrete section or case study.

**Table 4.1. Core lessons from international strategies**

Core lesson	Case study or section
Open access policy, in particular unbundling, played an important role in facilitating competitive entry in many of the countries observed; In many cases, where facilities-based alternatives are available, access-based entrants played an important catalytic role in the competitive market; In some cases competition introduced through open access drove investment and improvement in speeds, technological progression, reduced prices, or service innovations.	Japan, Denmark, the Netherlands, Norway, Sweden, France, UK, New Zealand
An engaged regulator practically enforcing open access policy is more important than the formal adoption of the policy; incumbents resist access policies whether they are formerly government-owned or not	Japan, South Korea, France, Germany, UK, Canada
Broadband providers are regulated as carriers, and their carriage function is regulated and treated separately from their retail service function	All surveyed countries.
Access rules are now being applied to the next generation transition, particularly to fiber	Japan, South Korea, Sweden, Netherlands, France, UK, European Regulators Group/EU, New Zealand
Ubiquitous access has led regulators to accept increased vertical integration between mobile and fixed broadband providers. In some places this has also led to application of open access requirements to mobile broadband platforms	Japan, South Korea apply access; France, Germany experience greater integration but have not extended access
In the two earliest instances where functional separation was introduced, it had rapid effects on competitive entry, penetration, prices, and/or speeds	UK, New Zealand
Functional separation is increasingly adopted or considered to achieve open access into the next generation transition	UK, New Zealand, Sweden, Netherlands, Italy, Australia
Facilities-based competition usually complements, rather than substitutes for, access-based competition	Japan, South Korea, Denmark, Norway, Sweden, the Netherlands, UK, France, Germany, Italy, New Zealand
Entrepreneurial competitors have tended to enter through bitstream and unbundling access	Japan, South Korea, Denmark, Norway, Sweden, the Netherlands, France, UK
Unbundled access can also be used by incumbents from neighboring countries or regions to enter adjacent markets and introduce competition; in some cases they do so by acquiring initially entrepreneurial entrants	Denmark; Norway; Sweden, Finland; Germany
Where unbundling was formally available but weakly implemented competition was limited to facilities-based entrants, with weaker results	Germany, Canada
The anticipated high costs of next generation transition are pushing countries and companies to seek approaches to share costs, risks, and facilities, rather than focusing primarily on creating redundant facilities to assure facilities-based competition; they aim to mitigate the loss of facilities-based competition with a range of new models of open access and shared facilities, tailored to fiber	European Regulators Group, Netherlands, France, Germany, Switzerland, UK

## 4.2 Overview

Talking about “unbundling,” or more broadly open access in the United States today is unfashionable, and, it appears, controversial. We nonetheless open with this subject because it is impossible to discuss the international experience in the past decade, or to describe contemporary thinking in other countries about the next generation of high-speed networks and ubiquitous connectivity without discussing access regulation and its effect on market structure and competition. It would be no more plausible than discussing current policy debates about climate change, but not mentioning emissions caps and tradable permits. The most surprising findings to an American seeped in the current debate in the United States are the near consensus outside the United States on the value and importance of access regulation, the strength of the evidence supporting that consensus, and the central role allotted to transposition of that experience to next generation networks in current planning efforts.

Open access policies require telecommunications providers, mostly incumbents, to make available to their competitors, usually at regulated rates, various parts of their network or service, so that the competitors can begin to compete using these components as part of their service, without having to replicate the full investment that the incumbent originally made. The various types of access—unbundled local loop, shared access, bitstream access, or wholesale—differ primarily in how they trade off the level of investment a competitor must make to provide competing services, in exchange for the flexibility that the new entrant has in what improvements it may offer consumers. With unbundled local loop, the competitor leases the right to use the copper loops of the incumbent, and adds the electronics and switching. With shared access, the competitor leases only the right to use high frequency portions of the local loop, not those frequencies used for voice telephony. In both cases the competitor must invest in putting equipment deep in the network, so that it controls the technical characteristics of the DSL service, but to do so it must make substantial investments. Bitstream access gives entrants less control over the technical characteristics of the service, because the incumbent provisions the DSLAM, which in turn defines the parameters of what DSL services can be provided. It nonetheless offers more flexibility, and requires more investment, than wholesale offerings. With wholesale, the incumbent is providing a finished service, but selling it to competitors at wholesale rates. The entrant can try to improve administrative efficiency or marketing; compete on customer care, packaging or service bundling; or improve billing, but not innovate on the technical characteristics of the service.

The theory underlying open access obligations is that entry barriers in telecommunications markets are high and deter competitive entry. By requiring incumbents to sell, at regulated rates, the most expensive, and in the case of local loop and shared access, lowest-tech elements of their networks, regulators enable competitors to invest a fraction of the total cost of setting up a competing network, focus that investment on the more technology-sensitive and innovative elements of the network, and compete. In this model, regulated access provides one important pathway to make telecommunications markets more competitive than they could be if they rely solely on competition among the necessarily smaller number of companies that can fully replicate each other's infrastructure.

Some form of open access regulation has at this point been adopted by every country in the OECD except the United States, Mexico, and the Slovak Republic (which has been in the process of passing unbundling requirements for over two years, but has not yet done so). Mexico has the lowest penetration per 100, the slowest average advertised and actual speeds, and the highest prices for the low speeds that are on average available there. The Slovak Republic's fixed broadband penetration is 28<sup>th</sup> or

26<sup>th</sup> of 30 countries, and its residents pay the highest prices of any OECD country for medium speeds, and almost highest for the high speed services available to them.<sup>60</sup>

The United States is the country that invented the Internet, drove initial popularization through dial-up service on what functioned like an open access model, and was among the earliest to formally introduce open access policies as the centerpiece of the major, bipartisan, telecommunications reform in the almost unanimously approved Telecommunications Act of 1996. From the start however, implementation of unbundling was burdened and thwarted, largely by incumbents' resisting of implementation through foot-dragging and litigation, but also by a judiciary highly skeptical of the theory behind unbundling, receptive to the arguments of the incumbents, and exhibiting little deference to the judgment of the FCC.

Our review of the experience of other countries shows that open access policies were gradually adopted throughout most other OECD countries over the course of the following decade. In some cases, this was done without appreciable incumbent resistance. The Nordic countries seem to stand out in this regard, although the recent imposition of functional separation on Sweden's incumbent suggests that even there the path has been bumpy. In many cases, incumbents resisted open access as vigilantly as they had in the United States. France Telecom and its union were no less reluctant to share their rents with entrants than were the Baby Bells; nor was Deutsche Telekom. In various countries, the degree to which either the regulator or the European Union's pressure enabled a country to overcome this resistance was a factor in whether the policy then in fact became a reality. In some countries, the moment of the shift in the relative professionalism, independence, and power of the regulator in relation to the incumbent, and its will and capacity to engage in enforcing a competitive playing field are widely seen as the moment of takeoff for their present generation broadband deployment. Japan's newly-reorganized MIC succeeded in overcoming a weakened NTT's resistance in 2001. The new regulatory change was followed almost immediately by entry of Softbank, using unbundled capacity, which in turn forced NTT to shift from a strategy focused on high-priced ISDN services to a highly-competitive DSL market. France succeeded in breaking through the resistance of France Telecom and its politically powerful unions in 2003. The change was followed almost immediately by the introduction of unbundled services by Iliad and Neuf Telecom, who now hold about 46% of the French market between them. The best bundle currently available from Iliad's "Free" service includes 100Mbps service to the home, digital TV with HD and the ability to create your own private television channel for others to watch on their TV sets, unlimited voice telephony throughout France and to 70 other countries, including the U.S., and secure nomadic Wi-Fi access wherever one's laptop or Wi-Fi-enabled phone is within range of the Freebox of any other Free subscriber in the country (24% of the French market), for USD32.59 PPP a month.

Much of this part of our report reviews the experience of other countries as they implemented open access. The premise is that if open access policies work, they work through their effects on the actions of firms. Here we offer detailed qualitative case studies of open access and competition in fourteen countries. We describe how open access did, and did not, work through the choices of firms in broadband markets during the first transition, and what the regulatory and planning bodies in these countries are doing today to transpose their experience during the first broadband transition to the next generation. Where pertinent, we describe the political economy that surrounded the adoption of an effective access regime.

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60 On the other hand, the Slovak Republic has a respectable level of fiber connectivity relative to other OECD countries (slightly over 4% as of March 2009) due to a recent \$40 million investment by Orange Slovenska in connecting fiber in 12 Slovak cities. This investment, and its meaning for the questions of investment incentives created by unbundling will be discussed below.

What we found in our review of the evidence is a pattern similar to what we described for Japan and France. In other countries that implemented open access successfully, like Sweden, Norway, Denmark, or the Netherlands, the policy enabled entrants like Softbank and Iliad to compete, and that competition quite clearly followed close on the heels of adoption of the policy and contributed to the creation of a more competitive market. In some cases, open access allowed incumbents from neighboring countries to enter and consolidate some of these entrants into more powerful entrants. The Nordic incumbents, Telenor, TeliaSonera, and TDC have followed that model. In Finland, open access has been used by the long distance incumbent, Sonera (now TeliaSonera), as it was initially by AT&T and MCI in the United States before the FCC abandoned open access regulation, for competitive entry. In other countries that implemented open access more weakly, results were mixed. Canada in particular offers an example of halfhearted efforts to impose unbundling, and increasingly heavy reliance on competition between local telephone and cable incumbents. Its results, as our benchmarking study shows, have been weaker than those of other countries we review here. There are, of course, countries whose experience does not fit this model as neatly. In South Korea unbundling was introduced late, after it had already reached high levels of service. In this regard, it is an example of a case where high urban density and government investment were sufficient to generate facilities-based competition. Nonetheless, even in South Korea the early entrants relied on open access to *cable* facilities, rather than unbundling of telephone infrastructure as elsewhere. We discuss these below, in the case studies themselves. Switzerland has been the strongest example of successful broadband performance without effective adoption of unbundling. Nonetheless, that case is rendered ambiguous by the fact that Swisscom is majority-owned by the Swiss government, and that the Swiss regulator and Swisscom had been battling over the former's efforts to impose unbundling, as it ultimately succeeded in doing in 2007. Even after the imposition of unbundling on copper there are continued debates over whether to extend unbundling to fiber. Moreover, responding to competition from both cable companies and publicly-owned municipal power companies, Swisscom's new fiber strategy adopts a voluntary open access model for fiber, so as to share the costs and risks of investment in next generation roll out. Swisscom has been negotiating cooperative arrangements with competitors for laying four-fiber plants into each home and sharing the resultant infrastructure.

The United Kingdom's experience introduces an additional policy element. There, efforts to implement the most extensive form of open access—unbundling—met with subtle resistance from BT. As a result, although the UK had adopted unbundling in 2001, by late 2005 there were still only 200,000 unbundled loops in the entire country. At that point, Britain's regulator, Ofcom, forced BT to undertake functional separation: that is, create a separate unit, Openreach, which specializes in selling open access components to telecommunications providers, both to the retail operations of BT itself and to its competitors. The separation changes the incentives of the provider, and eases monitoring of its behavior. Functional separation was followed by a flurry of investment activity by entrants, resulting in the strengthening of competitors Carphone Warehouse, Tiscali UK, and BSkyB and their shift to competing over more flexible unbundled loops instead of almost solely through wholesale offerings. By the end of 2008, there were 5.5 million unbundled loops in the UK. Prices fell by over 16% each year between 2006-2008. While the UK's competitive market did not result in the very high speeds we see in France or Japan, our analysis of prices advertised by 78 companies in the countries we review here shows that the UK companies do have among the lowest prices in the high speed (as opposed to very high speed) category of services. In our benchmarking study, the UK now has prices that are among the top quintile of performers for all tiers of service save for the very highest speeds. Following the UK's experience, New Zealand implemented functional separation in December of 2006 in a dramatic reversal of its consistent policy of regulatory abstention since 1989, and in response to its substantial under-performance on broadband penetration. Between the last quarter of 2006 and that of 2008 New Zealand saw its penetration per 100 rates jump, surpassing those of Austria, Italy, Spain, and Portugal; it saw

speeds increase more than in any other OECD country, and the primary competitor to New Zealand Telecom, TelstraClear, invested in its own fiber ring connecting all of South Island's towns. Sweden, Italy, and Australia have now followed this path in preparation for the next generation transition, and the Netherlands has nudged its incumbent into what is effectively an equivalent arrangement, through a new joint-venture that is deploying open access fiber.

The experience of all these countries has led to a wide consensus (not shared by the incumbents in many of those countries) outside the United States that open access policies played an important role in creating competitive broadband markets in those countries that adopted and enforced them. As a result, current planning efforts emphasize transposition of the lessons learned about open access to the different topologies and cost structures of next generation networks as a core element of these countries' policy. The clearest documents in this regard are those produced by the European Regulators Group (ERG), which coordinates among the European regulators. The ERG has studied the lessons of its members extensively over the past several years, and has produced a series of reports on implementation and transposition. These include analysis of when “active access,” that is, access akin to bitstream and wholesale, and when “passive access,” or access to ducts and dark fiber would be desirable, and consideration of when functional separation is sensible.

We follow the detailed qualitative analysis with a firm-level pricing study. The study looks at prices offered by the 78 companies that offer the very high speeds in the countries we review here, or if none do, the highest speeds otherwise available in the country. It incorporates data from both our own research and OECD data. It identifies companies by their status as incumbent telecommunications companies, cable operators, unbundling-based entrants, and utilities or other facilities-based entrants. We find that U.S. and Canadian companies—both telephone and cable incumbents—that occupy markets that rely on inter-modal competition, offer the lowest speeds at the highest prices, joined by Norwegian power companies. Japanese, French, Swedish, and Finnish firms, including telephone incumbents, cable companies, and access-based entrants, offer the highest speeds and lowest prices, together with South Korea. The rest of the companies we observed occupy a middle ground.

We conclude this part with a detailed review of current efforts to transpose the experience of open access to the very different context of next generation connectivity. We include here, in particular, a review of the European Regulators Group efforts, instances of narrow regulation, like the French emphasis on in-building fiber plant sharing, instances of very foundational regulation, like functional separation introduced in the UK, but also case studies of the voluntary infrastructure-sharing models developed in the Netherlands and Switzerland. The range of approaches for transposition is significant. We also note that some of the responses take the form of government funding and are therefore treated in part 6 under government investment. However, Amsterdam CityNet described there is on its way to being largely privatized to Reggefiber, and the Australian National Broadband Network is intended to be privatized under an open access regime within a few years of deployment. These examples emphasize the wide range of avenues used to transposing the lessons of the first broadband transition to the next generation transition, without imagining that the universe of options is limited to either staying the course or adopting the unbundling policies of the late 1990s lock, stock, and barrel. It may well be that different types of policies may fit different specific regional market conditions in different regions throughout the country. Our role here has not been to provide a single recommendation, but to survey the range of options and lessons that can be learned from them.

### **4.3 The second generation Internet: From dial-up to broadband**

During the 20<sup>th</sup> century telecommunications services were a monopoly business. Outside the United States, these monopolies were mostly state-owned. In the United States, AT&T became a de facto monopoly in the second decade of the century. The theory throughout this period was one of natural monopoly. Because the fixed investments necessary to create a telecommunications network were so high, while the marginal costs to serve each subscriber over time relatively lower, and because it was valuable to subscribers to be connected to all other subscribers, it was thought to be most efficient to have a single network connect everyone, and then subject the carrier to regulation to assure that it would not abuse this monopoly by charging high prices for poor service.

By the end of the twentieth century this model was globally seen as a failure. The state-run telecommunications carriers were seen as inefficient and bloated. In the United States, the Bell System repeatedly outwitted the FCC and the Department of Justice, preventing competitors from entering into competitive lines of business that depended on the core, hard-to-replicate facilities of the local copper loop, like long-distance telephone service, the manufacture of telephone or office switches, or data processing at a distance, and continued to capture rents that, in theory, should have been regulated away. The global disenchantment with the idea of a well-regulated monopoly swept the industrialized nations. In the United States, AT&T was broken up in 1984. Its “daughter companies” operated under antitrust court supervision for over a decade, until Congress passed the Telecommunications Act of 1996 to modernize the law to fit the new competitive environment. In the rest of the world, national telephone companies were gradually privatized in the late 1980s and throughout the 1990s, although in many places the government still holds a non-controlling share—and an influential voice—in the resulting private companies.

The history is important because the quandaries presented by the transition from regulated monopoly to competition continue to be the core quandaries facing regulators everywhere as they ponder the next transition to a ubiquitously networked society. Just like now, the entry barriers to creating a second, independent, competitive telecommunications network were enormous. While these regulators were disenchanted with the idea of a well-regulated monopoly, they worried that competition was unlikely to emerge in many places, and where it did, it certainly would not be a perfectly efficient market. So a shift to inevitably imperfect competition was a second-best solution; just like regulated monopoly had been before it.

The core institutional innovation intended to square this circle—imperfect competition in a market for a network good with extraordinarily high upfront costs—was open access. The idea was that the incumbents—the former Bell companies in the U.S., Nippon Telegraph and Telephone (NTT) in Japan, British Telecom (BT) in the United Kingdom, and so forth—would be required by law to lease to newly entering competitors parts of their existing network on nondiscriminatory, regulated terms. This would lower the cost of entry and allow entrants to innovate in the electronics attached to the network, or in customer care systems or services they would offer, rather than investing in digging trenches and making holes in the walls of the houses of subscribers to pull their own, independent wiring. To give entrants flexibility, open access policies provided a menu of options for trading off investment for flexibility. Entrants could lease access to copper loops or portions of them, which were very expensive to build because of the high costs of digging trenches or pulling wires, but were not particularly technologically advanced. If they did so, they would have great flexibility in what electronics equipment to attach to these loops, but at the cost of having to invest heavily in their own equipment. In the alternative, incumbents were required to provide competitors with access to DSL service at different points in their networks, in ways that provided different tradeoffs. Because the incumbent had market power, the rates at which these components of the network were to be sold would be regulated so as to set them at a level

that allowed the incumbent to recover its costs while leaving enough room for the entrant to make a retail profit. After a while, it was thought, the entrants would gain market share and brand recognition, they would be able to predict more reliably what their investment prospects were like, and they would increase their levels of investment deeper into the network. Throughout this period incumbents argued that forcing them to sell to competitors at regulated rates reduced their own incentives to invest: Why invest, they would ask, if you know that you will be forced to share the benefits of the new networks you are building with competitors, at regulated rates? The theoretical and empirical debates continued throughout the first decade of the 21<sup>st</sup> century, as academics and consultants made their contributions to clarifying, and sometimes to obfuscating, the case.

#### **4.4 Review of the literature on the effects of unbundling on performance and investment**

We review here 57 studies, dividing the papers into three categories: quantitative studies that focus on broadband penetration, quantitative studies that discuss broadband investment, and qualitative studies, most of which cover a single country or comparison of a small number of countries. This review is based in part on a recent literature review published in *Telecommunications Policy*<sup>61</sup> and comments filed in response to our draft report, supplemented by our own research.

Fifteen of the papers we reviewed analyze the effects of unbundling on penetration. Of these, three rely on data from before 2001, when most of the relevant cross-country variation began, or exhibit methodological weakness. Of these fifteen, six papers find positive effects of unbundling on penetration, three found negative effects, and six had indeterminate findings—they found either no effect or both positive and negative effects.

We have reviewed twenty-three papers related to unbundling and investment. In this set we included all the papers characterized as empirical investigations of investment and unbundling in the recent Cambini and Jiang (2009) review, which is the most recent authoritative review. Several of these are not empirical at all, but are rather conceptual; some include fatal methodological flaws, deeper than the broader limitations of the approach as a whole. Of these twenty-three papers, two show positive effects on investment by incumbents or entrants; one shows positive and negative effects; two report no findings; and one reports negative findings. The remaining seventeen papers are either conceptual or modeling exercises, rather than empirical studies, or have serious methodological flaws. The papers we categorize in this group are divided equally (8 and 8) between finding negative and positive effects on investment. One paper that reviews the literature up until 2006 concludes “Almost ten years have passed since the Telecommunications Act transformed telecommunications regulation in the United States and economists still do not have a thorough understanding (theoretically or empirically) of how local loop unbundling affects investment.”<sup>62</sup>

We note that twenty of the thirty-eight quantitative or theoretical papers we reviewed are self-published. At least sixteen of the thirty-eight are directly sponsored by a corporate sponsor with direct interest in the outcomes of the research. The papers on investment exhibit this characteristic at a particularly high rate. Thirteen of twenty-three are sponsored by a party with direct commercial interest in the outcome. While the work should obviously be read on its merits, it is appropriate to note the conflict of interest, as

61 Cambini, C. and Jiang, Y. Broadband investment and regulation: A literature review. *Telecommunications Policy* (2009). 33 559-574.

62 Guthrie, Graeme. Regulating Infrastructure: The Impact on Risk and Investment. *Journal of Economic Literature*. 44(4): 925-972 at 969.

many of the original papers do, but the Cambini and Jiang literature review does not, and to exercise a higher degree of caution when reading these papers.

Given the limitations of the quantitative cross-country studies, discussed in a later section, we place particular emphasis on qualitative research, which is able to take account of the nuance and local variation to a much greater degree, although it is not, of course, without its own limitations. We reviewed nineteen qualitative papers or book chapters, none of which were self-published, three of which had industry sponsorship. Of these papers, ten identified open access policies as having positive effects on broadband deployment and prices. Two papers (both industry sponsored) identified negative or no effects where positive effects would be anticipated. One found both negative and positive findings. Six found no effect, or focused on the political economy rather than on the outcomes.

Given this state of the literature, the present unstated consensus in U.S. telecommunications policy circles that open access is a theory in disrepute is without foundation in evidence. Quite the contrary, open access should be a continued subject of study, experimentation, and observation as one among the many tools in the toolbox of telecommunications policy.

We now turn to a description of the conceptual models that inform this literature.

#### **4.4.1 Conceptual models of the relationship between open access and investment**

Five basic relationships have been proposed in the literature for the relationship between investments and access regulation, and a sixth emerges as a possible framework from our own case studies and review.

The simple theory that underlies the claim that access rules undermine investment argues that incumbents will not invest in their networks if they are forced to share their networks at inappropriately low rates. This includes two components. First, if the rates are set below costs, the negative effects are obvious, as investment will immediately have a negative value. Hausman (1998) argues that the sunk-cost nature of many of the core network investments made by incumbents, and changing technology, can systematically lead forward-looking price regulation to be too low. Second, the fixed and sunk costs make the investments in broadband infrastructure analogous to investments in innovation (Hausman 1998; Gayle and Weisman 2007), and so the innovation is pursued in expectation of rents derived from a non-competitive market (See also Pyndick 2007). The investment is driven by the expectation of rents from the downstream product, just as investment in innovation is driven by patents that exclude competition, in a downstream product market that is less competitive than it would be with access regulations in place. According to this theory, incumbents would invest less when they are subject to unbundling, unless the prices for the elements would compensate them for all the unsuccessful innovations they installed. We note, however, that just as in innovation economics, if the prices are too high they will deter entry by entrants, and the welfare and innovation benefits that would come from that entry would be lost (Gayle and Weisman 2007).<sup>63</sup> As a result, whether unbundling will or will not undermine investment, and what rates would induce the most dynamically efficient levels of investments by both, depends on the effects on both incumbents' and entrants' incentives.

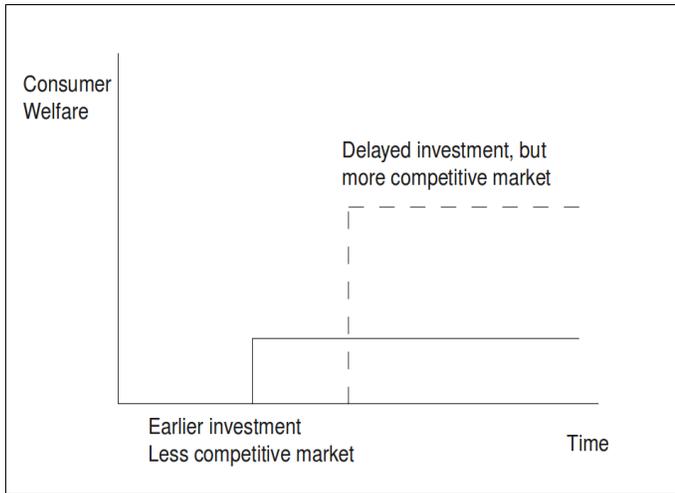
The second approach similarly posits that investment will undermine investment incentives, but also accepts that unbundling and open access improves competition, and during the period after investment, consumer welfare is enhanced by the more competitive environment that uses the infrastructure (Hoffler

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<sup>63</sup> Gayle, P., & Weisman, D. (2007). Efficiency trade-off in designing competition policy for the telecommunication industry. *Review of Network Economics*, 6(3), 322–341.

2007). Figure 4.1 describes this relationship conceptually (Alter 2009). The basic trade-off for infrastructure that represents a very long term investment, as in the case of the passive elements of next generation networks, such as the trenches, ducts, holes, and dark fiber which may persist for twenty or thirty years, is the cost of delayed deployment compared to the value of increased welfare over the lifetime of the installed infrastructure.

**Figure 4.1. Tradeoff between time of investment and welfare generated by the investment over its lifetime.**  
Based on Alter 2009



The third, best-known theory in favor of unbundling is what was in the U.S. referred to as stepping-stone, and what is referred to now in Europe as “investment ladder,” introduced by Cave and Vogelsang (2003).<sup>64</sup> The basic idea is that entrants will initially enter the market using wholesale access and later move into unbundled loop access, initially leasing those aspects that are hardest for them to replicate. Then, over time, entrants may be able to build a brand and customer base and shift over to compete on their own facilities to free themselves of dependence on their competitor. We will turn to the empirical literature testing these various hypotheses shortly, but we first note that our own case studies do lend some support to the investment ladder theory, but suggest that there is room for further theoretical development. In the Nordic countries, investment ladder seems to have worked through investments in the form of consolidation by the neighboring incumbents entering each other's territories, in part by buying existing facilities from cable and power plant owners, combining with unbundling providers, and expanding their reach. In Japan, Softbank's moves into mobile and (very recently) fiber are consistent with the theory; and in France, the current (small) actual investments and (large) planned investments by Iliad in fiber, as well as the large investments in fiber in the core of the network by Neuf and Cegetel (Fevrier and Sraer 2007) are also consistent with that theory. There is stronger evidence for a less complete version of investment ladder, or for its existence at an early stage, indicated by the move from bitstream—which allows entry with lower investment but less flexibility—to unbundling, which requires more investment on the part of the entrant and gives it greater flexibility to use the electronics it prefers and to innovate in services. Data gathering by the organization of European entrants, ECTA, on the relative use of bitstream versus unbundling lines over the past few years shows that in a majority of countries for which there is data, unbundling is increasing at the expense of bitstream while total entrant lines are also increasing. This includes in particular the UK after functional separation, as well as Austria, Denmark, Finland, France, Germany, and Italy.

<sup>64</sup> Cave, M., & Vogelsang, I. (2003). How access pricing and entry interact. *Telecommunications Policy*, 27(10–11), 717–727.

A fourth theory suggests that greater competition will spur investment. It suggests that low cost unbundled elements lower the costs to entrants, who in turn can offer lower cost and more differentiated products to consumers. These low cost, new products increase the consumption of communications services which in turn improves incumbents' cash flow as long as the rates are not set too low (Chang, Koski, and Mujamdar 2003; Friederiszick, H., Grajek, M. & Roller, L. 2008)

A fifth, new conceptual framework is proposed by Bauer (2010).<sup>65</sup> Bauer offers a neo-Schumpeterian model that sees regulatory policy as playing a role in a market dynamic in which many players, both regulated and non-regulated entities, react to a set of regulations. On the question of the relationship between open access or market-structuring regulation and investment, Bauer (2010) relies on a neo-Schumpeterian innovation model that suggests that the market structure most conducive to long-term, dynamic investment is one where there is neither too much concentration, nor too much competition. Instead, a small set of large firms, with smaller firms constantly contesting, but with sufficient scope to provide a serious threat, is most conducive to dynamic investment. How to reach that state may vary from country to country, and is unlikely to be a single, one-shot decision, but will require continuous updating and “fine tuning” over time. The basic neo-Schumpeterian model is consistent with the experience of countries that have a small number of moderately sized competitors to a large incumbent—such as in Japan, France, the Nordic countries—along with the tendency in the past few years for larger players to consolidate several smaller entrants—be it Telenor in Sweden, Carphone Warehouse in the UK, or SFR in France. It is also consistent with the findings of Jung et al. (2008), that while a larger market share of entrants positively effects incumbent investment, the number of entrants does not. The core question that this model presents for the U.S. is whether two is a sufficiently large number of competitors to sustain that dynamic, or whether the regulatory toolbox needs to include a set of tools that can increase the number of competitors and allow for the entry of newer, more agile competitors (Fransman 2006). It is important to note that while critics of unbundling will often quote evidence of consolidation in the entrant market as evidence against the feasibility of competition, this framework would actually interpret such evidence as a maturation of the entrants.

Finally, our own case studies, described below, and our synthesis of the various theories that support open access, as well as our observations of current plans for infrastructure sharing in Switzerland, the Netherlands, and perhaps in Germany and the adoption of functional separation in the UK, Sweden, New Zealand, Australia, and Italy (and voluntary effective separation in the Netherlands), suggest that as a practical matter regulators are edging away from investment ladder and towards a quite different theory, which has not been well articulated in the literature. These cases seem to suggest that much of the competition is carried on not by replicating the trenches and ducts, holes and poles, but by sharing a single, non-redundant high-capacity basic physical infrastructure, and investing in electronics or optics and innovation in processes and services. Open access allows separating out portions of the infrastructure that are slow moving, trenches, ducts, holes in walls, and making those either monopoly or duopoly at most, but allowing competition in electronics, optics, and services on top of that slower moving shared core. This theory would be supported by Chang et al. 2003; Jung et al. 2008, Hoffler 2007; Alter 2009; and Bauer 2010. The basic idea is that open access and unbundling is not necessarily a pathway to the development of completely redundant facilities, but might be channeled towards complementary investments around a shared common set of slow-moving, extremely high cost elements: the passive infrastructure. Facilities-based competition that grows out of the happenstance of existing incumbent infrastructure would then contribute to competition, but it would complement, rather than substitute, for competition over the shared facilities as well. Completely redundant facilities are a good, but socially costly, hedge against regulatory failure. In principle there is nothing about the

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65 Bauer, J., Regulation, Public Policy, and Investment in Communications Infrastructure. *Forthcoming* Telecommunications Policy. 34. 2010.

physical limitations of a trench, or a fiber optic cable that makes duplication of this infrastructure a precondition for competition. Rather, it is the concern that regulation will fail to detect anticompetitive behavior by the owner and operator of the shared infrastructure that the duplication insures against. Whether that insurance is worth the enormous social cost of redundant infrastructure, or the long term cost of reducing entry only to those actors able to fully duplicate facilities, is far from clear.

#### 4.4.2 General notes on the empirical literature

##### *Systematic limitations in cross-country econometric models*

This section describes the systematic weaknesses of cross-country econometric studies that seek to identify causal explanations regarding the complex interactions that contribute to the impact of regulatory policies on the diffusion of broadband. The attractiveness and potential value of conducting quantitative, multivariate analysis of broadband policy is understandable. However, we conclude after extensive review that the quantitative analysis from a majority of these studies, particularly the cross-country econometric studies, does not offer meaningful guidance for policymakers.

The challenge of quantitative broadband policy analysis is to estimate the impact of policy choices on outcomes, most commonly Internet penetration or investment levels. In order to do so, the analysis must control for a large number of variables that are correlated with policy choices and have an influence on penetration or investment rates. This requires a solid theoretical basis for specifying a model and sufficient data to estimate the model. In most cases, neither of these requirements is met.

There are a large number of potential factors that influence broadband adoption and investment decisions. These may include income, demography, geography, local market conditions, financial markets, strategic behavior by firms as part of the regulatory negotiation problems, strategic behavior by regulators, existing technologies and infrastructure, inter-platform competition, the structure and composition of the telecommunications sector, and regional variation within countries, among many others.

Cross-country econometric studies are based generally on data from the 30 OECD countries or a set of EU countries. For each country, six observations over time are typically available. This is simply too few observations to tease out the interaction of these many factors. This factor alone is enough to severely curtail the utility of such studies. There are, however, several other issues.

A necessary step in quantitative policy analysis is finding an adequate measure of the relevant policy variables. However, many of the policy variables of greatest interest are difficult to observe and characterize. Assessing the level of regulatory intervention requires a measure of its effective implementation, rather than just the statement of policy goals and intentions. The policy of greatest interest here, unbundling, is often specified as a binary variable, obscuring important distinctions in the policy approaches taken across different countries. Others have proposed a variable that measures the time since the implementation of a policy to capture the learning, adjustment and investment period that companies and regulators need to settle into a new policy environment. This too glosses over important policy differences across countries. More fine-grained measures of different policy sets, even if available, compound the problem of few observations. Moreover, objective measures of policy implementation are generally unavailable.

Measures of another key variable, inter-platform competition are also highly imperfect. Inter-platform competition is typically measured by comparing the shares of the overall broadband market that are captured by different technologies, e.g. cable versus DSL. This is quite different from measuring the

extent of head-to-head inter-platform competition in retail markets. Furthermore, not all technology platforms are distinct competitors, and countries differ in the degree to which the different technology platforms are used as anchors for competing firms, as opposed to being used by firms that combine platforms and compete across platforms; the extent to which this occurs is different in different countries.

The adoption of broadband Internet is subject to time diffusion effects, as with other new technologies. These general time diffusion effects are hard to separate out from the time effects of other factors, such as the quality of regulatory enforcement or the maturation of competition.<sup>66</sup>

Many of the variables of greatest interest are jointly determined (this is commonly referred to as “endogeneity” in the econometric literature). For example, multiple companies are more likely to compete in markets where there is high demand for broadband services. A modeling approach that seeks to explain high penetration by the existence of competitors without accounting for the simultaneous determination of these variables will render biased and unreliable results. More complex structural equation models and instrumental variable approaches are the standard remedy for these issues. However, such estimation techniques require more data and effective instrumental variables; neither of these is generally available in cross-country studies. Country or region-specific studies that have access to use richer micro-level data are better able to surmount this obstacle. A reduced-form modeling strategy, which drops the endogenous variables from the list of explanatory variables, helps to mitigate this specific problem, but at the cost of dropping many of the variables of prime interest. Panel data analysis is often able to overcome the specific problem of unobserved variables, but can not resolve all of the issues mentioned here.

Another issue with cross-country quantitative models is that they are often driven by the experiences of a small number of countries. This issue stems back to the fundamental data problem.

The issue of inadequate data alone is enough to cast serious doubts over the ultimate effectiveness of cross-country broadband policy studies. After careful review of the various cross-country studies and methodologies, we have concluded that the quantitative results from these studies offer little useful guidance to policy-makers, although several of these studies are well written, are carried out by highly competent researchers, and contain excellent background materials and perspectives well worth reading. This conclusion will come as no surprise to scholars from other fields that have a history with such analytical approaches. The study of economic growth, in particular, has seen innumerable cross-country econometric studies drawing on much richer data and highly sophisticated estimation approaches. Even there, this general approach has been out of favor for well over a decade.<sup>67</sup>

Given the shortcomings of quantitative cross-country studies, future quantitative studies are best carried out where more granular data is available, which is typically within a single country. Two recent studies, Alter (2009) and Sraer (2008), are good examples of such an approach. While quantitative work can be a powerful heuristic tool for researchers to identify areas for further scrutiny, investing faith in

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66 Glenn Boyle, Bronwyn E. Howell and Wei Zhang. July 2008. “Catching Up in Broadband Regressions: Does Local Loop Unbundling Really Lead to Material Increases in OECD Broadband Uptake?” Available at: [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1184339](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1184339)

67 See for example, Levine, Ross, and David Renelt, “A Sensitivity Analysis of Cross-Country Growth Regressions,” *American Economic Review*, September, 82(4), 1992, 942-63. Durlauf, S. N., Johnson, P. A., & Temple, J. R. (2005). “Growth econometrics” In P. Aghion & S. Durlauf (Eds.), *Handbook of Economic Growth*. Elsevier. William Easterly, “National Economic Policies and Economic Growth: A Reappraisal” In P. Aghion & S. Durlauf (Eds.), *Handbook of Economic Growth*. Elsevier. Dani Rodrik, (2005) “Why We Learn Nothing from Regressing Economic Growth on Policies” Available at: <http://www.hks.harvard.edu/fs/drodrik/policy%20regressions.pdf>

the numerical results rather than the much richer historical and qualitative information is misguided. We believe that a more instructive alternative approach to international comparisons is qualitative case studies. This is the approach that we have chosen for this study.

*A note about the role of industry-sponsored research into telecommunications policy*

We organize our review based on year of publication and type of author or sponsor. We do so because, as we worked through the review, it became clear to us that the genre of literature review tends to “wash out” the disclosures that many of the authors properly make in their papers. We cluster the reviews in each of the sections into three groups: government employees and commissioned reports; academic work, as well as work in think tanks where there is no clear evidence of direct industry sponsorship; and industry-sponsored work. This is most important in the section on unbundling and investment, where more than half the papers widely cited as pertinent were sponsored by industry. While we think that all work should be considered, as in many other disciplines, where empirical work is written to the specifications of a party with a direct commercial interest in the outcome, the work needs to be handled with a high degree of skepticism. This is true for the econometrics work in particular, because of its high sensitivity to the precise technique and model used, and the opacity of its techniques to the vast majority of policy makers. In the telecommunications literature, there appears to be no general ethical disclosure requirement (although much of the work does properly disclose its sponsor), and no practice of giving substantially different treatment to papers written by interested parties, including those papers that are not only industry sponsored, but are also self-published and not refereed. Such papers are treated on par with peer-reviewed academic papers that were done without industry funding not only in other similar submissions, but even in the most recent comprehensive peer-reviewed literature review. We believe the Commission would do well to institute a set of rules or expectations about what sorts of disclosure would be required about a paper's funding before it can be seriously considered in the development of an evidence-based policy.

#### **4.4.3 Econometrics studies of unbundling and broadband penetration**

Here we offer a review of 15 quantitative papers that focus on the impact of broadband policies. A majority of these papers are saddled with the methodological issues associated with cross-country models described earlier. Of these papers, we found six papers that found an unambiguously positive impact of unbundling on penetration and three that had a negative impact, while the other six found either evidence in favor of both propositions or were unable to uncover any relationship.<sup>68</sup> All of the papers that studied inter-platform competition concluded that it had a positive impact on penetration levels. Three of the papers reviewed in this section were sponsored by industry. A majority of these papers are self-published by the authors or organizations for which they work. Six of the papers appear to have been in peer-reviewed publications.

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68 This set of papers overlaps substantially with the 12 papers reviewed by Empiris, LLC, on behalf of both the National Cable and Telecommunications Association and the United States Telecom Association in response to our draft study. They come to remarkably different conclusions from our own assessment of the same literature: “the incontrovertible fact is that open access policies have not been shown to increase broadband adoption, availability, or infrastructure investment. To the contrary, the bulk of the available evidence points in the opposite direction.” This response, filed by longstanding participants in the debates over telecommunications policy in the U.S., helps to illustrate why we were surprised by our findings. It well represents the state of the literature and sense of the U.S. telecommunications policy community in the past few years that open access policies had been academically disproved.

**Table 4.2. Papers on Unbundling and Broadband Penetration**

Citation	Published=1 Self-pub=0	Sponsor	Impact of inter-platform competition on penetration	Impact of open access policies on penetration +, -, +/-, 0	Comments
<b>Government / Int'l organization</b>					
Grosso 2006	0	Australian Competition Authority	N/A	+	OECD 30, 1999-2005.
Denni & Gruber 2007	~1 (not clear whether refereed)	EU Investment Bank; Italian competition authority	+ platform competition strongly positive	0, +/- small number of largish entrants beneficial	U.S. data only from 2001-2004; period with strong incentives to game regulatory system (U.S.)
De Ridder 2007	0	OECD	+ / 0	+	OECD 30; 2002, 2005; uses multiple factors; seeks to identify the effects of unbundling over time
Sraer 2008	0	ARCEP; academic	N/A	+	French data from 2006; micro-data from 1500 exchanges in France; strong instruments on entrant investment and penetration
<b>Academic/ Think tank</b>					
Bauer et al 2003	0	N/A		0	Old data (2001 and pre-); early innovative effort to quantify effects; Uses broad policy baskets; no policies significant
Garcia-Murillo 2005	~1	N/A	N/A	+	Older data (pre-2001). ~100 countries. Unbundling positive and significant for middle income countries, not low income countries; logit and OLS regressions, various models; not significant in some.
Distaso, Lupi, and Manteni (2006)	1	N/A	+ platform competition strongly positive	+ low LLU rates increase penetration	Paper emphasizes the inter-platform competition effects. Findings support mixed strategies
Wallsten (2006)	0	N/A	N/A	+/- different forms of open access have positive, negative, or no correlation with penetration	Paper sets out different types of unbundling regimes; finds that different forms, with different specifications, show up as alternatively significantly positive; insignificant; or negative.

Citation	Published=1 Self-pub=0	Sponsor	Impact of inter-platform competition on penetration	Impact of open access policies on penetration +, -, +/-, 0	Comments
Cava-Ferreruela and Alabau-Munoz (2006)	1	N/A	+	0/+	Older data (2000-2002); “Cable” represents houses passed, not actual cable upgraded to broadband; LLU formal application trends positive, not significant; likely reflects strong role of cable in early success of U.S. & Canada.
Hoffler (2007)	1	N/A	+	+ lower LLU prices increase penetration	Analyzes welfare effects of facilities based competition; suggests duplicative investment in facilities may impose more welfare costs than provide gains
Boyle, Howell, and Zhang (2008)	0	N/A	N/A	0	Authors point out that it is systematically impossible to separate the effects of straight diffusion time from the effects of unbundling over time
Hazlett & Caliskan (2008)	1	N/A	N/A	-	Fails to account for time diffusion effects; mistaken characterization of legal regime used as instrument
Industry supported					
Aron and Burnstein (2003)	0	LECG		- higher- penetration where both cable and telco present	Old data (pre-2001); finds higher penetration where cable present, during period when cable primary mode of delivery
Waverman 2007	0	ETNO		-	Lobbying document; emphasizes that unbundling-based access undermines investment in cable
Bouckaert et al (2008)	0	Belgacom	+	0/- resale decreases penetration; unbundling has no effect	Very weak significance on all; case study component suggest learning from French and Dutch markets that unbundling is better than resale-based competition

*Unbundling and Penetration: Government-sponsored Studies*

Grosso (2006)<sup>69</sup> is a working paper by a researcher at the Australian competition authority. It uses OECD data from 2001-2004, and reports a positive effect for unbundling on penetration significant at the 1% level.

Denni and Gruber (2007)<sup>70</sup> is a paper in a journal published by the market analysis firm IDATE. It analyzes data from the U.S. from 2001-2004, that is, exactly the period during which the FCC and the incumbents were battling over whether to eliminate unbundling altogether, between the initial introduction of the idea of inter-modal competition and its final approval in *Brand X* and the Triennial Review process. The authors find unambiguously that inter-platform competition is beneficial for diffusion. They find that intra-platform competition is beneficial to diffusion only if the number of firms entering through unbundling is not too large: “in the case of ADSL lowering the market share of the incumbent is beneficial as long as the market retained by the entrants is not too fragmented.” The authors use the Herfindahl index to measure inter-platform competition, but refer to technologies market-shares as opposed to firm's market share (this is less fatal in the U.S. context, as in this paper, than it is in real international comparisons, as is used for example in another of the papers, (Waverman et al 2007), where it masks the fact that in some high performing countries cross-technology-platform competition is used to complement unbundling-based competition, rather than as its alternative). This paper looks at U.S. data alone, from a period of intense political maneuvering around the negative investment effects of open access, and so potentially reflects strategic behavior on the part of either incumbents or regulators, rather than any real incentives effect.

De Ridder 2007 was discussed extensively in our draft report, as well as in the comments. Authored by an economist at OECD and published by OECD, that report seeks to identify the effects of diverse variables on penetration. The paper finds a significant positive effect on penetration from the years since unbundling was enacted. It was critiqued in Boyle et al. 2008; we discussed both the paper and the critique, confirming in the main de Ridder's findings in our draft report; our discussion was in turn critiqued in the comments; we provide a response to a version in the annex to this part.

Sraer (2008)<sup>71</sup> is a working paper by an academic; based on work done for the French regulator, ARCEP. Using sophisticated analysis and instruments, and fine-grained data from 1,500 local exchanges in France, representing over 70% of the French market, collected in 2006, Sraer finds that unbundling-based entry by even one entrant results in an increase in penetration of between 1.1% in the short term and 5.9% in the medium term. This represents almost a full standard deviation in penetration rate. The underlying data in the paper shows that unbundling-based entrants invest in their own fiber backbones and complementary investments to the incumbents' local loop. Moreover, the paper shows that while the effect is partly driven by price competition, a large part of it cannot be explained by price, suggesting that quality or marketing efforts in the competitive market play a role in increasing adoption.

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69 Marcelo Grosso, “Determinants of Broadband Penetration in OECD Nations,” Working Paper, Regulatory Development Branch, Australian Competition and Consumer Commission (2006).

70 The Empiris declaration cites this as Denni and Gruber 2005. That unpublished conference paper was later published in a market analysis firm's publication, IDATE's Communications and Strategies. M. Denni and Gruber H., The Diffusion of Broadband Telecommunications in the U.S. Communications and Strategies (IDATE) No. 68, 4<sup>th</sup> Q, 2007, 139-157.

71 David Sraer. 2008. Local Loop Unbundling and Broadband Penetration. Unpublished MS.

*Unbundling and Penetration: Academic and Think Tank*

Two widely-cited early papers use older data, from before 2001. These early efforts were innovative for their time, but because unbundling began in earnest as a policy only at around that period, the use of the older data necessarily limits the degree to which the data can provide strong insights. Bauer et al. (2003),<sup>72</sup> an unpublished conference paper, was an effort to use OECD data for 26 countries to extract lessons about policy. It tried to account for a very large set of potential causes, and used relatively broad baskets to classify countries into one of several regulatory categories. Given these broad baskets, the wide range of potential explanatory variables, and limited observations, it is not entirely surprising that the study did not find statistical significance for any of the policy variables. The second academic paper that relies on old data, Garcia-Murillo (2005),<sup>73</sup> is a paper published in an IDATE journal. The paper analyzes data from about 100 countries, from very early in the development of broadband. It includes price as well as unbundling, which creates difficulties. It finds particular significance in middle income countries, not in higher-income countries, although it is important to recall that 2001 is prior to effective implementation in many countries, both high and middle income.

Distaso, Lupi, and Manteni (2006)<sup>74</sup> is a paper published in a peer-reviewed journal that develops a theoretical model that predicts that inter-platform competition will be more important than intra-platform competition. The authors then test this model on 14 countries. It is important to note here that the paper defines “penetration” not by actual uptake by consumers, but rather by percentage of all lines upgraded to transmit high-speed data. Consistent with their model, the authors find that inter-platform competition is a significant driver of broadband adoption. This is not controversial; no one who supports unbundling denies that inter-platform competition, in addition to unbundling, is beneficial. Distaso et al. also find a significant association between lower unbundling prices and higher levels of penetration. Conceptually, this is not surprising: lower unbundling rates attract competitors, greater retail competition leads to lower prices and better services, which in turn increase demand. Because of this finding, and the noncontroversial claim that inter-platform competition contributes to penetration, Distaso et al. is more supportive of unbundling than of the proposition that it does not matter, much less that it is harmful.

Wallsten (2006)<sup>75</sup> is a think tank working paper that is often cited as empirical support for the proposition that unbundling has no effect or is negative. The characterization of this paper as providing evidence that unbundling does not work is surprising. In the original paper, the author describes his findings thus:

I begin by estimating a simple ordinary least squares regression without any fixed effects. The first three columns of Table 1 show the results of this series of regressions. Full unbundling (LLU) is significantly positively correlated with broadband penetration. Including also bitstream and subloop unbundling changes the results somewhat: LLU remains positive and significant, bitstream is not statistically significant, and subloop unbundling is negative and significant. Including year fixed effects to control for the general increasing trend in broadband penetration has little impact on the other coefficients. This series of regressions

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72 Bauer, J. M., Kim, J. H., & Wildman, S. S. (2003). Broadband uptake in the OECD countries: policy lessons and unexplained patterns. Paper presented at the 14th European regional conference of the International Telecommunication Society, Helsinki, Finland. August 23–24.

73 Martha Garcia-Murillo, “International Broadband Deployment: The Impact of Unbundling,” *Communications & Strategies* 57 (2005)

74 Distaso, W., Lupi, P., and Manenti, F. Platform competition and broadband uptake: Theory and empirical evidence from the European Union. *Information Economics and Policy*. 18(1) 87-106.

75 Scott Wallsten, “Broadband and Unbundling Regulations in OECD Countries,” AEI-Brookings Joint Center for Regulatory Studies, Working Paper 06-16 (June 2006).

seems to suggest that local loop unbundling is correlated with higher broadband penetration over time, while the more extensive subloop unbundling reduces growth in broadband penetration.

[After explaining that density has a significant impact on penetration, independent of regulation, Wallsten continues:]

Table 2 shows the results of a similar, but more extensive, set of regressions controlling for country and year fixed effects. Here, LLU by itself is not significant. The results on the LLU coefficient are, in general, ambiguous in this set of regressions. Under some specifications it is positive and significant, under some it is insignificant, and under one it is negative and significant. Bitstream access is positive, but is not always statistically significant. Subloop unbundling—the most extensive type of unbundling included here—is negative and statistically significant under all specifications.

Unbundling regulations typically coincide with other regulations on collocation and wholesale pricing. Including these additional regulation variables causes the coefficient on LLU to become insignificant (and in one case negative and significant), while bitstream access becomes just barely significant at the 10 percent level or insignificant. Subloop unbundling remains negative and significant. The coefficient on commingling is positively correlated with broadband penetration though it is insignificant in a few cases. Virtual collocation is negatively correlated with penetration. Regulatory approval of line rental charges is positively correlated with penetration though not always significantly, and approval of collocation charges is negatively correlated, though again, not always significantly. (Wallsten 2006 12-13).

In its discussion, the paper begins with its findings on subloop unbundling and price-regulation of collocation, concluding that “These results support opponents’ view of unbundling by suggesting that extensive unbundling (like the sort mandated in the U.S.) has a deleterious effect on broadband investment.” The paper immediately follows this conclusion, however, with the acknowledgement that “Other results, however, suggest that regulation can also be an important tool in promoting broadband adoption. Rules that might be interpreted as making it more difficult for the incumbent to exercise market power—but without putting the incumbent at a disadvantage—seem to foster broadband adoption” (Wallsten 2006, at 16). The recent literature review, Cambini and Jiang (2009, described below), similarly categorizes Wallsten in the set of papers that tend to support unbundling, concluding their analysis of the paper thus: “Results show that if it is true that extensive obligations on the incumbent reduce broadband penetration, regulation per se could also be an important tool in promoting broadband adoption and milder regulations ensuring easier interconnection with the incumbent can increase penetration and investment.”<sup>76</sup> In other words: if one sees sub-loop unbundling as excessive regulation, less intrusive forms of access regulations are shown to be an important tool in promoting broadband adoption. As with the other studies in this section, this paper suffers from the limitations of quantitative cross-country policy analysis described earlier. In particular here, it is unclear if the explanatory policy variables reflect actual policies or are merely reflective of policy aspirations at the time.

Cava-Ferreruela and Alabau-Munoz (2006)<sup>77</sup> is published in a peer refereed journal with no industry sponsorship. It uses panel data from 2000 and 2002, still reflecting mostly older data. The authors find that inter-platform competition has a statistically significant effect on broadband penetration among

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<sup>76</sup> Cambini and Jiang, at 568.

<sup>77</sup> Inmaculada Cava-Ferreruela & Antonio Alabau-Munoz, “Broadband Policy Assessment: A Cross-National Empirical Analysis,” *Telecommunications Policy* 30 (2006) .

OECD countries. They define “cable” broadly, however, to include all cable TV, whether or not upgraded for broadband. Their positive findings therefore suggest that countries with cable TV and the possibility of cable-based competition do better, and cannot separate out countries that actually have cable broadband competition. In the extreme case, this would include Germany, a country with high television cable penetration, but where cable broadband only began to grow long after that study was concluded. Moreover, their analysis shows that countries with mandated unbundling and actual loops used for unbundling have higher penetration, but the effect is not statistically significant using their specifications. This is also a paper from a very early period, when the U.S. and Canada were both doing extremely well, and both had high cable penetration. While we have not re-analyzed their data for this review, this observation would make the data a good candidate to test for the degree to which the early, cable-based lead of these two major countries influenced the results.

Hoffler (2007)<sup>78</sup> is by an academic, published in a refereed journal. It shows no indications of industry involvement. The paper uses data from 16 European countries, between 2000 and 2004. The paper has results that are similar to those of Distaso et al. 2005, focusing on broadband performance and, to a lesser extent, investment. The paper finds that head-to-head competition between cable and telephone infrastructures has the highest effect on broadband penetration, and estimates the contribution of cable competition as an increase of about 2% in penetration, with about 4% attributed to the presence of cable in the countries where cable had the strongest presence. The paper also finds that lower unbundling rates have a statistically significant effect on broadband penetration. The interesting additional twist in this paper is more theoretical than empirical—the author estimates whether the benefits of inter-platform competition, in terms of broadband penetration, are worth the costs of redundant investment in infrastructure. Using price and capital expenditures data from the period from his 16 European countries, the author calculates that the total welfare effect of inter-platform competition was at best neutral, and quite possibly negative because the welfare losses of duplicating facilities were not offset by sufficiently large welfare gains from the added facilities-based competition.

Boyle, Howell, and Zhang (2008) is a think tank paper.<sup>79</sup> It criticizes De Ridder 2007, and was discussed extensively in the original draft of our report.<sup>80</sup> Its core claim is that it is not feasible to separate out the effects of simple passage of time on the diffusion of broadband from the effects of regulation over time. We agree with the broad claim about the systematic difficulty of separating out the effects of technology diffusion over time from the increased effects of regulation over time, although we disagreed in our original report with the technique used to apply that insight to De Ridder’s data and analysis.

Hazlett and Caliskan (2008)<sup>81</sup> is an academic paper with no observable sponsorship. It provides an excellent illustration of two of the major difficulties presented in econometric studies of the causal role of policy on penetration: separating out policy from technological diffusion rates, and separating out whether and when a rule is technically adopted from whether and when the rule is in fact subject to effective regulatory implementation. The paper seeks to estimate the impact of changes in the regulation of access to telco infrastructure as a natural experiment in studying the effect of regulation on penetration. To do so, the authors compare adoption rates of different broadband technologies in the U.S. under regulatory regimes that change over time. First, they observe that cable broadband was

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78 Höffler, F. (2007). Costs and benefits from infrastructural competition: Estimating welfare effects from broadband access competition. *Telecommunications Policy*, 31(6–7), 401–418.

79 The New Zealand Institute for the Study of Competition and Regulation is funded by Telecom New Zealand along with several other companies.

80 Howell submitted a response to our draft report critical of the econometric methods employed there.

81 Hazlett, Thomas and Anil Caliskan. 2008. Natural Experiments in U.S. Broadband Regulation, *Review of Network Economics*. 7(4) 460-480.

subject to no access obligations throughout their study period. Second, DSL was subject to three different regulatory regimes over this period: before February 2003, when the FCC formally eliminated DSL line-sharing rules; from February 2003 until August 2005, when line-sharing was no longer required, but the incumbent telcos were still regulated as carriers; and after August 2005, when telcos, like cable companies, were no longer treated as telecommunications carriers for Internet service, but as information services. The hypothesis is that, if unbundling and line sharing increases penetration, then one should see higher growth rates in DSL than in cable from the 1996 Act on; that one should see higher growth rates during the period of line sharing, and lower growth rates after line sharing was abandoned, as well as after carriage is ultimately abandoned in 2005. The papers primary findings are focused on the effects of line sharing. The authors take the growth rate between Q1 1999 and Q1 2003, and use that growth rate to project what the expected level of penetration would have been in Q4 2006 had the same growth rates continued, and claim that DSL penetration was in fact 65% higher than projecting forward the growth rate from Q1 1999 to Q1 2003, while cable was only 11% higher. They rely on this relatively higher deviation from trend by DSL to reject the hypothesis that abandoning unbundling would have a negative impact on DSL penetration growth rates.

First, the paper presents an excellent example of the difficulty that econometrics faces in separating out time diffusion effects from policy effects. What the paper assumes away is that the two technologies were at different stages of what is known to be a nonlinear diffusion curve, or an S curve, where early in the development of a technology its diffusion proceeds slowly, as it catches on, its diffusion rate increases to the sharp incline part of the curve, and as the technology matures and has already been adopted in much of the market, its growth rate again flattens out. As the paper notes, cable modem service was introduced in the U.S. as early as 1995. DSL started much later. The FCC's first 706 Report<sup>82</sup> from 1999, for example, reports that there were, at the time, 350,000 cable modem subscribers in the U.S., but only 25,000 DSL subscribers. The Report describes DSL as a technology in the early stages of deployment: "BOCs and GTE have announced plans to offer broadband to approximately twenty million homes this year. SBC has announced a 'massive rollout' of ADSL, targeting more than 500 central offices and 9.5 million residential and business customers by year-end. In Bell Atlantic's service area, ADSL is available now to some customers in the Washington, D.C., area and in Pittsburgh, with plans to add Philadelphia and the Hudson waterfront of New Jersey next year."<sup>83</sup> This was the state of relative deployment during the last report before the FCC adopted its November 1999 line sharing order, which announced the regime purportedly tested in the Hazlett and Caliskan paper. The two technologies were clearly at different places on their diffusion curve during the period of observations from which the projections are made. Projecting forward from the beginning stage of a technology diffusion curve will, of necessity, understate the anticipated level of diffusion into the future. When the baseline for the projection is from a later stage in the diffusion of a technology that follows an S curve, but while its diffusion is still accelerating, the projection will deviate less from the later-observed results—consistent with Hazlett and Caliskan's observations about cable penetration deviating only 11% above their prediction. When the projection is from the earlier part of the curve, the anticipated underestimation would be much greater, as indeed they encounter. In this regard, if one observes the market shares of cable and DSL in Switzerland (See below, country case study on Switzerland), which had no unbundling throughout the relevant period, one again sees the same pattern—early diffusion of broadband over cable, followed by later introduction of DSL and then massive growth of the later DSL technology leading to its overtaking cable. South Korea experienced a similar pattern (although cable entry there was itself open access; the telco lines used for DSL were not unbundled until 2002). In both Switzerland and South Korea the pattern is complex to interpret because of the strength of the national incumbent as the main DSL-based player. The reference to the two here is

82 First 706 Report, Docket No. 98-146. January 28, 1999.

83 Id., at the text associated with footnotes 85-90.

merely to provide baseline reference for the fact that it is unlikely that the later adoption of DSL was itself the result of the regulatory regime, but rather reflected the relative technological state in which cable and telephone lines existed in the late 1990s. Cable's upgrade path to broadband occurred earlier than the telcos' migration path, which had a later start and later climb up the diffusion S curve for DSL.

Second, the paper is an excellent example of the difficulties of identifying the effects of regulation stemming from the difference between formal or technical adoption of a regulation, and its effective implementation. The Line Sharing order that provides the core instrument for Hazlett and Caliskan was passed in November 1999, two or three quarters after the beginning of the time series that the authors apparently use as their source of projection: Q1 1999. Moreover, the order was immediately challenged. It was vacated and remanded to the FCC in May 2002,<sup>84</sup> almost a year before the formal abandonment by the FCC that Hazlett and Caliskan use as the end point for their "instrument." In other words, during 6 or 7 out of 17 quarters that they treat as being under the line sharing regime, in fact that regime is not in place; and this does not account for any reticence on the part of entrants to invest in entry while the suit is pending throughout the formal existence of the rule, as well as the clear signals from the FCC as early as late 2001 early 2002 that it was going to change regulatory direction (see discussion of U.S. as baseline case, below).

#### *Unbundling and Penetration: Industry sponsored*

Aron and Burnstein (LECG 2003)<sup>85</sup> is a self-published paper produced by a consulting firm that essentially finds the entirely unsurprising fact that there was higher broadband penetration in the U.S. where cable and telco provisioning occurred. This finding is expected given that the data is from 2001 and the early dominance of cable broadband in the U.S. before 2001. Their results are potentially skewed by a failure to control for endogeneity as the causation in this specification is not clearly unidirectional.

Waverman et al. (2007)<sup>86</sup> is a consultancy report produced for ETNO, the lobbying organization of the European telecommunications incumbents, as part of the European policy debate over levels of access regulation. Its executive summary makes very clear that it was written in response to the European Commission study by London Economics and PriceWaterhouseCooper (2006), that had concluded that "Results of our regression model show that better performing regulatory regimes, as measured by the OECD regulatory index, contribute to higher investment levels."<sup>87</sup> The Waverman et al document focuses on the effects of unbundling on the rates of subscription to alternative access platform. In its executive summary, that report states:

More intense access regulation, as measured by a lower LLU price, stimulates intra-platform competition and may cause the overall broadband market to expand. However, it also causes a substitution away from broadband offered over alternative access platforms to copper-based platforms. Thus, lower access prices may lead to a reduction in the total number of subscribers who take up broadband offered over alternative infrastructures if the substitution effect

84 290 F.3d 415. (D.C. Cir. 2002).

85 Debra J. Aron and David E. Burnstein, "Broadband Adoption in the United States: An Empirical Analysis," Abstract, (2003)

86 Waverman, Leonard, Meloria Meschi, Benoit Rellier, and Kalyan Dasgupta. 2007. Access Regulation and Infrastructure Investment in the Telecommunications Sector: An Empirical Investigation. LECG Ltd.

87 London Economics and PriceWaterhouseCoopers, "An Assessment of the Regulatory Framework for Electronic Communications—Growth and Investment in the EU e-Communications Sector", Final Report to the European Commission, July 2006. (Note that the London Economics document underscored this conclusion even though its regression model only showed that regulatory indexes were significant at the 13% level, which would not normally be considered statistically significant.)

dominates the market-expansion effect. Our analysis tests for the strength of the substitution and market expansion effects of lower LLU prices, and quantifies the reduction in the number of subscriber lines served over alternative access infrastructures.

In other words, this document does not make a clear case that open access policies reduce competition or broadband access in the countries in which it is implemented. Instead, it falls back on hypothetical analysis of “what if” to produce hypothetical numbers of lost investment in alternative infrastructures. Essentially, what the report stands for is that open access policies increase competition in markets, and reduces the broadband market share of cable operators. That a larger market share for cable operators is itself a desirable policy goal is assumed, because of the assumed benefits of inter-platform competition. But the paper is not written in a way that allows one to confirm or deny the possibility that this loss of subscribers for the cable operators is not more than made up for by the gains for consumers and entrants. The most the report can say is that Europe will lose investment, arguing that for “a hypothetical ‘Europe’ (defined in Section 5), the lost long-term investment in alternative access platforms exceeds 10 billion Euros as a result of just a 10 percent LLU price reduction.”<sup>88</sup>

Bouckaert et al (2008)<sup>89</sup> is a self-published paper supported by the Belgian telecommunications incumbent, Belgacom. It looks at the Belgian market, compares it to the French and Dutch markets, and also conducts an analysis of 20 European members of the OECD countries. This smaller number of countries, of necessity, weakens the analysis. Most of the conclusions, to the extent significant, are significant only at the 10% level. These conclusions are: (a) that inter-platform competition increases broadband penetration; (b) that resale at regulated rates has a negative impact on penetration; and that (c) they can identify no significant effect, positive or negative, for unbundling. Furthermore, the authors claim that “intra-platform competition may even reduce investment incentives,” although their study does not actually measure or reflect investment. They do claim that lower prices and higher speeds increase penetration, but do not attempt to explain those with regard to the presence or absence of entry.

#### *Unbundling and Penetration: Conclusion*

In this section we reviewed 15 papers that studied the relationship between unbundling and broadband penetration. Of these 15, three reported unambiguous negative effects. Of these three, two were industry sponsored, one of which used old data and the other of which used hypothetical projections; the third, which was not industry sponsored, was methodologically flawed. Six of the papers found unambiguous positive effects. The remaining six papers were indeterminate.

#### **4.4.4 Econometrics studies of open access, unbundling, and investment**

There is substantially more literature, and more emphasis in the literature, placed on a particular causal model for the purported negative effects of unbundling: that is, the claim that unbundling in particular, and open access regulation more generally, undermines investment incentives. Several of the industry comments to our October 2009 draft report criticized us for focusing only on performance outcomes—price, quality, and penetration—and not on investment. These criticisms alleged that substantial literature supports the proposition that unbundling decreases investment, and in doing so cited a just-published literature review in Telecommunications Policy to support the argument. That literature review is indeed the state-of-the-art on this subject, and given the weight afforded to it by the comments, we will use it as the foundation of our own literature review. We do note, however, that the review

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<sup>88</sup> Waverman et al p. 4.

<sup>89</sup> Bouckaert, J., Van Dijk, T., & Verboven, F. (2008). Regulation and broadband penetration—what is required to regain speed in Belgium?. Belgium: University of Antwerp and Leuven. Available at: [/http://www.ua.ac.be/download.aspx?c=jan.bouckaert&n=72967&ct=68422&e=184390](http://www.ua.ac.be/download.aspx?c=jan.bouckaert&n=72967&ct=68422&e=184390) .

includes several papers that are perhaps inappropriately located in a literature review given their apparent roots in policy advocacy rather than impartial research. Nevertheless, we include them here only because they are included in that review. Upon reviewing the underlying papers, we largely concur with Cambini and Jiang's (2009)<sup>90</sup> own assessment:

“The picture that emerges is not conclusive, and further research is still needed, both theoretically and empirically, to better understand the real impact of regulatory incentives on investments.”<sup>91</sup>

Contrary, then, to the widely held background assumption in the telecommunications policy community in United States, as well as to industry claims in response to the draft publication of our study, the econometrics literature provides no definitive answer, and leads us back to affirming the centrality of the qualitative case studies. The theory that unbundling deters investment is not proven by the empirical econometrics literature or the theoretical literature. Neither, however, have any of the alternative theories that attempt to explain why unbundling would work been proven by econometrics. We are left to account for the fact that the United States has been doing less well since it abandoned open access than countries that effectively pursued various versions of open access over the last few years, and with rich, detailed case studies that explain what role open access played in making those markets that have performed better.

There are few peer refereed papers on the question of unbundling and investment. Many of the oft-cited papers are self-published. Moreover, this part of the literature exhibits a particularly large proportion of industry-sponsored research; over half the papers received industry support. Unfortunately, as the Cambini and Jiang (2009) literature review exhibits, papers by consulting firms explicitly funded by market-participants—either incumbents or entrants—are intermingled with academic papers with no distinction. Worse, the literature review effectively “launders” papers written by academics with appropriate conflict-of-interest disclosures, so that by the time they are discussed in the literature review that disclosure is no longer visible to the reader who encounters the results only by way of the review.

Twenty three papers are described in Cambini and Jiang (2009) as empirical papers bearing on the relationship between open access regulation and investment. As you will see in this review, not all of these in fact are empirical, but we will include them in this section because it is important to clarify their status, given their recent characterization as empirical papers on investment. Of those papers, we discuss Hausman and Sidak 2005 in the section on qualitative case studies, and included Wallsten 2006 and Hoffler 2007, both noted in the Cambini and Jiang review, in the penetration effects section, where each thematically belongs, rather than here.

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90 Cambini, C. and Jiang, Y. Broadband investment and regulation: A literature review. *Telecommunications Policy* (2009). 33 559-574.

91 Cambini and Jiang, at 559.

**Table 4.3. Papers on unbundling effects on investment.<sup>92</sup>**

Citation	Pub=1 Self- pub=0	Sponsor	Access on incumbent investment	Access on entrant investment	Comments
Government / Int'l organization					
London Economics & PriceWaterhouseCoopers (2006)	0	EU Commission	~+	~+	This study seeks to show that effective regulation increases investment. Uses surveys and annual reports data. Econometrics weaker than descriptive evidence.
Fevrier and Sraer (2007)	0	ARCEP		0	Highly granular data from 1500 French exchanges. No negative effects on entrant investments.
Academic/ Think tank					
Hausman 1998 (&1997)	1	N/A	- TSLRIC pricing will undermine incumbent investment because of sunk costs		Theoretical study.
Christodoulos and Vlahos (2001)	1	N/A	+ mix of LLU and facilities-based best; through increasing LLU prices over time	+ mix of LLU and facilities-based best; through increasing LLU prices over time	Theoretical study.
Chang, Koski, and Majumdar (2003)	1	N/A	+/- lower access prices correlated with more digital lines in U.S.; lower investment in EU		More data on U.S.; weaker data on EU. Uses interconnection rates, rather than unbundling.

<sup>92</sup> We include here several papers that are not empirical that were described as such in Cambini and Jiang 2009 or mentioned in comments to our draft as in this category. We identify the papers that are theoretical, not empirical, in the comments.

Citation	Pub=1 Self- pub=0	Sponsor	Access on incumbent investment	Access on entrant investment	Comments
Guthrie (2006)	1	N/A	+/- various outcomes	+/- various outcomes	Theoretical; critical review of literature to 2006; concludes that impact on investment or welfare unknown theoretically or empirically at that time
Jung et. al (2008)	1	N/A	+ Market share of entrants, in particular access-based entrants, increased investment, but number of entrants did not	+ Market share, but not number, of entrants, effected positively	Suggests that a relatively small number of entrants with credible staying power: using lower cost unbundling to enter, and remaining through lack of dissipation by excessive entry, most beneficial to investment by both incumbents and entrants
Wallsten and Hausladen 2009	1	N/A	-	-	Heavily influenced by Lithuania and Estonia; problems with specifications; discussed in body of memo
Foros et al (2009)	1	N/A	+		Theoretical study.
Alter 2009	1	N/A	- delays investment; small negative welfare effects		Detailed micro-level data from Kentucky; investment delay likely strategic; negative welfare effects small
<b>Industry Supported</b>					
Crandall and Singer 2003	0	Criterion Economics	-		Numeric examples and hypothetical investment losses. Primarily critique of a different paper on jobs-creation
Ingraham and Sidak (2003)	1 (student edited journal)	Criterion Economics	- Two incumbents had higher volatility than market in tech-bubble crash; two did not		Highly questionable paper. Shows increased volatility in Verizon and Bell South stock higher than major indexes, SBC not higher; and hides in footnotes that Qwest also not higher. All during periods of stock bubble crash
Phoenix Center Bull. No. 5	0	AT&T (as entrant)	+		Criticized at the time by consultants for the other side; conclusions not pursued by authors later
Phoenix Center Bull. No. 6	0	AT&T (as entrant)	+		Criticized at the time by consultants for the other side; conclusions not pursued by authors later

Citation	Pub=1 Self- pub=0	Sponsor	Access on incumbent investment	Access on entrant investment	Comments
Crandall, Ingraham, and Singer (2003)	1	Criterion Economics	- Higher LLU prices lead to higher CLEC investment in own-facilities		Primarily theoretical; more limited data
Ford and Spiwak 2004	0	Phoenix Center / AT&T			Zip-code level broadband availability; significant at 10% level; this is not an investment paper at all; but a penetration paper with low significance and weak data
Hazlett and Bazelon (2005)	0	Verizon / Analysis Group	-	-	Heavy emphasis on lower investments post tech-bubble crash; weak causal connection to LLU
Zarakas et al (2005)	0	Brattle Group / AT&T?		+ LLU but with higher prices increase innovation	Agent-based simulation; not real data; heroic assumptions (3 facilities-based competitors; all with 100% immediate uptake for all investments)
Willig (2006)	0	AT&T	0/+		Not new evidence; discusses other work in a conceptual framework
Waverman and Dasgupta (2006)	0	France Telecom	-	-	Conceptual rather than evidence-based.
Pyndick (2007)	1	Verizon	-		Theoretical paper that reconfirms Hausman 1998 using option value.
Cadman 2007	0	ECTA	+	+	Part of same exchange with London Economics and Waverman 2007; uses more powerful econometric techniques than either of the other two pieces in that exchange
Friederiszick, H., Grajek, M., & Roller, L. (2008)	0	Deutsche Telekom	0 No effect on incumbent investment in fixed line, or in mobile	- Unbundling lowers investment by fixed line entrants; no effect on mobile entrants	Suggests that the absence of an effect on incumbent investment reflects that competition driving innovation and service increases demand to a point of compensating incumbents for the lower margin

*Access, unbundling, and investment: Government sponsored*

London Economics and PriceWaterhouseCooper (2006)<sup>93</sup> is a consultancy study, commissioned by the European Commission. It began a flurry of other papers, here represented by Waverman et al 2007 and Cadman 2007. It sought to evaluate the levels of investment by incumbents and entrants, and their determinants. The data reflected company annual reports and the results of a survey of companies. The report concluded that “Results of our regression model show that better performing regulatory regimes, as measured by the OECD regulatory index, contribute to higher investment levels.” However, the descriptive data was more consistent with that statement than the econometrics, which showed significance only at a level slightly below what would conventionally count as weakly significant.

Fevrier and Sraer (2007) is an unpublished piece by academics who conducted a report for the French regulator, ARCEP. It uses highly granular data from 1500 Central Offices in the French market, and develops a sophisticated econometric model to study the effects of unbundling on entrant investment. Although it begins with outlining the game-theoretical prediction that entrants would “soften” their investment to avoid too harsh a level of competition in the second stage, their data suggests that unbundling does not in fact reduce entrant investment as the model would predict.

*Access, unbundling, and investment: Academic and think tank*

Hausman (1998)<sup>94</sup> is a restatement of portions of a 1997 Brookings paper that was included as a separate paper in Cambini and Jiang. The paper is a theoretical paper, not empirical. It argues that the fact that many of the investments incumbents make in the core of their networks cannot be reallocated to other uses when the regulated rate drops, their sunk-cost nature, given changing technology and reduced costs over time, will systematically lead cost-based price regulation to be too low. Hausman argues that fixed and sunk costs make these investments similar to investments in innovation, and incumbents would invest less when they are subject to unbundling, unless the prices for the elements would compensate them for all the unsuccessful innovations they install when entrants buy the successful network elements. This paper, while interesting in its own right on the question of the appropriate rates at which unbundling should be applied, does not speak to the question of whether unbundling, priced using a method other than TSLRIC (the technique discussed there), would in itself reduce investment.

Christodoulos and Vlahos (2001)<sup>95</sup> is a peer-refereed theoretical paper. It uses agent-based simulation to test three hypothetical cases: a market with only infrastructure-based competition, a market with only service-level (or wholesale) competition, and a market with unbundling. The paper concludes, “that a ‘mix’ of infrastructure and service competition, like the one promoted in the Netherlands, stimulates investment by both incumbents and entrants and offers better consumer benefits.” It achieves this by initially offering low ULL prices to stimulate service entry and offer price competition fairly early on. However, it also provides an explicit way in which the ULL prices increase to forward-looking prices, allowing entrants to assess whether they should stay in the market and invest in their own infrastructure

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93 London Economics and PriceWaterhouseCoopers, “An Assessment of the Regulatory Framework for Electronic Communications—Growth and Investment in the EU e-Communications Sector”, Final Report to the European Commission, July 2006.

94 Cambini and Jiang list Hausman, Pakes, and Rosston (1997)<sup>□</sup> (Brookings paper; non-refereed) and Hausman (1998) (book chapter) as Cambini and Jiang as two papers in the text. In the Table in that paper, they are both more correctly described as (Hausman 1998), though the table oddly refers to them twice: they are the same paper in relevant part (the 1997 piece includes additional discussions not pertinent here; the 1998 paper is the relevant subset). Hausman, J. (1998). The effect of sunk costs in telecommunications regulation. In J. Alleman & E. Noam (Eds.), *Topics in regulatory Economics and Policy: The New Investment Theory of Real Options and Its Implication for Telecommunications Economics*, Vol.34 (pp.191–204). NewYork: Springer.

95 Christodoulou, K., & Vlahos, K. (2001). Implications of regulation for entry and investment in the local loop. *Telecommunications Policy*, 25(10–11), 743–757.

or, should they not be as efficient, exit the market.” As in the case of the Hausman paper, this is not an empirical paper, but a theoretical paper. It supports the proposition that some form of unbundling is beneficial, emphasizing the details of implementation as the relevant policy lever, in particular pricing, rather than the principle that open access regulation, properly designed, is superior to purely facilities-based competition. Its simulations are certainly consistent with the experience of the European countries we studied and Japan; although its emphasis on the beneficial effects of sunset and increasing rates is questioned by the experience of Canada. In this regard, the paper may understate the degree to which sunset periods that are too short will have an effect equivalent to unbundling prices that are too high and deter competitor entry.

Chang, Koski, and Majumdar (2003)<sup>96</sup> is a refereed journal article. The paper analyzes separately data from the U.S. on investment by ILECs under unbundling; and data from Europe. The U.S. data measured the ratio of fiber to total lines (this is long before fiber to the home; fiber here is in the network); and, separately, digitalization, or the ratio of digital to total fixed lines. In both cases, the target was to estimate the impact of regulation on investment in technological upgrading. The panel used included data from 41 local exchange carriers for a 5-year period from 1994-1998. Unlike many other of the studies here, it did test for influential points and removed outliers from the data. The weakness is that the paper uses access charges for interconnection as the measure of the open access regulatory intervention. While conceptually similar—in that interconnection is a form of (minimal) required access to the incumbents' network—interconnection pricing is not a perfect stand in for unbundling. The study finds that lower prices do not have a significant impact on fiber, but do have a positive significant correlation with digitization of lines. The authors hypothesize that the lower prices lead to greater competition, which in turn leads to lower consumer prices, higher usage, and higher cash flow to the incumbents, who in turn can reinvest it in increasing the capacity of the network to carry the new, higher demand. Their analysis cannot test that causal hypothesis. It does show a positive correlation between lower access prices and investment in leading edge technology of the time. The paper's results for Europe, however, trend in the opposite direction—suggesting that cost-based pricing methods and higher access prices induced higher investment. However, the paper's authors caution that their data on Europe is, as they put it, “relatively sparse, meagre and likely to be insufficient,” and cannot account that for the period they were observing, one-third of the countries did not have an independent regulatory agency. The paper, then, overall offers stronger support for a positive effect of lower access prices on investment than for a negative effect, but is not conclusive.

Guthrie (2006)<sup>97</sup> is a refereed journal article by an academic with no industry support. It provides an exhaustive review of the theoretical literature on various forms of regulation, in particular price and access, of infrastructure industries, particularly power and telecommunications. Guthrie reviews the various arguments, considering a range of models, from those that predict delayed investment as a result of open access, where market conditions characterize investment as a waiting game, to models that predict excessively early investment, where firms find themselves in a preemption game. The author concludes: “First, the impact of access price levels on investment is not yet fully understood, even in the relatively simple situations described here. Second, even less is known about the overall impact on welfare. For example, even if higher access prices would accelerate investment, is this necessarily good for welfare?” (965). Guthrie concludes this 2006 article with the statement: “Almost ten years have passed since the Telecommunications Act transformed telecommunications regulation in the United

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96 Chang, H., Koski, H., & Majumdar, S. (2003). Regulation and investment behaviour in the telecommunications sector: Policies and patterns in U.S. and Europe. *Telecommunications Policy*, 27(10–11), 677–699.

97 Guthrie, Graeme. Regulating Infrastructure: The Impact on Risk and Investment. *Journal of Economic Literature*. 44(4): 925-972.

States and economists still do not have a thorough understanding (theoretically or empirically) of how local loop unbundling affects investment.” (969)

Jung et al (2008)<sup>98</sup> is a refereed journal article that does not appear to have been sponsored by an interested party.<sup>99</sup> It uses panel and dynamic panel analysis from the U.S. market between 1997 and 2002. It finds that the market share of competitive entrants was positively correlated to investment by incumbents—that is, the larger the market share of entrants, the higher the investment—an effect statistically significant at the 1% level; that this continued to be true at the 1% level of significance for UNE-based entrants, but its significance was only at the 10% level for facilities-based entrants; that the number of CLECs was negatively-related to incumbent investment, and that when dynamic modeling was used the significance remained, but dropped to the 10% level. In other words, the results of this study are most consistent with the claim that the market share of entrants, particularly entrants with a serious prospect of successful entry, was positively correlated with incumbent investment. A small number of entrants increases the likelihood that these entrants will not foreclose each others' markets; unbundling-based access predicts faster entry than facilities based entry. In combination, these factors suggest that a direct and immediate threat of entry that might stabilize into sustained competition will result in higher investments by incumbents. This is indeed consistent with our findings in the case studies, where the entrants began either as a small number, as in Japan, or consolidated into a small number, as in the Nordic countries, France, or the UK after functional separation was introduced. It is also consistent with the approach in Bauer (2010).

Wallsten and Hausladen (2009)<sup>100</sup> is a recent study of the effects of unbundling on deployment of fiber-to-the-home in Europe. It has been cited frequently by industry comments to the initial draft of our report as evidence that open access policies clearly harmed, rather than helped, next generation connectivity. The paper is published in a peer-reviewed journal with no apparent industry backing. The paper analyzes data from 27 European countries, from 2002 to 2007, and claims to find a negative correlation between the presence of effective unbundling, as measured by the number of unbundled loops per capita, and the deployment of fiber to the home, as measured by FTTH subscriptions per capita.

Taking the actual model used by Wallsten and Hausladen without any critique, the paper is highly sensitive to specific country effects. Specifically, because Lithuania and Estonia, two post-soviet Baltic republics with dynamic governments and markets have no unbundling and substantial fiber deployments, their results drive the outcomes. In the annex to this part, we include replications of Wallsten and Hausladen Table 3a, in each case removing one country. What is important is to observe the effect of removing each country on the coefficients for unbundling to entrant and incumbent fiber (and similarly for bitstream.) The coefficient on incumbent fiber remains roughly -0.04, as it is in the original, when any single country is removed, except Estonia. When Estonia is removed, the coefficient is 0.000. Estonia is driving the entire result for effects of unbundling on incumbent fiber, reflecting the big moves by Elion, the wireline arm of the formerly state-owned incumbent, now majority owned by TeliaSonera, into fiber, leapfrogging the Soviet-era copper infrastructure. The coefficient on entrant

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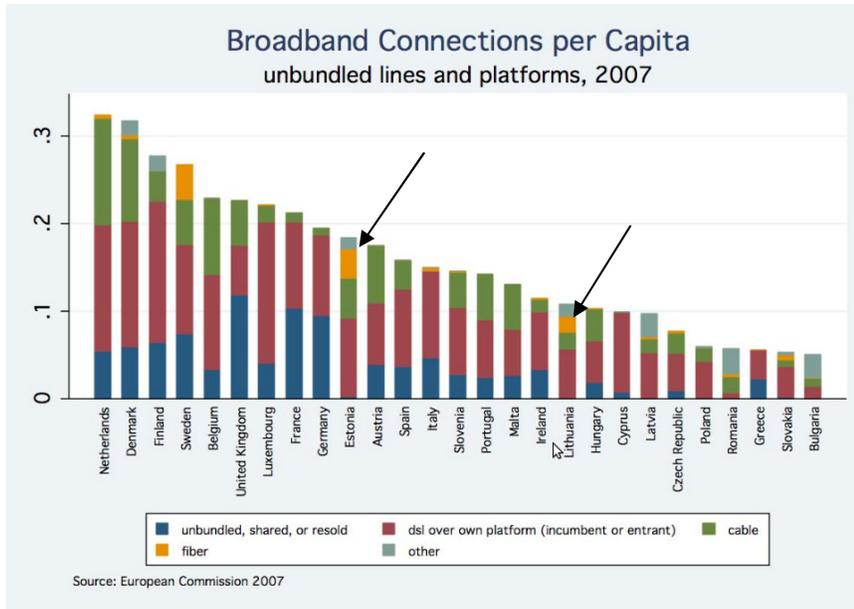
98 Jung, I., Gayle, P. G., & Lehman, D. E. (2008). Competition and investment in telecommunications. *Applied Economics*, 40(3), 303–313.

99 Its first author's affiliation is listed as SK Telecom in Korea, which is now a facilities-based entrant. However, the study is U.S. focused; the results, if anything, are least favorable to facilities-based entrants, and there is no disclosure of funding or support from SK Telecom. In combination, these factors lead us to categorize this paper as not industry sponsored.

100 Wallsten, S. and Hausladen, S. Net-Neutrality, Unbundling, and their Effects on International Investment in Next-Generation Networks. *Review of Network Economics* 8(1) 90-112. March 2009. Scott Wallsten was gracious enough to provide us with the data.

fiber remains within 5% to 10% of its original value in the table when removing any single country, except that it drops 40% when removing Lithuania, from -0.103 to -0.062,<sup>101</sup> and it drops about 25% when removing Estonia, to -0.079. Removing both of these fast-growing post-Soviet Baltic republics eliminates almost three-quarters of the effect, dropping the coefficient from -0.103 to -0.031. A similar relationship holds for the impact of bitstream. Estonia and Lithuania are essentially driving the results. To grasp the problem intuitively, however, one need not go to the regressions. Below is a copy of Figure 4 from Wallsten and Hausladen. It is easy to observe with the naked eye that Estonia and Lithuania have a highly unusual share of fiber (yellow), relative to virtually non-existent unbundling (blue).

**Figure 4.2. Broadband Connections per Capita, Wallsten and Hausladen, 2009**



**Figure 4: Broadband connections per capita**

Rather than providing new insights into the relationship between fiber investments and unbundling, the quantitative analysis obscures the basic observation that these small post-Soviet countries share an unusual mix of broadband access conditions.

Second, it is important to understand that fiber subscription rates are co-determined by subscriber demand, as well as by supplier costs and investments. The most obvious confounder here is that if incumbents and entrants, in fierce competition though extensive use of combining their own fiber or electronics with incumbent copper loops, are successfully delivering 28 or 50 Mbps service at low prices, demand for fiber will be delayed. It is far from obvious that the welfare implications of delay in fiber deployment because of substitution to high speed, low cost DSL are negative.

Third, when treating cross-country data over time, as here, country-level clustering is appropriate. Without clustering, the model treats each year as an entirely new observation, as though the random unobserved effects in country X in year 1 are entirely independent of the random unobserved effects in

101 It is not entirely clear whose investments these entrant investments reflect, given that reports on Lithuanian fiber investment identify TEO LT, the incumbent, now majority-owned by TeliaSonera, as the primary source of fiber investment, alongside an EU-funded rural fiber project, RAIN.

that same country X in year 2.<sup>102</sup> Correcting this problem in the model results in larger standard deviations, smaller t-statistics, and loss of statistical significance even with Lithuania and Estonia in the dataset.

Table 3a: Without Lithuania

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumbent Fiber per Cap	Entrant Fiber per Cap	Incumbent Fiber per Cap
Unbundled Lines per Cap	-0.062 (0.042)	-0.046 (0.049)		
GDP per Cap	0.009 (0.174)	0.025 (0.062)	-0.050 (0.248)	0.011 (0.091)
Bitstream Lines per Cap			-0.188 (0.137)	-0.070 (0.060)
Constant	0.004 (0.005)	0.001 (0.002)	0.007 (0.007)	0.001 (0.003)
Observations	235	235	224	224
Number of Countries	26	26	25	25
Adjusted R-squared	0.15	0.05	0.20	0.05

Robust standard errors in parentheses

\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 3a: Without Estonia

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumbent Fiber per Cap	Entrant Fiber per Cap	Incumbent Fiber per Cap
Unbundled Lines per Cap	-0.079 (0.054)	0.000 (0.003)		
GDP per Cap	-0.043 (0.142)	0.027@ (0.015)	-0.087 (0.211)	0.021 (0.017)
Bitstream Lines per Cap			-0.177 (0.134)	-0.015 (0.014)
Constant	0.006 (0.005)	-0.001 (0.000)	0.008 (0.007)	-0.000 (0.001)
Observations	235	235	224	224
Number of Countries	26	26	25	25

102 “Heteroskedasticity-Robust Standard Errors for Fixed Effect Panel Data Regression”, James H. Stock and Mark Watson, *Econometrica*, January 2008, Vol. 76, No. 1, pp. 155-174. ); Petersen, Mitchell A. “Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches.” *Review of Financial Studies*. Volume 22, Number 1, 2009.

Adjusted R-squared	0.15	0.02	0.18	0.05
Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, @ p<0.1				
Table 3a without Lithuania and Estonia				
VARIABLES	(1) Entrant Fiber per Cap	(2) Incumbent Fiber per Cap	(3) Entrant Fiber per Cap	(4) Incumbent Fiber per Cap
Unbundled Lines per Cap	-0.031 (0.031)	-0.000 (0.003)		
GDP per Cap	0.020 (0.144)	0.026@ (0.015)	-0.028 (0.197)	0.019 (0.017)
Bitstream Lines per Cap			-0.138 (0.136)	-0.016 (0.016)
Constant	0.003 (0.004)	-0.001 (0.000)	0.005 (0.006)	-0.000 (0.001)
Observations	226	226	215	215
Number of Countries	25	25	24	24
Adjusted R-squared	0.11	0.02	0.15	0.06

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Fourth, the use of unbundled access share as an explanatory variable is problematic. This variable is itself the result of a complex set of demand and supply relationships that match consumers with broadband providers shaped by government policy. This variable is jointly determined with the other broadband shares such as the share of broadband connections that are cable and fiber and does not thereby constitute an appropriate explanatory variable.

In conclusion, the Wallsten and Hausladen (2009) paper at most can be brought as evidence to focus attention on the positive experience of Lithuania and Estonia that have successfully and admirably emerged from their post-Soviet experience with increasingly advanced fiber networks.

Alter (2009)<sup>103</sup> is a refereed, academic paper. It uses micro-data from Kentucky and Bell South investments to quantify the effect of unbundling and regulatory jockeying on investment. The paper suggests that (a) investment is indeed postponed under unbundling; (b) the pattern of investment suggests strategic postponement more strongly than non-strategic; and (c) the welfare costs of delayed investment are not huge, and it is unclear whether they would outweigh the benefits of a more competitive market, even with delayed investment.

Foros et al (2009)<sup>104</sup> is an article in a refereed journal, authored by academics with EU science funding. It is a theoretical model, not an empirical model. The model takes a duopoly facilities-based market as its baseline, and explains the parameters under which “platform sponsors,” that is, platform owners that provide access, either voluntarily or because of open access regulatory requirements, have an incentive to invest more in their network given the presence of access-based entrants. Their analysis combines

103 Alter, A., The Effect of Access Regulation on Broadband Deployment. Review of Industrial Organization (forthcoming).

104 Foros, Øystein, Hans Jarle Kind, and Jan Yngve Sand. 2009. Entry may increase networks providers' profit.

Telecommunications Policy. 33(9), 486-494.

both the effects of the increasing size of the market brought about by network effects and service innovations by entrants, and the benefits of investment that differentiate the platform owner from entrants.

*Access, unbundling, and investment: Industry sponsored*

The Cambini and Jiang (2009) literature review lists several papers that are industry supported, without noting their provenance. It begins with six papers that are part of an exchange between, on the one hand, the Phoenix Center, apparently funded by AT&T when AT&T was an entrant and sought access to unbundled loops,<sup>105</sup> and Criterion Economics, whose clients include the major telecommunications incumbents, and whose principal authors at that period are now part of Empiris, whose declaration on behalf of the industry associations introduced this literature review into the comments. While it is important to read these pieces and understand their arguments and methods, in general it is also important to approach them cautiously, and treat these papers and others like them as a different species of paper than refereed, academic papers, or government agency or international body papers. These are papers prepared for and paid by competitors in a market, about the costs and benefits of regulatory changes then being considered by the FCC, whose outcome would affect their relative viability in the market. Their conclusions are all aligned with the interests of the commissioning party. Given, however, the complexity of the problems, the subtlety with which every minor assumption or choice in model specification can affect the results, such provenance counsels great caution on the part of the reader. (As we shall see, these six are not the only papers generated with funding from the interested parties that are collected in the literature review.) It is not insignificant that AT&T was absorbed by SBC almost immediately after this regulatory battle was settled in favor of the incumbents. The fossil record of their lobbying efforts can still be seen in the literature. MCI, the other major entrant at that time, was absorbed by Verizon after the regulatory debate for which these papers were prepared was resolved in favor of the incumbents. For purposes of understanding the literature, it is also significant that the creation of the new AT&T seemed to have marked the end of U.S.-based papers of this kind. All industry-supported, U.S.-based papers that support unbundling appear to have been funded by AT&T when it was an entrant seeking access to local loops. The elimination of effective competition by entrants appears to have also eliminated industry-sponsored papers in favor of unbundling. The same is obviously not true for the winning side in that debate, in support of the opposite conclusion.

The first of the papers in this group of six, (Crandall and Singer 2003)<sup>106</sup> is a consultancy report by Criterion Economics, issued in response to an entrant-funded study that purported to show that unbundling under the U.S. 1996 Telecommunications Act added 92,000 jobs.<sup>107</sup> The paper aims several well-taken criticisms at the weak paper it was attacking, but then launches into some questionable claims of its own. First, the paper assumes that jobs in resale and marketing are not “jobs,” but are socially wasteful. The paper explains its rationale with a metaphor:

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105 See Drew Clark, *Broadband*, Technology Daily July 26, 2006 (“Spiwak said the Phoenix Center is funded by “the old AT&T, the new AT&T, wireless companies, software providers” and other Bell competitors. Unlike other telecommunications think tanks, he said the Phoenix Center does not participate in lobbying coalitions or in FCC proceedings”); Drew Clark, *Telecom*, Technology Daily November 10, 2005 (“Everyone has to make a living in this town,” Phoenix Center Executive Director Lawrence Spiwak said in reference to contributions from AT&T and the Bells. “The point is, go and look at the work” of the Phoenix Center, he said, describing it as “dispassionate” and scholarly.”).

106 Crandall, R. & Singer, H. (2003). An accurate scorecard of the Telecommunications Act of 1996: rejoinder to the Phoenix Center Study No. 7. Report by Criterion Economics, Washington, DC.

107 The underlying report to which this was a response was “The Positive Effects of Competition on Employment in the Telecommunications Industry, Phoenix Center Policy Bulletin No. 7, Oct. 15, 2003 .”

If a principal of a high school can manage a student body of 250 efficiently by herself, society is not better off when the school hires an additional administrator. Likewise, if a Bell Operating Company requires a sales force of one employee for every 500 lines, then society is not better off when a CLEC hires one or more additional telemarketers to resell the same 500 lines. Domestic product is not increased by either new job. Presumably, the additional administrator and telemarketers could be put to better uses that would increase domestic product.

By this rationale, marketing jobs created by market actors who think they can make money by offering better deals on, say, the same cars, are not adding to the GDP. By this rationale, lower prices and more marketing do not increase the quantity sold. Indeed, the authors conclude: “The purported savings to consumers who have switched to a CLEC do not constitute an increase in economic welfare—these dollars are merely a transfer of income from the ILEC to the customers.” (at p. 22). In other words, supply and demand are fixed; the only thing happening when competitors enter is transfer of rents from producer surplus to consumer surplus. We note that, in comparing LLU for voice and LLU for broadband in a paper commissioned by France Telecom, apparently in its capacity as a cross-border broadband entrant through Wanadoo, Crandall and Waverman (2006) write: “Since broadband offers consumers the prospect of genuinely new and distinctive services, marketed and bundled for them in genuinely new and distinctive ways, the consumer welfare gains from services-based broadband competition might be significant, thus sustaining entry.”<sup>108</sup> The Crandall and Singer paper follows the questionable assumption about fixed supply and demand with an effort to establish that unbundling causes reduced capital expenditure, but rather than doing so using actual numbers of reduced investments, properly controlling for the fact that the relevant period was also a period of boom and bust in the industry, the document employs a variety of numeric examples and hypothetical losses in investment based on projected reduced cash flow from unbundled lines relative to ILEC-sold lines.

The next paper, Ingraham and Sidak (2003),<sup>109</sup> is an econometrics paper published in a student-edited law journal. The authors are a founder of Criterion (although in the paper he describes himself as a fellow emeritus of the American Enterprise Institute, and does not disclose the Criterion affiliation) and a Criterion Vice President, the same consultancy that produced two of the other papers over this period that purported to show negative effects of unbundling. It calculates that the volatility of Verizon and BellSouth stock was higher than that of the S&P 500 and the DJIA after the tech-bubble burst than it was during the expansion that preceded the 2001 recession, while the volatility of SBC and Qwest stock was not statistically-significantly higher than that of these two indexes over the same period. For some reason, although Qwest was part of the study, the tables simply did not report the negative results for Qwest. These were, instead, reported only in footnotes. (Ingraham and Sidak 2003: at note 29: “The coefficient on RM\*Dr was not significant, either economically or statistically, in the Qwest regressions”; note 31: “For the Qwest regressions, the coefficient on RM\*Dr is insignificant in both statistical and economic respects. In particular, we cannot reject the null hypothesis that  $\beta r = 0$  for Qwest. Also, the estimates of  $\beta r$  that we obtained for Qwest (-0.01 when using either the S&P 500 Index or the DJIA) are very close to zero. Therefore, we find no evidence that Qwest’s beta changed during the recession.”). The paper argues that this “finding” (higher volatility for two of four players, not so for the other two) substantiates the hypothesis that mandatory unbundling will increase volatility of ILEC stocks in a recession.

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108 Crandall, Robert W. and Leonard Waverman. The Failure of Competitive Entry Into Fixed-Line Telecommunications: Who is At Fault. *Journal of Competition Law and Economics*. 2(1) 113-148. At page 140.

109 Ingraham, A., & Sidak, G. (2003). Mandatory unbundling, UNE-P, and the cost of equity: Does TELRIC pricing increase risk for incumbent local exchange carriers?. *Yale Journal on Regulation*, 20, 389–406.

The next two papers in the literature review are Phoenix Center Policy Bulletins. These are self-published, non-refereed documents. Policy Bulletin No. 6<sup>110</sup> is an effort to respond to methodological criticisms (from Criterion and other consultants) of Policy Bulletin No. 5.<sup>111</sup> Both attempt to show that unbundling, and in particular UNE-P, increase investment by the then-remaining Bell Companies.

The next round in this debate is Crandall, Ingraham, and Singer (2003).<sup>112</sup> It is a paper published in a refereed journal; its origin is in a Criterion Economics paper.<sup>113</sup> It is primarily a theoretical model arguing that lower unbundling rates will lead entrants to use unbundled loops to provide service, rather than invest in their own facilities. To the limited extent that data is used in this paper, it reflects data provided by the Bell Companies to the researchers, analyzing a total of 56 observations from 2000 and 2001, excluding somewhere between 15 and 20 states. From these data the authors claim that higher rates for unbundled loops are correlated with higher levels of facilities-based CLEC lines. The authors then use the theoretical model to argue that the mechanism is by displacement of incentives to invest away from unbundling, and towards facilities-based competition. Neither the model nor the data can establish the extent to which the high cost results in displacement to facilities-based competition, as opposed to exiting the market. While the former is likely desirable (assuming that social cost of the redundant investment does not outweigh the welfare gain from competition that does not depend on regulation), the latter clearly is not.

The parting shot in this series is again a policy paper from the Phoenix Center, seeking to establish that unbundling increases broadband availability (as measured by zip codes in which at least one provider is available and zip codes in which four or more providers are available.) (Ford and Spiwak 2004.)<sup>114</sup> Although it is placed in a literature review on investment, it is not a paper on investment, but on penetration. The argument for effects on investment is by derivation—if performance is high, therefore investment likely happened. However, given that entry here can be over existing lines, it is feasible in principle to get higher penetration, and greater competition, without greater investment. The results, in any event, even as specified, show only weak statistical significance, at the 10% level.

The Cambini and Jiang paper goes on to cover several other papers that either explicitly or by clear implication, are industry-sponsored. Hazlett and Bazelon (2005)<sup>115</sup> is an unpublished conference paper. Bazelon is a consultant with Analysis Group, where Hazlett, who holds an academic appointment at George Mason, also consulted at the time.<sup>116</sup> Analysis Group was, it appears, employed by Verizon during this period to produce work on unbundling.<sup>117</sup> As a consequence, it would be appropriate to treat

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110 Phoenix Center Policy Bulletin No. 6 (2003): *UNE-P Drives Bell Investment - A Synthesis Model* Available at <http://www.phoenix-center.org/PolicyBulletin/PolicyBulletin6Final.pdf>

111 Phoenix Center Policy Bulletin No. 5 (2003): *Competition and Bell Company Investment in Telecommunications Plant: The Effects of UNE-P*. Available at: <http://www.phoenix-center.org/PolicyBulletin/PolicyBulletin5.pdf>

112 Crandall, R., Ingraham, A., & Singer, H. (2004). Do unbundling policies discourage CLEC facilities-based investment. *Topics in Economic Analysis & Policy*, 4(1), 1136.

113 Footnote 24 of Crandall and Singer (2003) identifies what later became Crandall, Ingraham, and Singer 2004 as a Criterion Economics paper. As with Ingraham and Sidak 2003, one author, identifies himself by his think-tank affiliation, in the case of this paper, Crandall with Brookings, rather than Sidak with AEI, and not by the consultancy that he chairs and that the other author/authors work for.

114 Ford, G., & Spiwak, L. (2004). The positive effects of unbundling on broadband deployment. Phoenix Center Policy Paper No.19. The Phoenix Center. Available at: <http://www.phoenix-center.org/pcpp/PCPP19Final.pdf>.

115 Hazlett, T., & Bazelon, C. (2005). Regulated unbundling of telecommunications networks: a stepping stone to facilities-based competition?. George Mason University. Available at: <http://mason.gmu.edu/~thazlett/pubs/Stepping%20Stone%20TPRC.10.04.05%20.pdf>

116 Hazlett CV, 2006. <http://www.law.gmu.edu/assets/files/faculty/cv/hazlett.pdf>.

117 Robert Pyndick uses Analysis for his consulting, and in Pyndick 2007 properly discloses that the analysis there was commissioned by Verizon. He then thanks Hazlett and Bazelon for their help. His CV, again, with admirable candor, discloses that he was a consultant to Verizon at the relevant period (2003-2005). Similarly, the Hazlett and Bazelon

the results of this paper with the caution properly associated with industry-sponsored papers, although no sponsorship is formally disclosed in the paper itself. The first conclusion of the paper—that unbundling harms investment—is based on the observation that investment in telecommunications dropped massively after the tech-bubble burst in 2001. The authors' sole effort to tie this fact, which was true in many countries, including Switzerland, which did not have unbundling during this period at all, is a graph that shows investment declining from 2001 and number of UNE-P lines increasing over the same period. No effort is made to control for overall changes in the market. Much of the causal explanation simply refers to financial analysts' beliefs that the regulatory structure is anti-investment. The second conclusion of the paper does actually rely on a regression, and claims to show that use of unbundling in earlier periods does not predict facilities-based investment by CLECs in later periods. However, it seemed to show a negative relationship initially, and a positive relationship over time, describing only the total effect over three periods as statistically insignificant. The authors' final assertion is that the rate of DSL subscription increased by better-than-trend after the FCC's formal abandonment of line sharing, based on subscription data from Legg Mason. This is simply an early version of the erroneous analysis discussed in the context of Hazlett and Caliskan (2008) above.

Zarakas et al (2005)<sup>118</sup> is a consultancy-produced paper that relies on an agent-based simulation. The paper used strategic action modeling to claim that unbundling at TELRIC rates increased innovation.<sup>119</sup> The assumptions in this model are nothing short of heroic. It assumes three facilities-based competitors and one unbundling competitor, and it assumes that each of the three facilities-based competitors immediately achieves full capacity whenever it deploys lines, does not need to build market share over time, and “there is no unused capacity.” (p. 16). For this assumption to be true, it would have to be the case that three separate wires would be going into each home, each capable of serving all of that household's needs, and the household would nonetheless subscribe to all three wires. Using these assumptions and various rounded-up and rounded-down data from actual markets, the paper hypothesizes the effects of different levels of prices for unbundled network elements. It predicts based on these simulations that decreases in the prices of unbundled elements would lead to increases in investments in facilities (by these firms whose every new line is immediately taken up by a new customer, even though that customer already had access to two other wires and was subscribing to both of them).

Willig (2006)<sup>120</sup> is a self-published paper by an academic at Princeton. The paper originated in an analysis done for a declaration on behalf of AT&T, in an FCC filing, while AT&T was an entrant.<sup>121</sup> It begins with an informal conceptual description of what it calls the Investment Deterrence Hypothesis and the Competitive Stimulus Hypothesis. The two names are self-explanatory. It primarily emphasizes that investment deterrence must necessarily rely on the idea that TELRIC price regulation does not in fact do what it is designed to do—mimic efficient investment costs for an entrant. It also emphasizes that competitive stimulus relies on the observation that entry into markets with such high fixed and sunk costs are high, and that competition, where feasible, performs better than monopoly. Lower prices will

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paper itself, in footnote 19, cites to a declaration filed by Hazlett and Bazelon and one collaborator on behalf of Verizon, covering some of the materials discussed in the paper.

118 Zarakas, W., Woroch, G., Wood, L., McFadden, D., Ilias, N., & Liu, P. (2005). Structural simulation of facility sharing: unbundling policies and investment strategy in local exchange markets. Report by The Brattle Group, Washington, DC. Available at: [/http://www.brattle.com/\\_documents/UploadLibrary/ArticleReport2347.pdf](http://www.brattle.com/_documents/UploadLibrary/ArticleReport2347.pdf) .

119 Clarke, R. N., Hassett, K., Ivanova, Z. and Kotlikoff, L., Assessing the Economic Gains from Telecom Competition. NBER Working Paper No. W10482 (2004).

120 Willig, R. (2006). Investment is appropriately stimulated by TELRIC. Princeton University. Available at: [/http://psc.ky.gov/psccef/2003-00379/5200700\\_efs/04132004/MCI\\_ST\\_MTB\\_EX\\_14\\_04%2013%2004.pdf](http://psc.ky.gov/psccef/2003-00379/5200700_efs/04132004/MCI_ST_MTB_EX_14_04%2013%2004.pdf)

121 Willig (2006) at notes 10, 24.

drive demand, and higher demand will drive new investment. It then reports on results of a different submission to the FCC, on several papers by the Phoenix Center, and on a dated OECD policy report.

The next paper, Waverman and Dasgupta (2006),<sup>122</sup> is a consultancy document prepared by LECG for France Telecom. It is a conceptual paper. It lays out the case that too much regulation will undermine incentives; it asserts that the basic high-fixed-cost structure of the telecommunications markets has largely been superseded; it specifically states that econometrics cannot capture the full complexity and multi-dimensionality of the regulatory process; and it states merely that if the purpose of regulation is to increase investment in a second infrastructure, then over-regulation is more of a risk than under-regulation.

Pyndick (2007)<sup>123</sup> is a refereed article<sup>124</sup> by an academic, whose headnote properly discloses that the study was commissioned by Verizon. It is a theoretical article. It provides an option-value approach to confirming the Hausman (1998) critique of TSLRIC pricing.

We include here the counterpart to Waverman et al 2007 produced for the entrants' side, Cadman (2007).<sup>125</sup> Cadman 2007 is a consultancy paper created for ECTA, the entrant's organization that is the counterpart to the incumbents' ETNO. Its provenance therefore requires as much caution as appropriate for the Waverman et al 2007 paper. Cadman 2007 provides an econometric analysis of the relationship between regulatory effectiveness and investment per capita. It uses ECTA's own regulatory effectiveness index. This raises the possibility that the index is biased, although at a minimum it likely reflects the degree to which entrants view a given country's regulatory environment as conducive to their entry. It also uses the OECD's regulatory reform index for the telecoms sectors. Running regressions controlling for GDP, population, area, and interest rate, it finds significant correlation to good performance on the regulatory efficacy indexes. It is important to emphasize that regulatory efficacy is not a direct measure of open access, and this analysis does not address itself to the effectiveness specifically of access-related regulations, but to the effectiveness of the telecommunications regulatory system more generally.

Friederiszick, H., Grajek, M., & Roller, L. (2008)<sup>126</sup> is an academic working paper, supported by Deutsche Telekom. It uses a sophisticated model, focuses on data at the operator level rather than the country level, and uses external indexes to identify not only formal, but also effective regulation and political environment. The paper finds that access regulation that forces incumbents to open access to their networks has a negative effect on fixed-lines entrants' investment, but no negative effects on fixed-line incumbents' investments, and no negative effects on either incumbents or entrants in mobile. While the framing of the paper strongly emphasizes its results on fixed-line entrants, its findings on incumbent and mobile investment support the proposition that open access regulation does not undermine investment overall, or socially efficient investment. The authors emphasize the displacement of entrant investment, projecting from their findings that entrants invest in a given five year period about half of what they would have invested without access regulation. As long as a strict investment ladder approach

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122 Waverman, L., & Dasgupta, K. (2006). Investment in telecommunication networks: a 21st century perspective. Report by LECG Consulting, London, UK.

123 Pyndick, R. (2007). Mandatory unbundling and irreversible investment in telecom networks. *Review of Network Economics*, 6(3), 274–298.

124 The paper is published, like several others, in the *Review of Network Economics*. That journal states that publication requires a single referee to provide a positive evaluation. It is not clear whether this requires the absence of negative reports.

125 Cadman, R. 2007. Regulation and Investment in European Telecoms Markets. SPC Network.

126 Friederiszick, H., Grajek, M., & Roller, L. (2008). Analyzing the relationship between regulation and investment in the telecom sector. ESMI White Paper No. WP-108-01.

is taken, this is clearly evidence against open access. However, given that redundant investment is a regulatory hedge with ambiguous long term welfare effects, the implications of avoidance of such investment become more ambiguous.

Friederiszick et al (2008) find that open access rules do not cause incumbents to invest less in upgrading their networks. They hypothesize that “One possible explanation of this is that entrants are able to boost end customer demand due to increased variety and innovativeness of their information and communication services offered on incumbents’ networks. In this case the lost profit margins of incumbents could be offset by the increase in total demand.” (Friederiszick et al 2008 p. 33). This finding is consistent with the empirical findings in Chang, Koski, and Majumdar (2003) and with some of the theoretical models discussed in Guthrie (2006). Friederiszick et al warn, however, that their findings do not necessarily carry over to investment in next generation networks, although nothing in their data either supports or refutes that extension.

#### *Access, unbundling, and investment: Conclusion*

We review here 23 papers on unbundling and investment. These include all the papers in Cambini and Jiang, except for those more appropriately reviewed in the sections on performance or the qualitative case studies. We add three academic, one governmental, and one industry-sponsored report, and treat one double citation in that report as a single paper. Of the 23 papers, over half, 13, are industry sponsored. Of these thirteen, only two or three are published, only one refereed. All but one take the position that would support the position of the paper’s sponsor. The majority of the papers exhibit weakness; several are not empirical. Of the remaining ten papers, two are government sponsored, unpublished papers. One shows that higher regulatory effectiveness increases investment, but its descriptive portions are more powerful than its econometrics. The second is methodologically powerful, hypothesizes weaker investments by entrants as a result of unbundling, but does not in fact find lower investments by entrants. The remaining eight papers are academic and think tank. They are all published. Four are theoretical, two showing positive effects on investment, one negative, and one emphasizes the current state of uncertainty about the effects of unbundling on investment. Of the remaining four, two find that investment increases and two find that investment declines or is delayed. Of these latter two, one has severe methodological problems. The second supports the finding of delayed investment. However, the paper suggests that delayed investment is likely a reflection of strategic jockeying for a more favorable regulatory environment, rather than a real incentive effect, and that the welfare lost may not be very large.

#### **4.4.5 Qualitative case studies of open access**

Given the relative ambiguity of the sum of the quantitative data, it is appropriate to rely primarily on the qualitative literature. For these same reasons, our own study draws heavily on qualitative work. In this section, we review the most relevant qualitative work. In comparison to the quantitative work, more of this literature is produced by academics and published in refereed journals. The studies in this segment of the literature are not as frequently sponsored by industry and largely provide more support for the proposition that open access policies have had a positive impact on the diffusion and performance of broadband.

**Table 4.4. Qualitative case studies of open access**

Citation	Pub=1 Self- pub=0	Sponsor	Countries covered	Open access played role? + / - / 0	Main observations
Academic/ Think tank					
Lee & Chan-Olmsted (2004)	1		South Korea; U.S.	0	Detailed study of broadband policy in South Korea; attributes South Korean success to wide range of geographic and demographic factors; emphasizes urban density; emphasizes government demand-side programs. Confirms that South Korean early entry was by leased access over cable. Confirms that a contemporaneous view of the U.S. regulatory shift was that early 2002 to early 2003 was when cable and telco broadband providers were clearly deregulated from access provisions pertaining to broadband.
Frieden 2005	1		U.S., Canada, Japan, South Korea	0/+	Emphasizes the different responses of the various incumbents to the regulatory and policy efforts in their countries. Emphasizes that U.S. incumbents fought to obtain an unregulated duopoly market structure. "Stakeholders appeared more intent on competing in the courtroom than in the marketplace."
Ida 2006	1		Japan	+	Highly detailed study of Japanese market, demand and supply elements. Strong emphasis on role of Softbank Yahoo!BB in driving DSL and demand. Strong emphasis on K-Opticom in fiber. Anticipates expansion of KDDI and Softbank to fiber.
Chung 2006	1		South Korea	0	Emphasis on geography and demand policies. Claims "hands off" approach of South Korean government played large role. Confirms that Hanaro entered over leased lines as an important way to enter at low cost.
Bauer (2006)	1		U.S.		Detailed study of the U.S. market, determinants of supply and demand, players, both incumbents and entrants, and political economy. "American broadband policy evolves in a piecemeal fashion, driven by political agendas, corporate strategies, and legal and regulatory battles." Detailed description of the regulatory battles, promises, and the retreat in early 2002 to early 2003 from unbundling for broadband.

Citation	Pub=1 Self- pub=0	Sponsor	Countries covered	Open access played role? + / - / 0	Main observations
Krafft (2006)	1		France	~+	Highly detailed study of the French market and regulatory environment. Author explains the failure to thrive of cable as in part caused by regulatory fragmentation, in part by France Telecom early control over facilities. Krafft emphasizes entry of Free/Iliad as important, but laments small market shares of Neuf, Cegetel, and Alice as too small to thrive (all are now part of SFR or Iliad). Regulatory shift in late 2002-2003; attributes to combination of change of leadership in ART/ARCEP, learning from Japan, and cooperation with the EU Framework Directive.
Bullingen (2006)	1		Germany	~	Detailed study of German market; emphasizes dominance of DT and weakness of regulatory agency; hypothesizes that the importance of DT to German industrial and labor policy immunizes it from effective regulation; confirms the regional boundaries of entrants in Germany.
Antonelli and Patrucco (2006)	1		Italy	0/~	Emphasizes highly regional nature of Italian market; the wealthy parts: 3% of landmass, 25% of population have high competition, including fiber from Fastweb; other areas lag. Emphasizes geographic concentration and facilities-based competition; sees unbundling as useful for the underserved areas of Italy.
Lindmark and Bjorstedt (2006)	1		Sweden	+	Detailed description of Swedish market. Emphasis on early entry by dial-up companies; early entry by facilities-based competitor Bredbandsbolaget; complementarities between facilities-based and LLU-based entry; concerned with too fragmented a market for the LLU portions of the market (pre-consolidation by Telenor).
Fransman (2006)	1		Synthesis of other studies of Japan, South Korea, U.S., France, Germany, Italy, Sweden, informal observations about UK	+	Emphasizes role of disruptive entrants, like Softbank or Free/Iliad. Emphasizes the less innovative nature of incumbents when they are the sole competitors. Confirms then-contemporaneous view, just before functional separation in UK, of strategic obstruction by BT. Emphasizes then-clear difference between France and Germany expressed in prices and speeds.

Citation	Pub=1 Self- pub=0	Sponsor	Countries covered	Open access played role? + / - / 0	Main observations
Picot & Wernick (2007)	1		U.S., South Korea, EU countries	+	<p>“LLU and access obligations play important roles throughout Europe and have contributed to high deployment rates in countries lacking alternative infrastructure as well as in countries with competing platforms.” Germany, however, continues to debate regulatory holidays</p> <p>“From a competition-related perspective, the leading position of South Korea has been furthered by platform competition between DSL and cable modem. While LLU played a negligible role, open access obligations for cable owners were important for new entries to compete on a level playing field.”</p> <p>“Thus, the U.S. is moving in an entirely different direction than Europe, and also in comparison to U.S. regulatory policy prior to about 2002”.</p>
Kushida and Oh (2007)	1		Japan, South Korea	+	Detailed political economy of regulation in both countries; emphasizes effective regulator and policy programs; emphasizes unbundling in Japan, through Softbank; notes role of open access over cable in Hanaro entry in South Korea
de Bijl and Peitz (2008)	1		Netherlands	-/+	More a conceptual piece than an empirical piece; seeks to persuade the Dutch regulator to phase out unbundling over time. Acknowledges that unbundling played an important role in competition and investment, but raises concerns over long term investment incentives and emphasizes the benefits of high cable penetration in the Netherlands.
Whallen and Curren (2008)	1		UK	0	Functional separation in BT was difficult; policing boundaries between the parts of the firm hard; no rush to adopt in other EU countries
Eskelinen et al (2008)	1	N/A	Finland, Sweden	+	Emphasis on comparing the level of government planning and funding; by implication, suggests that Finland's emphasis on competition, in part through early unbundling, coupled with competition among its former incumbents, was largely as effective as Sweden's more encompassing approach, although took longer to mature.
Sadowski et al (2009)	1	N/A	Netherlands	+/-	Analyzes municipal fiber initiative; argues access is important component; actual observations seem to support the opposite conclusion for a small municipality like the one studied.

Citation	Pub=1 Self- pub=0	Sponsor	Countries covered	Open access played role? + / - / 0	Main observations
Industry supported					
Hausman and Sidak (2005)	1	Vodafone	U.S., UK, NZ, Canada, Germany	-	Qualitative case studies; five countries: U.S., UK, NZ, Canada and Germany; all countries in the study had weak and contested implementations of LLU.
Crandall and Waverman (2006)	1	France Telecom	U.S., Canada, UK, rest of Europe in less detail; Japan	+ Likely positive effects for broadband competition, but not for voice	Extensive review of the covered markets; emphasis on the possibilities of unbundling to be a productive avenue for broadband, even if it is not for voice-only competition; strong emphasis on unbundling as entry strategy for incumbents in one country entering the turf of others; endorsement of Free/Iliad as a model for Europe; strong emphasis of Softbank role in Japan adoption, and more measured predictions on its future role in Japan
Crandall et al. (2009)	1	Verizon	UK, NZ, Italy, Australia, Sweden	-	Argues that functional separation harmed growth of penetration rates and investment in the countries that adopted it; emphasis on UK.

*Qualitative case studies of access regulation: Academics*

Lee & Chan-Olmsted (2004)<sup>127</sup> is a peer reviewed article by an academic and a researcher at Samsung. It provides a detailed case study of South Korea and the United States. The study seeks to provide insights into what each country can learn from the relative success of the other. The U.S. is seen as performing particularly well higher-up in the stack, in e-commerce and online content, while South Korea is seen as performing better at the infrastructure layer. At that level, the one more pertinent to our study here, the paper describes the range of investments, strategic programs, and interventions of the South Korean government, as well as the access regime. Consistent with Picot and Wernick’s (2007) characterization of South Korea’s cable infrastructure regulatory regime prior to 2002 as “open access,” Lee and Chan-Olmsted emphasize that, “It is also important to note that most South Korean cable ISPs are not cable system operators but lease space from the operators.” (661). In their review of broadband regulation in the United States, these authors had no difficulty concluding, based on the February and March 2002 NPRM and Declaratory ruling,<sup>128</sup> that “Thus, the phone companies’ and cable companies’ broadband services appear to be freed from many of the regulations in the United States.”<sup>129</sup> The

127 Lee, C., & Chan-Olmsted, S. M. (2004). Competitive advantage of broadband Internet: A Comparative study between South Korea and the United States. *Telecommunications Policy*, 28(9-10), 649-677.

128 Federal Communications Commission (FCC). (2002, February 15). Notice of Proposed Rule making: In the matter of appropriate framework for the broadband access to the Internet over wireline facilities; universal service obligation of broadband providers; computer III future remand proceedings: Bell operating company provisions of enhanced services (FCC 02-42). Washington, DC: FCC. Federal Communications Commission (FCC). (2002, March 15). Declaratory ruling and notice of proposed rule making: In the matter of inquiring concerning high-speed access to the Internet over cable and other facilities; Internet over cable declaratory ruling; appropriate regulatory treatment for the broadband access to the Internet over cable facilities (FCC 02-77). Washington, DC: FCC.

129 This contemporaneous assessment of the interpretation of the FCC decisions is consistent with our interpretation of the U.S. timeline, which has been disputed in comments to our report.

authors observe that actual competition—that is to say, at the local level where choice actually exists—is likely higher in South Korea than in the U.S.: among three, as opposed to two, providers per market. The paper then goes, in detail, into comparisons of the two countries in terms of potential determinants of Internet adoption: education, age, income, online activities, self-reported reasons for not connecting, and e-commerce. The study ultimately concludes that housing patterns played a large role in broadband deployment, a conclusion that will surprise no one. But it also attributes a real role to the basket of regulatory and investment policies of the South Korean government.

Frieden (2005)<sup>130</sup> is a peer-reviewed, academic paper with no industry sponsorship. Frieden's review of the U.S. experience juxtaposes the enormous success and innovation in the high-technology, Silicon Valley sectors of the U.S. information technology sector to the lackluster performance of U.S. telecommunications and broadband provisioning sector. He describes the history of the response to the 1996 Telecommunications Act in the United States, concluding that: “The combination of market downturn, legislative failure and lack of consensus on operating standards has removed many of the incentives for risk taking and investment, even as the need for network upgrades proved essential for the evolution of high-speed broadband ICT services. Stakeholders appeared more intent on competing in the courtroom than in the marketplace. The incumbent Bell Operating Companies made infrastructure investment contingent on securing massive regulatory liberalization which, if implemented, might result in the establishment of a shared monopoly among telephone and cable television companies without significant government oversight.” (602). In other words, Frieden's interpretation of the U.S. case is that postponement of investment was more strategic, as part of the regulatory negotiation process, than straight incentives-based. Frieden then goes on to observe the government investment and strategic planning, as well as demand side interventions in Canada, Japan, and South Korea, as higher performers, as well as at their competitive strategies. The study does not dig deep into the precise dynamics of firms and their investments, but emphasizes the differences between the heavy resistance and litigation tactics of the U.S. firms, relative to the more compliant and cooperative approach taken by firms in the three other countries he observes.

Ida (2006)<sup>131</sup> is an academic book chapter, with no industry sponsorship. It offers a detailed description of the regulatory choices and history in the breakup of NTT, and the introduction of access regulation. The paper analyzes the different market players, provides information about market shares, then-measured elasticities of demand for the various forms of broadband, and analyzes the interactions between the market segments. Ida focuses very heavily on the role of Softbank as an entrant over unbundled DSL as a driver of the market, as well as the entry by K-Opticom as a driver of fiber competition. The paper observes the KDDI entry over leased fiber, and, in 2006, anticipates that Softbank will expand their service to offer FTTH using the facilities of others.

Chung (2006)<sup>132</sup> is an academic book chapter. It offers market data on the role of the major players in initial broadband adoption in South Korea. Unlike the other case studies of South Korea, it describes Hanaro and Thrunet as having made major facilities-based investments of their own. On the other hand, when describing Hanaro's entry strategy in detail, the chapter specifically notes the company's emphasis on using already-installed fiber (which it did not install or own) to businesses and large apartment complexes. The chapter in several places describes the South Korean government's approach as a

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130 Frieden, R. (2005). Lessons from broadband development in Canada, Japan, Korea and the United States. *Telecommunications Policy*, 29, 595-613.

131 Ida, T. (2006). "Broadband, Information Society, and National System in Japan," M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 65-86 .

132 Chung, I. (2006). "Broadband, Information Society, and National System: The Korean Case," M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 87-108 .

“hands off” policy, which seems at odds with all other descriptions of the South Korean experience, but likely refers to the late introduction of unbundling of the copper plant. In all, the author attributes South Korea's success to “market, geographic, and demographic factors, to some extent. It is important, however, to note that facilities-based competition combined with the non-interventionist policy and various incentive programs greatly contributed to the earlier establishment of the market compared with other countries.”<sup>133</sup>

Bauer (2006)<sup>134</sup> is an academic book chapter that offers a detailed qualitative analysis of the state of the U.S. broadband market up to and following the decision to abandon open access policies. The chapter describes the anatomy of the U.S. broadband market after the 1996 Telecommunications Act, household and business demand, and the nature of the companies providing broadband in the market. It describes the relative dominance of the RBOCs and cable companies, while mentioning the early entry of other entrants. In particular, the chapter notes Covad's entry, based on unbundling, and what the author described as that company's uncertain future as a market participant, given the FCC's retreat from open access under Chairman Powell. The chapter describes the litigation and regulatory negotiations; and notes the promises by several of the incumbents that they would scale up investment in fiber after they received regulatory assurance that they would not need to unbundle those newer facilities. The chapter describes Verizon's investment in fiber-to-the-home, but the choice by SBC and Bell South to scale back from their fiber-to-the-home promises, and to deploy instead DSL services over fiber-to-the-node systems. (p. 144). The chapter speculates that this is a transitional approach, although looking back from late 2009, it is clear that the new AT&T continues the xDSL approach that SBC began in 2004, as described in Bauer (2006).

The paper begins its review of the regulatory history by stating “American broadband policy evolves in a piecemeal fashion, driven by political agendas, corporate strategies, and legal and regulatory battles.” It goes on to detail the early implementation of unbundling, and early efforts to extend open access to cable networks, at the franchising authority level; and then the shift, under the new FCC, beginning in the March 2002 decision to declare cable broadband an information service and concluding with the February 2003 Triennial Review order phasing out line-sharing, the decision that unbundling did not apply to new fiber-to-the-home deployments, and the later clarification that that exemption also applied to fiber-to-the-curb projects, which put xDSL networks outside of the unbundling regime and enabled Bell South and SBC to pursue their trajectory. The chapter, published in 2006, expresses a hope that the changes, if indeed they will have the positive investment effects they are intended to have, will result in the U.S. closing the then-small performance gap between the U.S. and the slightly better performing Nordic countries and the Netherlands. As of 2009, however, that gap has widened, and more European countries, mostly with improved open access regimes, have surpassed the U.S.

Krafft (2006)<sup>135</sup> is an academic book chapter providing a detailed qualitative analysis of the French market and regulatory environment. Krafft provides a highly detailed and careful analysis of the French market, its development, and in particular the regulatory developments in 2002-2003 that drove effective implementation of unbundling and France's broadband performance takeoff. Krafft attributes the failure of cable broadband in France in part to the regulatory fragmentation of markets, and in part from France Telecom's large ownership of essential cable facilities, which stifled its competitors on that platform. The author sees a major shift in French regulatory policies toward unbundling in late 2002 early 2003.

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133 Id., at 107.

134 Bauer, J. (2006). *Broadband in the United States*. M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 132-163.

135 Krafft, J. (2006). *Emergence and Growth of Broadband in the French Infocommunications system of Innovation*. M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 172-194.

She attributes these in part to insights internal to the ART, later ARCEP, and its observations of the successes of Japan and South Korea, in part to a change in leadership in January of 2003, and in part in response to, and with the support of, the new European Framework Directive. At the time, Krafft describes Free/Iliad as the primary entrant, based on unbundling, and laments the relatively fragmented state of the remainder of the market, with Neuf, Cegetel, and Alice holding very small market shares. From today's perspective, however, we know that through consolidation these too-small entrants formed the basis of today's likely more sustainable competitive structure of the French market. The paper offers an excellent snapshot of the observations of an academic in the mid-2000s of the French performance, at a time when the change in policies had begun to bear fruit, but had not played out its full effect as can be observed with three or four more years of data available to us today.

Bullingen (2006)<sup>136</sup> is an academic book chapter that provides a detailed case study of Germany. Bullingen starts by noting the unusually high market share of Deutsche Telekom in the early 2000s (falling from 97% in 2001 to 88% in 2004, still unusually high), and the odd fact that although Germany had very high cable television penetration, it had almost no cable broadband competition at the time. He describes DSL as dominant, and Deutsche Telekom as dominant in DSL. While unbundling was enacted early, and there is a substantial amount of unbundling, Bullingen discusses the relatively high prices for line sharing at the time and the lack of clarity on bitstream access and entry with complementary assets by entrants. As for cable, the paper attributes much of the late start of cable to outdated infrastructure and repeated mistakes by German regulators—both competition authorities that prevented various investments and consolidations, and what appear to be the equivalent of franchising rules that resulted in a highly fragmented cable market. The paper also surveys several other efforts at other sources of entry, but largely sees them as making no real inroads. It concludes with an effort to understand the relative inefficacy of German regulation, and hypothesizes that DT forms an important part of German industrial policy and labor policy, and that weakening DT through a more competitive market was simply inconsistent with the broader industrial and labor policies of the German government.

Antonelli and Patrucco (2006)<sup>137</sup> is an academic book chapter that offers a detailed case study of the Italian broadband market. The authors provide a detailed description of the broadband market, demand and application, major firms, and regulatory structure. The most important insight offered by this paper is the highly segmented nature of the Italian market, and the somewhat surprising relationship between the relatively low prices in the Italian market, on the one hand, and the low penetration rates, on the other. The paper covers the large differences in wealth, density, and deployment between Lombardy, Liguria, Emilia-Romagna, and to a lesser extent the Piedmont, which are wealthy, with high urban density, covering 25% of the population in 3% of the territory, and the lower density area of the third Italy, and the remainder of the country, mostly in the south and in some of the mountainous areas. The largest success story of competition in the northwest was Fastweb. The company was started by the Milan power utility, AEM, which in December 2004 merged with e.Biscom. Its strategy relied on using the utility's own ducts to lay fiber to the home, bypassing Telecom Italia's infrastructure, in the most densely settled municipalities—Milan, initially, and then in the other major Italian urban centers: Rome, Turin, Genoa, Naples and Bologna. Only later did Fastweb begin to combine its own fiber with unbundled loop to extend its service beyond the core high-density, higher wealth areas. The paper classifies Italy, therefore, as primarily a story about facilities-based entry, with a high geographic and demographic bias. In most of the country, however, competition is weak.

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136 Bullingen, F. (2006). Development of the Broadband Market in Germany. M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 195-218.

137 Antonelli, C. and Patrucco, P.P. (2006) *Broadband in Italy*. M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 219-239.

Lindmark and Bjorstedt (2006)<sup>138</sup> is an academic book chapter that provides a detailed case study of the Swedish broadband market. It begins with the history of the early and vigorous dial-up market, tracks the privatization of Telia, the divestment of its cable holdings in ComHem, the emergence of broadband through, in particular, early entry by Bredbandsbolaget into the fiber to the home business and significant early price competition that it introduced in the major urban centers, public investment in a national backbone, alongside public-private deals, most prominently mentioned was Tele2 and the Swedish Railway Administration. The chapter also describes the public investments through the municipalities. Particularly interesting is the description of the competitive dynamics in 2004, as Telia and Bredbandsbolaget competed by lowering installation charges; in response, Glocalnet, a ULL entrant, lowered installation charges to zero, while unbundling-base Bostream began to offer higher data rates. At the time of that writing, Telenor had not yet moved to consolidate these smaller broadband entrants.

Fransman (2006) is an edited volume that includes the prior book chapters and several synthesis segments. Fransman provides the synthesis of the specific and detailed case studies discussed above as book chapters. He argues that effective regulation clearly played an important role in the successful performance of the high performing countries, in particular Japan and South Korea. He attributes the success to the combination of effective access regulation and disruptive entrants, more entrepreneurial than the large incumbents that typify the U.S. market, even where they do compete. His classic example is Softbank in Japan. He seems more skeptical that Iliad in France is indeed of the same type, although he does suggest that Iliad was inspired by, and self-consciously followed the model of, Softbank. Published as a book in 2006, and likely written therefore in 2005, the synthesis is clearly consistent with our own observations nearly five years later about the role of agile, entrepreneurial competitors entering over access to incumbent networks. The synthesis also coheres with our own observations regarding the difference between the reluctance of the German regulator to impose access regulation, the relatively concentrated market structure in Germany, and the relative switch in the performance of France and Germany, particularly along dimensions of price and speed, rather than penetration, following the French regulatory changes in the face of German reluctance to adopt open access. Fransman adds insights into the UK market, because his description is written contemporaneously with the consideration of the imposition of functional separation on BT. He emphasizes that unbundling in particular was weakly implemented in the UK, and while wholesale competition existed, more disruptive entry of the Softbank style was impossible without unbundling. Fransman then quotes from an interview with the Director General of Oftel that “had 'he realised earlier that BT was playing a long game' he would have 'handled local loop unbundling differently,’” and would have been “more directive” (Fransman 2006, p. 189). This description is consistent with the observations of Ofcom, as well as the observation of the history since introduction of functional separation in the UK.

Picot & Wernick (2007)<sup>139</sup> is a peer reviewed, academic article with no visible industry sponsorship. It offers qualitative case studies of EU countries, South Korea, and the United States. It does not seek to draw normative conclusions about which of the various approaches is, overall, better. Its findings are largely consistent with our own. The authors concluded that “LLU and access obligations play important roles throughout Europe and have contributed to high deployment rates in countries lacking alternative infrastructure as well as in countries with competing platforms.” (672). They do, however, note the continuing debates over whether open access obligations undermine investment incentives, pointing in particular to the debates over regulatory holidays in Germany. (672). With regard to South Korea, the authors offer an interpretation similar to ours of the history of South Korean deployment.

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138 Lindmark, S. and Bjorstedt, P. (2006). The Swedish Broadband Market. M. Fransman (ed.), *Global Broadband Battles*, Stanford University Press: 240-265.

139 Picot, A., & Wernick, C. (2007). The role of government in broadband access. *Telecommunications Policy*, 31(10-11), 660-674.

That is, most of the work in South Korea was done by the various government intervention programs, but the competition policy component should be seen as a piece of, as opposed to entirely distinct from, the open access debate. Looking at the early use by Hanaro and Thrunet of leased access lines over cable: “From a competition-related perspective, the leading position of South Korea has been furthered by platform competition between DSL and cable modem. While LLU played a negligible role, open access obligations for cable owners were important for new entries to compete on a level playing field.” (671). Finally, with regard to the U.S., the authors conclude in 2007: “Thus, the U.S. is moving in an entirely different direction than Europe, and also in comparison to U.S. regulatory policy prior to about 2002.” (671).

Kushida and Oh (2007)<sup>140</sup> is an academic peer reviewed article. It describes the political regulatory history of Japanese and South Korean broadband development, surveying the relationships between the regulators and the incumbents and describing the market dynamics between the major firms. The paper suggests that the balance of power and professionalism between the regulator and the incumbent played a large role in the takeoff in broadband in both countries, and that access regulation played a significant role in Japan. Kushida and Oh, like Lee and Chan Olmstead (2007) and like Picot and Wernick (2007), observe the open access nature of cable infrastructure entry in South Korea: “In April 1999 Hanaro commenced broadband services, utilizing both DSL and cable, using its own DSL network and leasing cable capacity from Powercomm, a subsidiary of KEPCO and KT ” (495).

De Bijl and Peitz (2008)<sup>141</sup> is a peer reviewed journal written by an academic and a researcher at an independent government research center. It is addressed to Dutch policy makers, but is largely a conceptual piece, not a qualitative or quantitative analysis piece. It seeks to persuade the Dutch regulator to focus on an approach for phasing out unbundling and open access over time. While the study acknowledges that unbundling played a role in spurring competition and investment in the Netherlands as a practical matter, it raises concerns about longer term investment incentives. In particular, it emphasizes the fact that the Netherlands has a high degree of cable competition to DSL to argue that open access policy is unlikely, in the long term, to be better for the Netherlands.

Whallen and Curren (2008)<sup>142</sup> is a paper by two academics with no visible corporate sponsorship. It is published in *Communications and Strategies*, the IDATE journal. It is a relatively simple descriptive paper. It primarily tells the story of BT's functional separation as a difficult one. The emphasis is on the difficulty of practical implementation and the necessity of extensive, continuous monitoring and adjustment by the regulator to define the boundaries between the wholesale and retail divisions, and the content of what needs to be offered by Openreach. The paper also briefly reviews the experience of other countries and suggests that the Italian case was primarily driven by an effort to prevent AT&T's entry into the market in order to keep Telecom Italia under Italian control; it further suggests that elsewhere in Europe regulators were not jumping on the functional separation bandwagon.

Eskelinen et al (2008)<sup>143</sup> is an academic paper in a refereed journal with no industry support. It very broadly compares the Swedish early broadband plan and government funding model to the somewhat later Finnish national plan, which did not depend on government funding but rather on entry by former incumbents into each other's markets. It concludes that the Swedish approach resulted in earlier growth

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140 Kenji Kushida and Seung-Youn Oh, *The Political Economies of Broadband Development in Korea and Japan*, *Asian Survey*, Vol. XLVII, 2007. 49 0-504.

141 de Bijl, P., & Peitz, M. (2008). *Innovation, convergence and the role of regulation in the Netherlands and beyond*. *Telecommunications Policy*, 32(11), 744-754.

142 “Is Functional Separation BT-Style the Answer?” *Communications and Strategies*. (71), 3rd quarter 2008, p. 145-165.

143 Heikki Eskelinen, Lauri Frank, and Timo Hirvonen. 2008. *Does strategy matter? A comparison of broadband rollout policies in Finland and Sweden*. *Telecommunications Policy*, 32:412-421.

of penetration and lower prices earlier; but that the Finnish approach ultimately caught up. The authors conclude that the choice of approaches—government investment driven or competition driven—did not result in substantially different results. While the paper does to some extent note the historical difference between the incumbency structures in the two countries, it focuses primarily on the difference in funding policies, and does not seek to explore the different ways in which competition was introduced into the markets; the relative roles of cable and utilities in each of the markets, or the role and take-up of unbundling and access regulation in creating the competitive environment. Because of these omissions, the paper leaves much of what appears to be relevant and contested in the policy analysis under-explored. Nonetheless, its implication is that Finland's access-based competition, among incumbents entering each other's traditional regions using, in part, unbundling, is that competition in the presence of open access performed as well in the medium term as the more state-sponsored approach pursued by Sweden.

Sadowski et al (2009)<sup>144</sup> is an academic paper with no corporate sponsorship, published in a refereed journal. It provides a detailed case study of one municipal fiber-to-the-home network, and an overview of several others in the Netherlands. The paper outlines several approaches, ranging from public utility-like models to a joint-venture like model. It concludes that there is significant room for municipalities to play a role in constructing fiber networks, although its description suggests that implementation is far from simple. Moreover, the paper concludes that municipalities should mandate open access obligations on new networks. The case study itself, however, suggests that vertical integration turned out to be important in that case to recover the costs of deployment; that the studied system itself ended up being taken over by Reggefiber and operated, as a practical matter, as a vertically-integrated operation; that competitive service providers did not enter, and that open access was available for passive, Layer 1 elements, not for active components higher up in the stack.

*Qualitative case studies of access regulation: Industry sponsored*

Hausman and Sidak (2005)<sup>145</sup> is a peer-reviewed article. The headnote properly discloses that the research was commissioned by Vodafone.<sup>146</sup> The paper uses case studies to argue that none of the rationales of unbundling is borne out by the evidence from five countries' experience: the United States, the United Kingdom, New Zealand, Canada, and Germany. We note that all five countries are those that we, and other case studies described here, diagnosed as, at least at the time, having weak, ineffective, or strategically contested unbundling regimes. The study is from a period when the United States was passed the peak of its unbundling policy; the UK and New Zealand were both on the verge of reaching a decision that their approach had failed, and were about to shift to functional separation; Canada and Germany, in turn, were two of the countries that had adopted unbundling formally, but were among the most reticent in implementation. There are various places where Hausman and Sidak interpret their evidence more favorably to their position than we would have, but these are not fatal to the analysis. Given the countries they chose, however, the analysis primarily comports with the observation that half-

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144 Sadowski, Bert. M, Alberto Nucciarelli, and Marc de Rooij. 2009. Providing incentives for private investment in municipal broadband networks: Evidence from the Netherlands. *Telecommunications Policy*. 33:582-595

145 Hausman, J., & Sidak, G. (2005). Did mandatory unbundling achieve its purpose? Empirical evidence from five countries. *Journal of Competition Law and Economics*, 1(1), 173–245.

146 This does not necessarily connote a conflict. Vodafone at the time owned Arcor, in Germany, which is a facilities-based based CLEC, not an unbundling-based CLEC. It also owns shares in SFR, which at the time had not yet bought Neuf-Cegetel, and so was in mobile, not home-broadband. It certainly is not an incumbent-supported paper. To the extent that there is a conflict we have not detected, it would suggest bias in favor of entrants, rather than incumbents. The paper, however, supports the incumbents' case. The authors had written in opposition to unbundling several times in the prior years.

hearted implementations of unbundling do not work very well. The study does not include a single country that was at the time effectively implementing unbundling.

Crandall and Waverman (2006) is a refereed paper sponsored by France Telecom. Its abstract and some of the discussion suggest that this analysis was focused on “the emerging broadband strategy in Europe of large ISPs owned by incumbent telecommunication companies in other countries (for example, France Telecom’s Wanadoo)”: in other words, cross-border market entry by incumbents in one country to compete in their neighbors’ erstwhile backyards. In our own case studies this was most visible in the entry of the Nordic incumbents into each other’s markets. As such, it is an interesting paper by authors who normally write from the incumbents’ perspective, who are asked to write from the perspective of an incumbent in one jurisdiction as it seeks to enter another.

About the U.S., discussing primarily voice, rather than broadband, unbundling, Crandall and Waverman write:

AT&T and MCI largely abandoned mass-market local services because of the recent court decision that overturned the FCC’s liberal unbundling rules and have since been acquired by SBC and Verizon, the two largest incumbents." (at 119.) “The continued growth of local competition in the United States through June 2004 was due almost entirely to the growth of the unbundled network platform, which had been leased by incumbents at rates 40 – 60 percent of the incumbents’ average revenues per line. ... This form of competition was nothing more than regulatory arbitrage, but it may have been profitable until the incumbents responded with their own bundled service packages. This conjecture is now largely irrelevant because the courts have forced the FCC to change its network unbundling rules. As a result, AT&T and subsequently MCI largely abandoned the mass market for local and long-distance services and merged into the two largest Bell companies.

Regarding the UK, they write:

In the United Kingdom, unlike the United States, there was little CLEC entry aimed at residential markets. This may have been due to the fact that LLU began five years later than in the United States (2001 versus 1996), as well as capital market constraints that surely existed a year after LLU began in the EU. (p. 130)

In the United States, some commentators blame regulation, that is, the implementation of the 1996 Telecommunications Act, which resulted in very large wholesale discounts for entrants, for providing incentives for inefficient entry. Yet similar excessive entry occurred in the United Kingdom, where mandated resale and LLU did not exist. This suggests that capital markets as well as regulatory incentives played crucial roles in stimulating uneconomic entry into telecommunications generally. (132).

Reviewing the experience of Europe, the authors write:

However, there is one large and significant difference between narrowband and broadband services competition. In narrowband markets such (LLU based) competition merely replaces an incumbent’s services with identical services from an entrant. The welfare gains—and thus the overall prospects for revenue growth and sustainable entry—are likely to be limited. Broadband, however, is a relatively new service with a rapidly increasing number of residential subscribers in Europe. Since broadband offers consumers the prospect of genuinely new and distinctive services, marketed and bundled for them in genuinely new and distinctive ways, the consumer welfare gains from services-based broadband competition might be significant, thus sustaining entry.

Some analysts suggest an inverse relationship between the use of LLU and the rollout of broadband, because LLU diminishes the incentives for the incumbent to upgrade its network for broadband. In Europe, however, we see no simple inverse relationship between the number of lines unbundled and the percentage of homes with broadband, but there is a compounding issue. In Germany and France the incumbent telco is the major ISP, unlike the United Kingdom where BT until recently has been a minor ISP provider. It may be that the incumbent's desire to maintain its position as an ISP offsets the adverse incentives created by LLU in Europe. (141).

As broadband providers however, Wanadoo, AOL, and other ISPs control the broadband portion of the local loop. Moreover, if they do not use LLU but rather bitstream access, they have incentives to use VoIP, competing directly with the incumbent telco. Note the number of large multi-country ISPs in Table 11: Tiscali (an independent and the second largest ISP in Europe), Wanadoo, Tele-2, Chello Broadband (controlled by the Dutch cable company UPC), Easynet (controlled by the founders of Easyjet, the successful low cost airline), AOL, and NTL. These represent a potentially large, diversified set of competitors for telcos offering ADSL.

The experience of Iliad/Free in France also suggests that broadband ISPs with differentiated and innovative offerings can be viable. Free is the only nationwide "triple play" operator offering "ADSL 2+" technology over unbundled loops. By 2005, Free accounted for 43 percent of all unbundled lines in France. Further, Free reported 130,000 paying subscribers to Freebox TV services, and 1,135,000 telephone users. Iliad, Free's parent company, reported a 52 percent increase in revenue between the first quarter of 2004 and the first quarter of 2005, largely thanks to an 83 percent jump in Internet revenues. Free's stated goal is to reach 1.5 million ADSL customers for the year 2005. As of 30 June 2005, the firm had achieved an ADSL subscriber base of 1,316,000.73 Michel Boukobza, Managing Director of Iliad recently declared, "Our business model is simple, we have a E29.9 monthly rental [from our retail customers] and we pay France Telecom E10.5 per month per subscriber. The difference allows us to amortise our network as well as R&D costs." This would suggest that there is plenty of scope for entrants to use low LLU rates to operate profitably. However, other entrants have not replicated Free's successes, and French LLU rates are not significantly different from the European average. There is nothing obviously different about France (relative to the rest of Western Europe)—such as vastly lower input costs for entrants—that would explain how and why Free has been successful. On the other hand, Free has been offering innovative products such as TV over DSL, and it is this product differentiation and innovation that might explain its rapid increase in subscribership. Indeed, France's relatively low cable penetration might create an opportunity for ISPs that offer bundles of broadband along with Digital TV.

On Japan Crandall and Waverman write:

In December 2000, the Ministry of Public Management, Home Affairs, Posts, and Telecommunications introduced a network unbundling requirement in Japan, allowing new entrants to offer DSL services over shared NTT lines. At that time, there were less than one million broadband subscribers in Japan, and most of them were subscribing to cable modem service. DSL has since grown rapidly, attracting 12.8 million subscribers by September 2004, while cable modems have grown more slowly to just 2.68 million lines and fiber to the home has increased to 2.0 million lines. The new entrants had accounted for nearly 62.5 percent of Japanese DSL subscriber lines by March 2004, thanks largely to aggressive price competition from Yahoo!Broadband ("Yahoo!BB"), which is offering DSL for as little as 2280 Yen (about \$20) per month, not including the cost of the modem. In its first year, Yahoo!BB had more than 1 million lines, and by March 2004 it had increased its subscribers to 4.9 million using lines shared with NTT. Yahoo!BB is a subsidiary of Softbank, which provides the financing

and infrastructure for Yahoo!BB's operations. Although Yahoo!BB has reported substantial profits from its operations, Softbank has continued to report very large losses in its "Broadband Infrastructure Division." Softbank's objective is to build a very large customer base to which it can sell a variety of entertainment and information services, as well as VoIP. It has been extremely successful in selling VoIP to its subscribers, with 4.7 million of its 4.9 DSL subscribers accepting the service. Whether its strategy of building market share and eventually selling enough content to offset its huge start-up losses can succeed no one can know at this time.

Crandall et al. (2009)<sup>147</sup> is a forthcoming publication funded by Verizon; its authors are identified both by their affiliation as Empiris consultants and by other institutional affiliation, most prominently the Brookings Institute. The article is a qualitative analysis of the effects of functional separation in the UK, New Zealand, Italy, Sweden and Australia. The paper begins with a background conceptual framing of the costs of functional separation in terms of lost efficiencies of vertical integration. It then reviews the experience of the UK, in particular, and to a lesser extent the remaining four countries that adopted separation. The paper argues that the UK's efforts support the proposition that vertical separation has no positive effect on penetration and will undermine investment. In particular, the paper discusses the slower levels of growth in penetration in the UK by comparison to its own growth rate during the period of September 2002 to September 2005, and to the growth rate of the EU 15.

This claim is difficult to interpret because of the relatively low base from which the UK grew in the earlier period, relative to the later period. It is common for growth rates from a higher base to be lower than growth rates from a lower base, earlier in the diffusion process. From Q4 2002 to Q4 2003, the UK broadband penetration rate grew from 2.3% to 5.4%, and then the following year from 5.4% to 10.4%. The following year penetration grew from 10.3% to 16.3%. After separation, the yearly increases continued from 16.3% to 21.4%, then 25.8%, and 28.5% by 2008. By comparison, in the U.S over the same period, without functional separation and after the elimination of all access rules, penetration also started from an identical level to that of the UK in Q4 2005, 16.3%, but then grew more slowly than in the UK, to 20.3%, 23.4%, and 25.8% over the same periods. It is possible that the diffusion curves of each country are different, but that would make the comparison to the EU 15 at least as problematic. The Crandall et al paper does not address the dramatic increase in unbundled lines, from under 200,000 to five million, which suggests substantial complementary investment from entrants, or the substantial annual drop in prices emphasized by Ofcom in its own review of the separation.

Crandall et al then move to focus on investment. The authors acknowledge that BT's investment levels are among the highest in the EU, but attribute it to "the dreadful condition of BT's network at the end of the 20th century." No attempt is made to explain why the dreadfulness of the condition of the network has any bearing on whether or not an incumbent has incentives to invest. They do emphasize that BT's capital expenditures have grown more slowly since the recovery from the burst bubble than the average growth of 12 of the EU 15, but again, do so without identifying the base from which that growth has occurred. The paper recognizes that BT's base levels of investment were relatively higher than those in the other countries. Proceeding to compare BT's rate of growth in investment from the higher base is less revealing when compared to an average of 12 countries if those countries grew from lower baseline levels of investment. Finally, the paper underscores the difficulties of transposing open access to fiber, the relatively low levels of investments in fiber in the UK, and the increasing interest of the UK government to find government sources of funding for fiber deployment to much of the country. This description raises valid concerns with the application of separation to fiber, in particular the extent to

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147 Crandall, Robert, Jeffrey Eisenach, and Robert Litan. 2009. Vertical Separation in Telecommunications Networks: Evidence from Five Countries. *Forthcoming* Federal Communications Law Journal.

which functional separation indeed can be contained to passive elements only, as opposed to be extended to standardized active elements. On the other hand, the comparisons in the paper between BT's (absence of) investments in fiber to the home relative to Virgin Media's investments in DOCSIS 3.0 rollout are difficult to justify, since the cost structures of the two investment pathways are different—this is the great short-term advantage cable has over fiber—the near-term rough equivalence of performance coupled with an order-of-magnitude cheaper upgrade path. Furthermore, the comparison to U.S. investment in fiber is also complicated by the fact that U.S. fiber to the home reflects only Verizon's investments; it does not explain the absence of similar investments by AT&T or Qwest.

In discussing the other four countries, the Crandall et al paper also discusses penetration and investment. For penetration, because it focuses on growth, the paper uses a log-scale to show broadband penetration per 100. The authors write “In fact, if one plots the growth of broadband across most of the major OECD countries, one observes a convergence in both *the level* and the rate of growth of broadband penetration, as shown in Figure 4.” (emphasis added). With regard to the level of penetration, however, the log scale is inappropriate and distorts the penetration data preventing a real comparison. It treats Italy's level of penetration in Q2 2008, of 18.2%, as “converged” with Denmark's rate of 36.7%. On a log scale, this looks no greater than the difference between 2% and 4%, and as drawn in Crandall et al 2009, Figure 4, that near 20% difference is drawn as no greater than the difference between 0.2% penetration and 0.4% penetration earlier in the decade.<sup>148</sup> Furthermore, even on this scale, in Figure 3 of the paper, it is clear that New Zealand at the time of adoption of functional separation was well below the OECD average penetration, and well below Italy. After separation, New Zealand's penetration level reached that of the OECD average, and passed that of Italy, which had not yet, during this period, adopted functional separation (the paper itself pegs the approval of separation in Italy at December 2008, two quarters after the end of the evidence presented in the paper to show the effects of separation on penetration). The paper's analysis of fiber implementation by the companies that “succumbed to functional separation,” as the paper puts it (p. 28), suffers from the fact that it is looking at outcomes of fiber investment, investments with a multi-decade horizon, as responses to regulatory interventions that are, in the case of Italy, less than a year old, and in the case of Sweden, about 18 months old. Moreover, in Sweden, the market for fiber-to-the-home is influenced by the presence of municipal networks. The paper states, for example, “While Telia-Sonera began to roll out fiber to the home in 15 major cities in Finland in 2007, it has not launched a similar program in Sweden.”<sup>149</sup> In Sweden, however, much of the fiber to the home market begins with municipalities, and TeliaSonera does offer triple play bundles over the municipal fiber networks, and is itself a contractor for some of the municipal networks. The Swedish regulator's report on dark fiber states that “TeliaSonera accounts for 53 per cent of the total supply of optical fibre in Sweden and approximately 47 per cent of the coverage of all optical fibre;”<sup>150</sup> and also that “Municipal authorities and municipal companies represent the highest rate of growth, but, of the other stakeholders, TeliaSonera is by far the largest stakeholder rolling out fibre.”<sup>151</sup> While these statements refer to fiber generally, not to fiber to the home, they do suggest that it is difficult to discuss Sweden as a case of failure in fiber-to-the-home deployment, much less that such a “failure” was occasioned by the recent adoption of functional separation.

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148 If one were for a moment to take seriously the World Bank's recent calculation that a 10 point increase in penetration rate translates into 1.21% higher GDP growth, the paper is in effect treating as “convergence” a difference in penetration between countries that would translate into about 2.3% growth rate per year: more than the average growth rate of a developed economy in the period between 1980 and 2006.

149 Crandall et al 2009, p. 28.

150 Dark Fibre: Market and State of Competition. PTS-ER-2008:9. p. 22.

151 Id. at 19.

*Qualitative case studies of access regulation: Conclusion*

Of nineteen qualitative papers (several are discrete country chapters in a single 2006 edited volume), only two present clearly negative conclusions about unbundling. Both were industry funded. The observations of the older of the two papers are purely based on countries that at the time had not implemented unbundling effectively. The observations of the newer paper emphasize growth rates without regard to relative maturity of the market, and treat convergence on a log scale as convergence for practical policy purposes, characterizing vast differences such as between 20% and a 40% level of penetration as “converged.” Of the remaining papers, nine view access regulations, where implemented, as having played a positive role in penetration, consumer use, and/or investment. One of these nine was industry-sponsored. The remaining papers focus on the political economy, on the political and practical difficulties of effective implementation, or, in the case of South Korea, on the importance of other factors. The case studies, in the main, comport with our own observations in our case studies. They present a very clear picture of the extent to which in the U.S. unbundling and open access were litigated and blocked by the incumbents at every step. They suggest that in Germany too this was the case. They suggest that, while South Korea likely exhibits other factors as more important, early entry indeed was based on open access to cable plant, rather than on unbundling. They emphasize the role of entrepreneurial entrants, like Softbank Yahoo! BB in Japan, or Free/Iliad in France. In all, these qualitative case studies provide substantial support for our own independent review of evidence, which brings the history that these earlier papers discuss up to date.

The existing empirical literature, then, does not support the present dismissal of open access as a serious potential tool in the regulatory toolbox. The econometrics literature is systematically weak, and heavily influenced by interested parties. The qualitative work is more appropriate for the kinds of complex, nuanced phenomena involved in broadband policy, and is less polluted by interested research. It also tends more strongly to support the beneficial effects of open access policy.

The remainder of this part is dedicated to our own contribution to the existing work with new and updated studies of open access policies in fourteen other OECD countries. We precede the fourteen case studies with the case of the U.S. as a baseline for comparison.

#### **4.5 Baseline: The United States**

The Telecommunications Act of 1996 represented the most extensive overhaul of American communications law since the New Deal. It passed by a vote of 91 to 5 in the Senate, and 414 to 16 in the House of Representatives. Georgia Representative John Linder hailed it at the time as “the most deregulatory telecommunications legislation in history.”<sup>152</sup> The basic problem it dealt with was how to transition from monopoly to competition. The most innovative idea at the core of the 1996 Act was that in order to enable competition to develop, incumbents would have to open up access to components of their networks to competitors. The Act introduced unbundling, interconnection, collocation, and wholesale access as elements of open access.

Unbundling in the 1996 Act initially had little to do with Internet access. It dealt mostly with letting new entrants enter telephone markets. Residential Internet was peripheral to the Act, and what there was of it was dial-up over voice telephone lines. Dial-up Internet was, as a practical matter, “open access” from the start, but not because of unbundling. Early on the FCC treated Internet Service Providers as regular businesses, like the corner grocery, instead of like telecommunications companies. That meant that the ISPs were allowed to “use” the carriers’ network without paying a fee for every call carried.

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152 142 CONG. REC. HI 145, 1146 (Feb. 1, 1996).

They too, like the grocery store and unlike other telecommunications carriers, could simply pay a flat monthly fee for business service. Things changed with the introduction of digital communications over copper, first ISDN and then DSL, because to compete in these new offerings, providers had to invest in reconditioning lines and installing new electronics equipment.

After the 1996 Act, the incumbents litigated many of its provisions. The FCC's efforts to define what elements of the network needed to be unbundled were struck down by the courts. Later, when DSL became important and the Commission tried to implement line sharing, or what in Europe came to be called shared access, the D.C. Circuit Court of Appeals struck the decision down.<sup>153</sup> In the meantime, around 1999-2000, as AT&T purchased major cable systems, a new question emerged—whether cable should be subject to the same kind of open access regulation. In several instances cable franchising authorities tried to do this; but the power to impose open access on cable operators was seen as residing in the FCC, not local authorities.<sup>154</sup> Half a decade after the formal adoption of open access provisions, they still were not effectively implemented as the Internet access market began its broadband transition.

By the fall of 2001 a new FCC had changed course. Between that fall and the spring of 2002, the FCC passed a series of decisions that abandoned the effort to implement open access, and shifted the focus of American policy from the idea of regulated competition within each wire—competition over the copper plant of the telephone company and over the coaxial cable of the cable company—to competition between the owners of the two wires. The theory was that two competitors with a strong base in a technology they own were enough to discipline each other, and much preferable to the uncertainties of unbundling and the price regulation and continuous monitoring of anticompetitive abuses that it entailed. The two facilities-based competitors would drive each other to invest, would discipline any monopoly pricing, and would not suffer the negative incentives of knowing that some of their investments in upgraded networks would go to subsidize their competitors. The approach was initially proposed in the Triennial Review NPRM from December of 2001, which introduced the theory of intermodal competition as a reason to abandon access regulations,<sup>155</sup> and was immediately followed up and expanded as a broad basis for national broadband policy in the February 2002 NPRM on Appropriate Framework for Wireline<sup>156</sup> and the March 2002 Declaratory Ruling and NOI on cable broadband.<sup>157</sup> For those potential entrants who were slow and did not read the writing on the wall during the first quarter of 2002, the FCC's press release announcing the declaration of cable broadband as an information service specifically tied all these documents together, stating:

Today's decision follows five other related proceedings - the Cable Modem NOI, the National Performance Measures NPRM, the Incumbent LEC Broadband Notice, the Triennial UNE Review Notice and, most recently, the Wireline Broadband NPRM. These proceedings, together with today's actions, are intended to build the foundation for a comprehensive and consistent national broadband policy.<sup>158</sup>

At the time, this was not an unreasonable idea. Cable operators were leading the way in the broadband transition in the United States, while telephone companies were playing catch up. Exactly the same was true in neighboring Canada. In 2001 and 2002, when these decisions were being made, the United States had the fourth highest level of broadband penetration, while Canada had the second highest. The

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153 *United States Telecom Association v. FCC*, 290 F.3d 415 (D.C. Cir. 2002).

154 *AT&T v. City of Portland*, 216 F.3d 871 (9th Cir. 2000).

155 Triennial Review NPRM, FCC 01-361, Docket No. 01-338, December 12, 2001, paras. 27-30.

156 NPRM: In the Matter of Appropriate Framework for Broadband Access to the Internet over Wireline Facilities FCC 02-42, February 14, 2002.

157 Declaratory Ruling and Notice of Proposed Rulemaking (FCC 02-77), March 14, 2002.

158 Cable NOI news release, [http://www.fcc.gov/Bureaus/Cable/News\\_Releases/2002/nrcb0201.html](http://www.fcc.gov/Bureaus/Cable/News_Releases/2002/nrcb0201.html).

model of inter-modal competition (competition between firms, each of which uses a different technological mode to provide its service) seemed to work well. The battle continued until its final conclusion in 2005, after which the largest unbundling-based entrant, AT&T, was bought by SBC, MCI by Verizon, and other, smaller entrants shifted focus away from the residential market or disappeared.

Perhaps the most contested (at least legally) aspect of this series of decisions was that the shift was achieved not by simply forbearing from regulation, but by changing the definition of what the cable and telecommunications carriers were doing when they offered broadband. The new decisions defined “broadband” as a single, integrated information service, rather than a combination of two distinct services: telecommunications carriage—carrying bits from place to place—and information service—doing everything else, like hosting a web site or providing a portal. This move too was litigated all the way to the Supreme Court.<sup>159</sup> The decision split the Court. Justice Thomas thought that, while the decision was not clearly right, it was not clearly wrong either, and the FCC had the power to make it. Justice Scalia, in dissent, thought the idea was as silly as saying that because a “pizza delivery” company offered both together one could say that the company didn't offer delivery, as well as pizza. He thought it was silly enough that the Court should reverse the decision and force the FCC to treat carriers as carriers, and then decide to forbear or not based on established categories in the Telecommunications Act, not based on an unguided and uncharted part of the Act, the residual that would apply if the Commission's interpretation were upheld.

In summary, resistance by incumbents and skepticism by the courts meant that the unbundling provisions of the 1996 Telecommunications Act were largely stillborn, at least in their application to the emerging broadband market. In their stead, the FCC decided to embrace a theory that competition between the incumbent telephone companies and incumbent cable companies—inter-modal competition—introduced sufficient competition to discipline both. That decision was then upheld by a divided Supreme Court as permissible, if not necessarily advisable. Our review of the experiences of other countries during this past decade, relative to that of the United States, suggests that the original judgment made by Congress in the Telecommunications Act of 1996 represented the better course. The experience of other countries is complex, nuanced, and detailed. Not all of it lines up exactly with a single storyline, and not all of it unambiguously supports one conclusion. Still, as one works through the details, the weight of the evidence supports the conclusion that open access policies, where seriously implemented by an engaged regulator, contributed to a more competitive market and better outcomes. In turn, these policies and the experience with them now form the basis of much forward-looking planning throughout the world.

## **4.6 Japan and South Korea: Experiences of performance outliers**

Across a range of broadband measures, Japan and South Korea represent outliers as high performers. The experience of Japan and its current plan provide measured support for consideration of an open access policy. The South Korean experience is more ambiguous on access, pointing more toward heavy government investment. Both suggest that a strong, professional regulator, exercising effective power over incumbent providers, can foster significant market development and competition.

### **4.6.1 Japan: The first transition**

NTT was privatized in 1985, although the Japanese government continues to hold an interest in it. Up to that point, NTT was a powerful incumbent, which received appropriations directly from the Diet, whose

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<sup>159</sup> NCTA v. Brand X, 545 U.S. 967 (2005).

staff was more professional and could overwhelm the more weakly staffed Ministry of Posts and Telecommunications (MPT), and which was backed by a coalition of equipment manufacturers that manufactured directly to NTT's specifications and were tightly bound to it. The decade following the privatization of NTT was a messy one.<sup>160</sup> MPT battled not only NTT over its efforts to break up the incumbent, as AT&T had been in the United States, and to force NTT to lower the interconnection rates it charged competitors, but also with Japan's fabled industrial policy ministry, MITI, over which government agency would have power over telecommunications. The battle continued for a decade until 1996, at which point NTT was able to escape breakup, but MPT had grown in power. In the following three years MPT pushed an agenda of further privatization of NTT, as well as deregulating some aspects of its telecommunications law to come into compliance with WTO requirements. In 1999, NTT was reorganized into one long distance company and two regional companies, NTT East and NTT West, while MPT was renamed the Ministry of Internal Affairs and Communications (MIC), with MITI-like capabilities, marking a new relationship between NTT and MIC, with authority finally shifting to the MIC.

In 1999 NTT was focused on building a high cost, per-minute fee-based ISDN service. Several new entrants, like Tokyo Metallic, tried to enter with DSL, but NTT was not at the time regulated to require it to provide the entrants with access, in that case collocation, to its physical network. Japan had no broadband to speak of, and the first efforts to start it failed. In 2000, the MIC created an IT Strategy Headquarters, created the e-Japan strategy, and received substantial regulatory powers in the Basic IT Law. In October of 2000, following an intervention by the Japanese trade authority, MIC promulgated a series of rules requiring collocation, and requiring NTT to publish a fee structure, to lease dark fiber at regulated rates, and to unbundle the last mile of its network to entrants. In 2001 the MIC created a public forum to resolve disputes between entrants and incumbents. That year, Softbank founded Yahoo!BB, based on leased access from NTT for backhaul and unbundled loops for access to consumers. Usen, a cable company, also at that time launched the first fiber effort in Japan, which was more facilities-based. Usen focused explicitly on high density areas with households and businesses, using its own facilities, but apparently also relying on the availability of NTT dark fiber to lease at low rates.<sup>161</sup> NTT was forced to abandon its ISDN-to-Fiber gradual move, and shift to DSL and fiber to the home investments. NTT had already built much of the heart of the fiber infrastructure in the 1990s.

What followed were several years of extensive competition, first in DSL, and then in fiber, leading to Japan's state today. In a 2006 paper, the director of the competition policy division in MIC, Yasu Taniwaki, presented the trajectory of events with a stark graph, reproduced here as Figure 4.3.<sup>162</sup> While we are skeptical of the strong, clear causal claim in such a complex dynamic, at a minimum we can learn how the Japanese regulators themselves understand the dynamic. What is clearly true is that unbundling enabled Yahoo!BB to enter the market with lower prices, aggressive marketing, free DSL modems and installation, and innovative new services, most disruptive of which was bundling free VoIP with broadband access as early as 2001. Today Yahoo!BB has slightly over a third of the DSL market, NTT has another third, and the remainder is shared among other providers, mostly KDDI and eAccess. Moreover, Softbank is now moving to retail fiber access over NTT's Flet's Hikari fiber-to-the-home service and has become a major player in fixed mobile convergence by buying Vodafone's Japanese operations in 2006. In this case, unbundling or open access operated exactly as anticipated—it created low entry barriers for an entrant who was able to introduce extensive service innovations, create a brand, and become an aggressive competitor which helped drive investment away from monopoly-rent-

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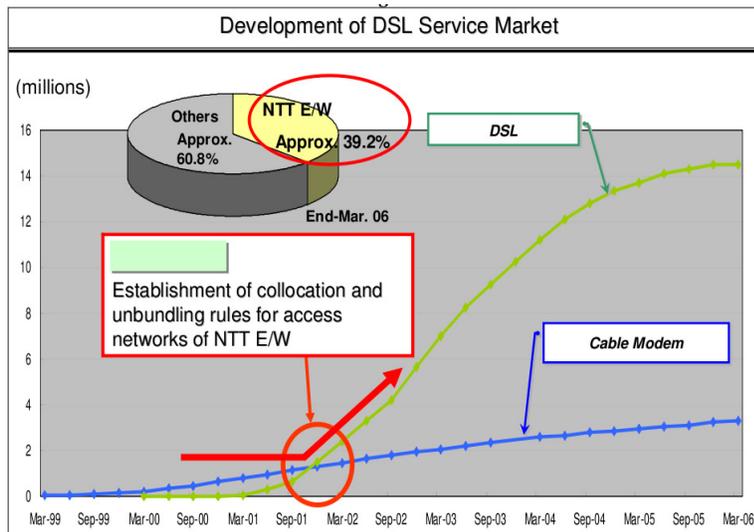
160 Kenji Kushida and Seung-Youn Oh, *The Political Economies of Broadband Development in Japan*, *Asian Survey*, 48(3) May/June 2007, 480-504.

161 USEN Annual Report 2001, *Broadband Stream*. (Verify veracity of this document)

162 Yasu Taniwaki, *Broadband Competition Policy to Address the Transition to IP-Based Networks*.

extraction devices, like NTT's ISDN policy. That entrant continues to be a major force in the market almost a decade later.

**Figure 4.3. Development of DSL Service Market, MIC, Yasu Taniwaki**



The story of fiber development, on the other hand, makes the Japanese case more ambiguous in its implications for open access, and more supportive of the argument that facilities-based competitors are sufficient. The first fiber launch in Japan was by Usen, a cable music distribution network, largely based on its own facilities. While Usen still has about 7% of the fiber market, much more important was entry by power companies, in particular K-Opticom, a subsidiary of Kansai Electric Power. K-Opticom entered using its own facilities, built over the electric utility's conduits and poles. K-Opticom became the first company, in 2008, to offer 1Gbps residential service. This part of the story supports the argument in favor of facilities-based competition, and against the need for open access. But even on the fiber side, focusing solely on facilities-based competition and ignoring the impact of open access would miss a part of the story. A major player in fiber today is KDDI, whose roots in the early 2000s were in mobile phones (through its au Corp brand), and wholesale carrier pre-selection of telephony (like Carphone Warehouse in the UK, as we will see.) KDDI expanded into fiber by purchasing Poweredcom, a fiber-delivery subsidiary of Tokyo Electric, and building its own fiber. It now offers service by combining its own fiber networks, those of some smaller cable providers, and, because it owns no DSL facilities of its own, offering various DSL services over the networks of other providers to complement its fiber facilities. KDDI's combination of facilities-based fiber and open-access-based DSL elements into its business model, as well as Softbank's entry into fiber services through reselling NTT's Flet's Hikari service, suggest that even in fiber the story in Japan is partly driven not only by the demand created on the DSL side, but also because some fiber entrants use unbundled DSL facilities to complement coverage in areas where these entrants' facilities have not yet been rolled out. Moreover, the overall level of investment in the fiber market questions the argument that open access deters investment. Despite early availability of unbundling for dark fiber, and Japan's continued commitment to assuring open access to the network layer independent of technology, NTT responded to the fiber challenge by investing and building out fiber (with support of low-cost loans from the government), and today has over half the fiber market in Japan.

The Japanese story is therefore nuanced. It does not suggest a single cause, but rather that a combination of some government-subsidized loans, open access policies on the DSL side, and facilities-

based competition, created both supply and demand for very high speed Internet access early on, and that this cycle led to further investments in both plants.

*Japan: Thinking about a ubiquitously networked society*

Japanese policy shares one assumption with the belief that underlay the FCC's decision to treat broadband providers as information services.<sup>163</sup> That assumption was that, going forward, carriage of bits would have to vertically integrate with higher-layer services and applications to work seamlessly and in an economically sustainable manner. Moreover, Japan's focus on a ubiquitously network society also contemplates "fixed mobile convergence." The policy conclusion that the Japanese MIC drew from this assumption, however, was exactly the opposite of the conclusion that the FCC drew. Rather than applying the anticipated integration to withdraw from access and carriage regulation, the MIC saw this anticipated business model as requiring the implementation of both open access at the network layer and net neutrality higher-up in the stack. These steps were intended to assure that the incumbent could be permitted to enter vertically integrated services (NTT East and West in collaboration with sister company NTT DoCoMo) while preventing it from undermining competition in any layer that depends on other layers, lower down in the stack. As a result, telecommunications carriers that carry more than 50% of subscriber lines in a given prefecture are required to offer equal treatment of all operators, including through offering price-regulated unbundling and interconnection of both fiber and copper. The price for the elements, in particular for fiber, is to be set so as to secure a profit for the incumbent that invested in the fiber. In this regard, the target of pricing policy is conceptually similar to the one used in the United Kingdom for BT and Openreach, where sustaining structural separation requires that pricing allow the company to invest specifically for sale to competitors. Moreover, following an 18-month dispute process, DoCoMo acquiesced in opening up its mobile network to competitor Japan Communications, and publishing leasing and interconnection terms more transparently. The result is the launch of two data-focused mobile virtual network operators (MVNOs) (Japan Communications and III Mobile) with a higher degree of control over their network than traditional resellers. In order to support and permit further integration, the MIC set up a close annual review process, designating a watch list of potential points of bottleneck or anticompetitive limitations, to be reviewed and updated annually with the anticipation of swift regulatory intervention where anticompetitive practices are observed.

The critical insight here is that the Japanese approach sees a highly competent and intensely engaged regulator as an enabler of competition, rather than that a weak and removed regulator is what competition requires. Precisely to the extent that market conditions require market actors to integrate and innovate across dependent parts of the network and services, to that same extent the activity of the regulator allows dominant market actors to experiment with new operating arrangements while assuring competitors and entrants that they too can invest, because abuses by carriers who hold market power will be checked by the regulator. The system of observation is not based on clear ex ante definitions of regulated versus unregulated elements (say copper, or even fiber), but on continuously updated and reviewed actual dependencies between elements of the integrated services, followed by continuous updating of whether, and what, elements require access by dependent services to assure continuing competition. As a practical regulatory matter, this approach becomes part of the definition of net neutrality, which is understood as a mandate to ensure openness of the platform layer functions and openness of interfaces between layers, so that every user (end user and intermediate) should have equal access to every layer, based on well-defined technical standards that offer ready access to content and application layers.

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163 Yasu Taniwaki, *Broadband Competition Policy to Address the Transition to IP-Based Networks* (2006); Taniwaki presentation 2008. Add here bibliography from case study. The book *Broadband in Japan*.

*Core lessons from Japan*

- The target of next generation policy is not one or another level of measured capacity, in terms of speed or applications supported, but a ubiquitously-networked society, focused on seamless user experience and centered on the needs of users, not carriers.
- A professional and engaged regulator can monitor and measure a market, and provide confidence in its capacity to diagnose and respond to abuses by market-dominant players.
- A regulator capable of continuous monitoring and updated response can permit greater latitude for business innovation, secure, for itself and competitors, that it will identify and be able to act upon anticompetitive abuses masked as innovations.
- Access to incumbent networks, at regulated rates, was a critical part of the most visible early introduction of broadband into Japan with Yahoo! BB and is considered in Japan to have played a major role in driving speed and price competition.
- Access has long been applied to fiber, as well as to copper, and this policy is extended into the future. It does not appear to be the case that fiber unbundling was an important factor for entrants in fiber, which were largely facilities-based entrants either in cable or in power. Copper unbundling that supported DSL was, however, important to the ability of important entrants like KDDI to roll out services in areas where they did not yet have fiber coverage, mixing and matching capabilities and infrastructures to offer complete service.
- Access requirements do not seem to have stymied investment in fiber by NTT.
- Access and net neutrality are seen as part and parcel of the same commitment to permitting vertical integration and business innovation in the creation of ubiquitous access.
- Access to the physical and network layers and net neutrality above them are seen as ways of assuring innovation and competition while allowing incumbents to innovate and expand capacity as well.
- The move to ubiquitous, seamless connectivity as a goal appears to be in the process of being transposed into expanding some access requirements on the dominant mobile platform.

**4.6.2 South Korea**

The South Korean experience speaks more to government investment than to access regulation. By one assessment South Korea invested \$24 billion in its first transition on connecting schools and government centers in the 1990s, over \$70 billion in low-cost loans to providers, and over \$12 billion per year from 2004-2007 on the transition to the next generation ubiquitous network.<sup>164</sup> It is not entirely clear how much of this is actual government subsidy, and how much is private investment. If these numbers are even roughly representative of actual investments, made by a country with higher urban density and a population roughly one-sixth the size of the United States, then what we say about access in this context is largely moot, given that what is considered to be a major investment by the United States was the \$7.2 billion appropriated in the American Recovery and Reinvestment Act. As we will see in the discussion of investment, it is more likely that these numbers reflect a large proportion of private investment complementing the public investment, in which case it is not outlandishly large by standards of

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<sup>164</sup> Atkinson ITIF Report, pp. 24-25 (2008), and see note 97 there on sourcing.

American total investment, adjusted per capita. Moreover, South Korea is often given as an example of a country that developed fantastic speeds and penetration without access regulation, and so it is worthwhile looking at that aspect of its policies in the context of this section.

Unlike in Japan, the South Korean MIC was long the more powerful and professional partner in the relationship between the regulator and the incumbent, Korea Telecom. The first generation transition occurred largely under the Korea Information Infrastructure (KII) initiative, from 1995-2005.<sup>165</sup> Much of this program was about liberalization and permitting competitors into a market earlier dominated by a state-owned incumbent. In addition, the program emphasized investment. The program did not include a formal unbundling obligation imposed on KT until 2002, after South Korea had already moved from having practically no broadband to having by far the highest levels of penetration in the OECD.

Two elements of early South Korean broadband adoption make the assessment that South Korea is a story inconsistent with access interventions overstated. First, KT, like NTT, was focusing on ISDN as its approach to high-rent extraction. DSL was introduced by facilities-based entrants Thrunet and Hanaro. The catch in this story is that Thrunet relied partly on its own, government-funded infrastructure, and partly on leased access to cable facilities owned by Kepco, the state-owned Korean Electric Power Company. Hanaro too relied in part on its own DSL capabilities, but in part on leasing cable capacity from Kepco. For both companies, being able to lease capacity from an incumbent who was not permitted to offer direct broadband services to users played a significant role in their early deployment. It was only after Hanaro and Thrunet introduced broadband that KT was forced to abandon its ISDN strategy and shift to DSL. Once it did, its size and penetration allowed it to quickly capture a large market share, whereupon the South Korean MIC imposed unbundling obligations on KT in 2002. The ambiguity in this story is that, from the perspective of the entrants, they functioned under economic conditions of an open access policy—they built their entry in part on leasing facilities from an incumbent, rather than facing the entire entry cost of rolling their own facilities from the start. From the perspective of the incumbent, however, there was no “cost” in terms of investment incentives, because this was a government provider, investing government funds, without reference to likely long term competitive abilities. The most we can say from the South Korean experience, then, is that leased access to incumbent facilities spurred new entry; that the new entrant was the more innovative, just as Softbank Yahoo! BB had been in Japan, and that this entry spurred competition in the market and its transition to DSL. We cannot make a full assessment because the incumbent sharing the lines did not internalize the cost of the regulation, and so the theoretically predicted negative effects on it were not brought to bear on the outcome.

The second element from South Korea's first generation transition that bears on the access question is the role of collocation agreements with apartment complexes. What had killed Tokyo Metallic in 1999 was its inability to collocate—to put its electronics sufficiently within the network of the incumbent that it could efficiently deliver service to customers. In South Korea, however, large portions of the population live in huge apartment blocks, covering hundreds or even thousands of families. Unlike in practically every other country, in South Korea the apartment building owners locate and own the small exchanges for the building. The new entrants could, thus, enter into agreements with the apartment block owners to collocate their facilities on the premises. The South Korean government amplified this effect by creating as part of its Internet deployment strategy a building certification program, in which it granted certification to buildings as “connected” when they had high capacity wiring installed. The size of the multi-dwelling units makes access to their inside wiring the practical equivalent, in American or European terms, to a neighborhood developer or association owning the neighborhood fiber closet, rather than the incumbent doing so. They provided ample physical space to accommodate new entrants,

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165 Kushida and Oh, *supra*; Izui Aizu, *A Comparative Study of Broadband in Asia: Deployment and Policy*, 2002

and had every incentive in the world to do so in order to introduce competition in telecommunications services for the neighborhood, or the building. The practical effect of the legal and urban design background facts was to replicate what required collocation rules to be put into effect in Japan, or, as we will see, in Europe. On a much smaller scale, achieving this in-building collocation and sharing of connection points for fiber is one of the regulatory reforms introduced in the past year in France.

Finally, as in Japan, in the last year the South Korean market has seen a substantial move toward fixed-mobile convergence. Mobile broadband leader SKT purchased the successor to Hanaro, SK Broadband. KT merged with the second largest mobile broadband provider, KFT. As a condition for approving these mergers, which cover over 80% of the wireless market and close to 70% of the fixed broadband market, each of the new merged entities will have to provide open access to its mobile data network. Because these orders are all from the first half of 2009, it is too soon to tell how, precisely, they will be implemented, and what effect they will in fact have on the ability of competitors to compete in handsets, network components, or value added services higher up in the stack. The development does suggest, however, increasing integration between fixed and mobile networks, consistent with the shift to a focus on ubiquity.

#### *Core lessons from South Korea*

- Large coordinated investment, much of it public, and high-density urban cores may confound any serious possibility of importing insights from South Korea. All other lessons should be taken with caution.
- The major market driver during the first transition was the introduction of new entrants, at least one of which relied on leased access to the plant of a government-owned cable incumbent. From the entrant's perspective it functioned as unbundled networks, or access to passive elements of a fiber network would. From the incumbent's perspective it functioned very differently because the incumbent here was government owned and not in the business of broadband provision.
- South Korea has had substantial facilities-based competition from cable and electricity.
- South Korea, like Japan, has begun to expand open access to its mobile data networks, while at the same time permitting its dominant players to integrate across the fixed-mobile connection.

#### **4.7 The highest performers in Europe: Mid-sized, relatively homogeneous societies with (possibly) less contentious incumbents: the Nordic Countries and the Netherlands**

The Nordic countries occupy five of the top 8 positions in penetration per 100 inhabitants, despite their relatively low population density and urbanicity; the Netherlands occupies the second position. By our own rankings, which include price and speed, Norway and Iceland slip because of higher prices, while Sweden, Denmark, Finland, and the Netherlands occupy four of the top seven spots, together with Japan, South Korea, and Switzerland. High per capita GDP and median income, high education, low inequality all likely contribute to this performance, as does government investment in Sweden and possibly to some extent the Netherlands. Iceland has a very small population which is extremely concentrated and urban, and we exclude it from our detailed studies here.

The four Nordic countries are reported to have had relatively smooth transitions from national ownership to privatized competition, in all cases with incumbents required to share their facilities with

entrants. Finland's market began with several regional monopolies and a single long-distance monopoly, rather than a single national monopoly, and has therefore had a different trajectory to competition. The Netherlands had what appears to be a bumpier implementation, but still smooth by comparison to the larger countries like France and Germany. We report here in some detail the particulars of the market conditions in each, because the details explain, much better than theory, how unbundling in the context of a smoothly regulated environment works.

#### **4.7.1 The Nordic Countries: Cross platform competition and “investment ladder” through entrepreneurial entrants being bought out by neighboring national incumbents**

In Denmark, Norway, and Sweden, unbundling and open access worked exactly as they “should” have, according to the underlying theory that supported unbundling. Innovative entrants opened up markets; some continued to operate; others were bought out by pan-European or pan-Nordic players and became the basis for entry by those players. The risks—that incumbents would disinvest, that entrants would never graduate to independent competitors—did not materialize. Finland is the example of incumbents invading each other’s territories using unbundling as an element in the entry strategy. Finland's fixed-line competition developed from the former regional and national telephone monopolists entering the more densely populated parts of their rival's territories, combining unbundled access with their own fixed-line plant. More recently, these incumbent-entrants seem to have shifted to extending their reach through mobile broadband only, placing Finland in what its government considers a mini-crisis on long-term growth and spurring plans for government investment in less densely populated areas.

The Nordic countries appear to represent the case that a well-functioning unbundling and open access regulatory regime, combined with well functioning markets and facilities-based competition, create a competitive market and deliver high levels of penetration and quality at, mostly, reasonable prices. Competition occurs between companies that each compete across multiple platforms, not between companies that use different platforms. Investment and expansion are opportunistic, wherever there is capacity to be bought or built, and companies mix-and-match unbundled and own copper with cable and fiber.

#### **4.7.2 Denmark**

Denmark introduced local loop unbundling in 1998. The primary sources of competition to the privatized former state company, TDC, are now owned by the privatized former national operators in the other three Nordic countries: the Swedish-Finnish merged incumbents, TeliaSonera, and the Norwegian Telenor. These large competitors entered the market in the last few years, in large part by acquiring local entrants that had begun to operate through local loop unbundling and bitstream access.

Telenor entered the Danish market by purchasing Danish DSL providers, Cybercity and Tele2, both of whom had their roots in unbundled and bitstream access. Cybercity was a dial-up ISP founded in 1995. It moved to provide broadband primarily over unbundled loops, and to a lesser extent over bitstream access, until it was acquired by Telenor in 2005. Tele2 was a Swedish company that launched voice telephony services in 1996. It entered the DSL market by purchasing Tiscali in 2003. Tiscali had been a competitive ISP that built its business model on local loop unbundling where it was available, in relatively high-revenue areas. By the time it was purchased by Tele2 in 2003, it was one of Denmark's leading four providers. Telenor bought Tele2 in 2007. TeliaSonera entered the Danish market through a combination of cable facilities-based competition and unbundled access. First, it entered in part by purchasing the cable company Stofa. It also did so in part by purchasing DLG-Tele, an agricultural

cooperative that had entered the fixed telephony and DSL markets after the 1996 privatization and introduction of unbundling.

Danish competition today is a composite of large incumbents from neighboring countries entering each other's territories, buying up both copper and cable lines, rolling their own fiber as well. The DSL side of the story very much depends on unbundling, and fits the “investment ladder” story about unbundling, although with a twist. Unbundling attracted entrants like CyberCity or Tiscali. They used it to establish a customer base and presence, generated some competition to the incumbent (these entrants occupied on the order of 15% of the market) and ultimately, as the market matured, were purchased by larger established competitors who could combine these customers with their own infrastructure.<sup>166</sup> At the same time, however, competition developed over cable. But just like the entrants, here too the incumbent, TDC, owned both copper and cable. What we see in Denmark, then, is competition that includes cross-technology competition, but it is not run by a monopolist in either technology. Instead, each of the major competitors buys different bits and pieces of existing companies, using various technologies, to create coverage. Like the Japanese story, the Danish story is an “and/both” story. Competition developed both within each technological platform, and across platforms; to some extent benefiting from unbundling when it was available, and to some extent benefiting from relatively low levels of investment necessary to upgrade an existing infrastructure like cable, or, in Japan, using power ducts. The consolidation of entrants we observe here, as well as in Sweden, in which Telenor plays a productive role, is precisely what a Schumpeterian model of competition would seek and predict—more competition than a monopoly or duopoly, but less than perfectly free entry resulting in competitors that are too small to sustainably threaten the incumbent.

### 4.7.3 Sweden

Sweden introduced local loop unbundling in January of 2001. It also has large public investments and over 200 municipal initiatives. It has the highest fiber penetration of all the Nordic countries, and is behind only Japan and South Korea in levels of fiber deployment. The incumbent, TeliaSonera, is the largest broadband provider in the country, with about 40% of the market. While it accepted the regulator's requirement that it unbundle its copper loop, it fought the requirement that it offer unbundled bitstream access until it ultimately lost its appeals in 2007. As in Denmark, Telenor has moved in to become the second largest broadband provider (21.5%), competing with TeliaSonera throughout the country. As in Denmark, Telenor did so by buying several entrants, some of whom relied exclusively on unbundling to start up and build a customer base.

Telenor entered the Swedish residential market by buying a large block in Glocalnet. Glocalnet was launched in 1998 as a voice competitor, using wholesale purchase and repackaging voice, and then moved to offer broadband over unbundled copper from TeliaSonera. Telenor, which now covers 90% of Swedish homes through unbundled DSL, purchased Glocalnet in 2003. Telenor bought Bredbandsbolaget (B2 Bredband) in 2005, which by then was Sweden's second largest broadband provider. B2 Bredband itself bought unbundling-based provider BoStream a year earlier. B2 Bredband combined unbundled DSL with fiber over its own facilities to businesses and high end users. Telenor later bought Spray from Lycos. In all, Telenor acquired, over the course of four years, several entrants, all of which depended either fully or mostly on unbundling to launch and sustain their business. It continues to combine both owned facilities, particularly fiber, and unbundled copper loop. In 2006-2007 Glocalnet launched Wi-Fi mesh networks in 24 cities, called “Glocalzone,” and agreed with a pan-

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166 Sources: Broadband Prices in Nordic Countries; Market research using TeleGeography's *GlobalComms Database* and various news reports.

European hotspot provider, the Cloud, to roll out 800 hotspots in Sweden and give its subscribers access to 8000 hotspots throughout Europe. Telenor now bundles access to hotspots in Sweden's 20 largest cities with its mobile broadband offerings on the cellular side. Telenor also bought nationwide WiMax licenses in the 3.6-3.8GHz and in the 2.6Ghz bands in 2007 and 2008. The third largest broadband provider is Com Hem, which offers a cable alternative, covering 18% of the market. It represents the straight facilities-based, cable alternative.

The fourth provider, with 15.4% of the market, is Tele2, which launched in 1991 as the first dial-up ISP in Sweden. Tele2 combines all three major avenues for fixed broadband networks. It offers DSL service over unbundled local loop that it acquires from TeliaSonera. It increased its investment in these unbundled networks in 2005 to the point that since 2006 it has been selling access to components of unbundled local loops that it installed and owns to other providers, alongside its own retail services. It is also Sweden's third largest cable company, and offers broadband and triple play over its cable network. Finally, given the high level of municipal fiber networks in Sweden, Tele2 has fiber and fiber/DSL combination networks as the contracted provider in 30 municipal fiber networks throughout Sweden. More generally, Tele2 has focused on selling to government purchasers, as well as businesses, as an independent line of investment. Finally, Tele2 purchased nationwide WiMax licenses in May 2008, and plans to roll out WiMax networks to complement its other strategies.

Convinced by the perceived success of unbundling in fostering competition, investment, and innovation in its broadband markets, concerned about managing the transition to next generation networks, and possibly smarting from the long fought battle over bitstream access, the Swedish regulator PTS concluded that it would best manage the transition to next generation connectivity by imposing functional separation on its incumbent.<sup>167</sup> The PTS then “leaned” on TeliaSonera to accept functional separation in June of 2007. In September of that year, TeliaSonera announced its agreement, and by January 1, 2008, it formed TeliaSonera Skanova Access to provide services to its wholesale customers. In March 2008 the government proposed a bill that formalized the action by empowering the regulator to require functional separation; in the summer of 2008 legal guidelines implementing the law were put into effect.<sup>168</sup>

#### 4.7.4 Norway

While Norway ranks high on penetration per 100, its overall performance based on our multidimensional benchmarking here is lower than that of the other Nordic countries because of its higher prices. Norway introduced unbundling in 2001. The incumbent Telenor serves half the broadband market. The second largest broadband provider is NextGenTel, which was bought by TeliaSonera in 2006 and now has a 10% market share. NextGenTel was launched as a business-oriented ISP in March 2000, and expanded to the residential market using unbundled copper loops and bitstream access from Telenor, after the introduction of local loop unbundling. NextGenTel also owns and operates WiMax networks in some of Norway's harder-to-reach areas. TDC has also entered Norway, but has focused on providing high-end connectivity to businesses over its own facilities. In the broader broadband market, therefore, NextGenTel is followed by a clutch of smaller, 5-7% of market share sized competitors: Get, Ventelo/Norge, and Tele2 Norge.

Telenor's competitors are made up of both cable operators and entrants who, like NextGenTel, built their networks on unbundled elements. Get is the main competitor to Telenor's cable system, Canal Digital

<sup>167</sup> [http://www.pts.se/upload/Rapporter/Tele/2007/EN/Improved\\_broadband\\_competition\\_through\\_functional\\_separation\\_2007\\_18.pdf](http://www.pts.se/upload/Rapporter/Tele/2007/EN/Improved_broadband_competition_through_functional_separation_2007_18.pdf).

<sup>168</sup> TeleGeography, *GlobalComms Database*, Sweden Country profile.

Kabel, and reaches about 7% of Norway's broadband market over its cable systems. Another of the 5-10% market share competitors is Tele2. In Norway, Tele2 is a subsidiary of the Swedish Tele2 (the Danish Tele2 subsidiary was bought by Telenor), and was launched as a dial-up ISP in 1997. In August 2002 it began to offer DSL using wholesale access as a complement to voice telephony, which it also was offering on a resale model. In 2005 it began to roll out its own DSL service using unbundled elements, and in 2008 to switch customers over to its own facilities. This pattern of investment fits the investment ladder model, but may also be driven by the absence of wholesale bitstream access price regulation in Norway. At the same time, the absence of bitstream access price regulation may contribute to the fact that Norway's prices are substantially higher than they are in the other Nordic countries. Indeed, for the very high speeds our pricing study shows that the prices in Norway are the highest in our entire dataset: mostly the offerings of Telenor and Canal Digital, but also of the southern power company Lyse. Only NextGenTel's 40Mbps offer is priced at rates that are mid-tier and consistent with Danish prices, though still much higher than prices in Sweden or Finland for next generation speed offerings. The third competitor in this cluster is Ventelo/Norge, a composite of a business-focused provider and two earlier entrants, BlueCom and Catch. While it is clear that the company combines own-infrastructure with unbundled and wholesale bitstream, as did its predecessors, the details are difficult to tease out. It appears that, like NextGenTel and Tele2, Venetelo/Norge also is built of a composite that, at least insofar as its residential business goes, was built on unbundling, bitstream, and wholesale access.

#### 4.7.5 Finland

Finland became the first Nordic country to introduce unbundling in 1996. Finland's old telecommunications system was different from those of other European countries. It had a single long-distance and international monopoly, Sonera, which in 2002 combined with Swedish monopoly Telia to form TeliaSonera. It also had 27 local phone monopolies. Of these, two, Elisa and DNA, now operate as independent players. The other former local monopolies form the Finnet Group. Finland also has a cable company, Welho, which provides broadband, but holds less than 7% of the market. The aggregate national market is not highly concentrated. Elisa, the former local monopoly in Helsinki, is the largest, and TeliaSonera, the former long-distance monopolist, each has slightly less than 30% of the broadband market. The remainder is split between DNA, Finnet, and Welho. Because all of these players are former local monopolists, each is the incumbent in its own area. They then appear to selectively enter each other's markets: In Helsinki, Espoo, and Vantaa, it would be Elisa, TeliaSonera, and Welho, while in Oulu, a historically DNA incumbency, it would be Elisa, TeliaSonera, and DNA, and so forth for the various Finnet Group members. While interviews and published materials about Finland do not mention unbundling as an important component of entry strategy, the sheer numbers of unbundled loops used in Finland suggest that much of this entry indeed occurs over unbundled loops. According to the ECTA scorecard for the first quarter of 2009,<sup>169</sup> Finland had 347,400 fully unbundled loops used for broadband, and an additional 26,800 shared access loops for broadband. Given a total number of 433,000 retailed broadband connections provided by DSL entrants reported in the same report for Finland, the data strongly suggest that almost all broadband connections sold by a competitive xDSL provider in Finland are sold over unbundled loops. In the discussion of the Canadian market below, we see that a similar structure, where former incumbents can enter each other's markets using unbundling, has not in fact resulted in significant competition. In Finland, on the other hand, competition has indeed emerged. Finland has a high level of penetration, at some of the highest speeds available in the world, at prices that are among the five best prices, in every single speed range, in the OECD. Moreover, as we observe in our company-level pricing study (See Figure 4.4), Elisa and TeliaSonera Finland have practically

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169 ECTA Broadband Scorecard; March 2009.

identical offerings at the very high speed tiers that are comparable to the affordably priced highest-speed offers of the entrants in South Korea (but not KT) and France Telecom, and at prices only somewhat higher than those in Japan, France (entrants only), and Sweden. It is possible, however, that the impetus for this has been the high levels of investment and penetration of wireless mobile networks: Over 85% of the country is covered by 3.5G networks. Concerned that broadband providers would fail to invest further in fixed technology and rely too heavily on wireless mobile broadband that will not lead to sufficient long-term capacity, the government of Finland passed a resolution in September of 2008 committing to deliver 100 Mbps service to 99% of permanent residences by 2015. The practical consequence is a commitment to invest in government subsidies, where necessary, to reach that goal where market conditions appear not to be leading in that direction.

#### **4.7.6 The Netherlands: From unbundling and facilities-based competition to shared next generation infrastructure**

The Netherlands offers a case where facilities-based competitors use the incumbent's unbundled network elements to extend their reach, and offers particularly interesting observations about current approaches to competitors sharing capacity of newly constructed fiber plant on an open access model. The Dutch experience combines substantial facilities-based competition with relatively early availability of unbundled access to drive competition.

The Netherlands has a very high level of cable penetration. Cable providers began to provide broadband early on. Cable broadband providers Zesko and UPC account for 36% of the market.

Competitive DSL providers seem to rely heavily on their own middle-mile facilities-based infrastructure, combined with last mile unbundled local loop from the incumbent KPN. Tele2-Versatel uses backhaul facilities from its telephony side, Versatel. A second DSL provider, BBned began to offer an alternative partial-facilities-based competitor as early as 2000, over its own telecommunications infrastructure, as well as offer its network for other providers to use on a wholesale basis. BBned is now owned by Telecom Italia, which uses its network to offer triple-play offerings, and offers DSL as BBned and Alice. Online is another provider, a subsidiary of T-Mobile Netherlands (that is, a subsidiary of Deutsche Telekom).

The presence of substantial facilities-based investment in the middle mile is complemented by unbundling in the last mile. KPN reported in the last year 3.7 million unbundled loops at Main Distribution Frames and 800,000 at the cabinet. Negotiations over next generation network deployment in 2007-2009 focused on how to retire 1,400 exchanges at which KPN competitors had collocated facilities. These data strongly support the conclusion that the DSL competitors combined their facilities with KPN's local loop through unbundling.

The Dutch experience seems, then, to suggest a clear example of a context in which unbundling complements facilities-based investment and competition. Current plans described by KPN suggest that a pattern of investment aimed at developing a shared core set of facilities will continue, aiming for an open access next generation network, and rolled out on a regional basis, lowest-cost areas first.<sup>170</sup>

OPTA, the Dutch regulator, is the first regulator in Europe to have implemented a requirement for fiber unbundling on regulated terms.<sup>171</sup> OPTA uses a price-cap approach, subject to three-year review, with

<sup>170</sup> Update on KPN's fiber roll-out: Next phase in consumer strategy. KPN 15 December 2009.

[https://www.kpn.com/v2/upload/4140a0cd-d7b7-4104-b7b1-76ba7c3419fc\\_Presentation\\_Fiber\\_update.pdf](https://www.kpn.com/v2/upload/4140a0cd-d7b7-4104-b7b1-76ba7c3419fc_Presentation_Fiber_update.pdf).

<sup>171</sup> ERG (19) 2009. at pp 13, 17.

levels backed out of the business case of KPN and Reggefiber (discussed below) with an explicit commitment to leave enough headroom to make the positive business case for investing in an open fiber network. OPTA also set a deadline for KPN to reach agreement with its competitors on how it was to transition its network to next generation access, including the open access element, or face an OPTA-designed plan.

In 2008 telecommunications incumbent KPN responded by announcing a plan to roll out its next generation network on an open access model, using a joint venture to spread the risk and separate the functions of wholesale access for providers from retail. KPN concluded memoranda of understanding with Tele2-Versatel, BBned, and Orange Netherlands (now T-Mobile) on the terms of next generation roll out and the sharing of facilities. The core of the plan, as it has been implemented since 2008, seems to be a self-imposed quasi-structural separation. In November of 2008 KPN entered an agreement with a private company that had begun to invest in fiber-to-the-home as a real-estate-like investment, Reggefiber, to deploy the fiber infrastructure in a number of towns. KPN will own 41% of the stock of the new venture, which is expected to invest 6-7 billion Euro in rolling fiber out to the home. KPN will then provide service over that platform alongside, and on equal terms with, its competitors. Reggefiber has, as part of this effort, sought to increase its share of a public private partnership that was rolling out fiber in Amsterdam, Glasvezelnet Amsterdam (GNA) to 70%, while leaving the city and housing corporations that are part of the project some important veto rights (see below, part on municipal investments). Unlike Deutsche Telekom, France Telecom, and Bell Canada, which have argued that the investments necessary to deploy next generation infrastructure require that they be allowed to exclude competitors, KPN has used the transition to the next generation of connectivity to decrease its share of the cost and risk in laying out the basic network, and coupled its investment with a structural commitment to implement open access. As in Sweden, and perhaps with Telecom Italia, and unlike in the UK and New Zealand, this was achieved not by explicit regulation, but by agreement between the incumbent and its competitors, backed by the threat of a regulatory solution if no such agreement was reached. This model is of sufficient discrete interest that we offer a more extensive analysis of the business case for Reggefiber and the KPN Reggefiber JV as an annex to this chapter.

#### **4.7.7 Core lessons from the Nordic countries and Netherlands**

1. Facilities-based competition from cable and unbundling-based competition are complementary forms of competitive entry, not substitutes.
2. Entrepreneurial competitors mostly entered through wholesale and unbundling. Their “investment ladder” advancement was facilitated by being purchased by incumbents from nearby countries expanding into neighboring countries. In Finland, where there were several regional incumbents, competition developed through their expansion into each other's territories.
3. Competition occurred between companies across platforms, rather than between platforms where each platform was itself monopoly-owned. Entrants mixed-and-matched low-cost entry strategies whether upgrading cable, partnering with an electric utility, or acquiring an unbundling-based broadband entrant.
4. In Sweden the translation of the lessons of the past decade to the next generation transition has taken the form of imposing functional separation on the incumbent as it moves to deploy the next generation network. In the Netherlands, KPN's new joint venture with Reggefiber and its regulatory treatment result in the effective equivalent of functional separation for open access fiber. In both countries that approach was complemented by municipal efforts, as we will discuss in the part on municipal investments.

## 4.8 The larger European economies: Diverse responses to recalcitrant incumbents

Compared to the Nordic countries, France, Germany, the UK and Italy are much larger countries and economies with more diverse populations. In all of them, dealing with recalcitrant incumbents was a more pronounced part of the story. France and Germany represent in many cases symmetric stories, with a divergence point in 2002-2003 that offers a particularly sharp view of the differing effects of an engaged regulator genuinely improving conditions for competitors. The UK represents a different case yet, with an incumbent that was less directly confrontational, but that effectively succeeded in resisting unbundling until the regulator forced functional separation. Italy rounds out the group with an overall more ambiguous case, where it is unclear that unbundling played much of a role, where fixed broadband penetration is low, despite low prices, where there is high regional divergence, and where mobile broadband seems to have taken off and to a great extent substituted for fixed broadband.

### 4.8.1 France and Germany: Divergent responses to incumbent opposition

Despite having roughly similar GDP per capita (Germany slightly higher) and population concentration (France slightly higher), the two countries present somewhat different trajectories. In 2002-2003, France revamped its regulatory scheme to emphasize the needs of innovative entrants over those of incumbent France Telecom. Germany postponed action, and only extended access practically after much of the debate shifted to next generation infrastructure, where it continues to struggle to implement an access model. France Telecom's two major competitors both have their roots in access-based entrants. They have a larger market share than do Deutsche Telekom's competitors, present more entrepreneurial corporate profiles, and are among the most innovative in the world in terms of services and fixed-mobile-nomadic integration.

In 2002, France had half the penetration levels of Germany. Today, the two countries have similar levels of penetration, with France slightly ahead.<sup>172</sup> In speed, France today is part of the small group of first-tier countries with substantial offerings of 100 Mbps service. At least three companies are now pulling fiber through Paris. Germany occupies the second tier, where 50Mbps speeds are the highest available residential offering. Average prices are lower in France for every tier of service, from the very low speed offerings to the very high speed offerings, than they are in Germany. France's prices are among the lowest in the world for all but the very low speeds. Levels of mobile cellular data access are similar, but nomadic access in France is about two and a half times as widespread as it is in Germany, the result of an innovative business model introduced by the competitors in fixed broadband. In our composite measures, both countries perform better than they are generally perceived to have performed based on the penetration metric alone. France ranks 8<sup>th</sup> rank by our measures; Germany is 12<sup>th</sup>.

#### *France*

If the United States was about a decade ahead of the main body of OECD countries on what we called deregulation and the Europeans call liberalization, France was about a decade behind. Throughout the 1990s, under the governments of both Presidents Mitterrand (left) and Chirac (right), France Telecom (FT) was left very much intact, the state kept a substantial investment in it and dragged its feet on easing competitor entry. In 2001, France's broadband penetration levels were less than one-quarter that of the United States, and about one-third of the average broadband penetration across the OECD countries.<sup>173</sup>

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<sup>172</sup> France is clearly ahead in penetration per 100. The recent Eurostat household survey suggests that in 2008 France was ahead in per household penetration as well. The 2009 numbers suggest that France had zero growth, in household terms, in penetration, and is now slightly behind Germany. This is difficult to square with France's growth trend as well as that of every other country in the survey, and its continuing growth in per inhabitant penetration.

<sup>173</sup> OECD, G7 historical penetration rates. <http://www.oecd.org/dataoecd/22/14/39574797.xls>.

Its broadband penetration rate per 100 inhabitants was 15<sup>th</sup> in the world, compared to the U.S. position of 4<sup>th</sup>.<sup>174</sup> In 2003, 86% of FT employees were still civil servants.

The French 1996 Telecommunications Act created the first independent telecommunications sector regulator in France, the ART. The ART was a five member commission whose members could not be removed during their 6 year term. However, the ART was a relatively weak regulator, by the standards of other European countries. Its decisions could be appealed in court, on both substantive and procedural grounds. FT used this power on several occasions to block ART efforts. On interconnection, the ART for the first few years could act only on complaints, not of its own accord, and its dispute resolution decisions were delayed and slow. As a 2003 OECD assessment of the state of regulatory reform in France put it: “There have been continuing criticisms about certain aspects of the ART’s approach to dispute resolution, but the real problem appears to be the number of appeals against ART decisions and the lack of power to enforce decisions or unwillingness to implement sanctions where these are not respected.”<sup>175</sup> The primary source of complaints was not so much explicit price abuses, but non-price abuses by FT, such as delays in interconnection and the use of imprecise terms, like using “average” delays rather than clear fixed commitments that would have allowed entrants to plan.

The degree to which change in France came as a result of the regulator’s own internal motivation, or as a result of European Union action, is somewhat murky. As part of the Lisbon Agenda aimed in part to make Europe “the most dynamic and competitive knowledge-based economy,” the European Commission passed a Framework Directive in early 2002,<sup>176</sup> as well as a series of more specific directives, requiring member states, among other things, to adopt wholesale local loop unbundling, bitstream access, and leased lines into national law by July of 2003. Formally, French law had long been in compliance. Unbundling had come into effect in January of 2001. The OECD’s regulatory review suggested at the time that the ART did not pre-approve FT’s reference offer, and did not effectively enforce it. In 2002 the European Commission brought an infringement action against the ART, forcing action on both requiring a reference offer and regulating the rates. By the end of 2002 France’s regulated unbundling and shared access rates dropped, and were the second lowest in the EU, second only to Denmark.<sup>177</sup> Between February 2003 and January 2004, the number of unbundled loops in France grew from practically none to over 250,000.<sup>178</sup> In 2004 the French parliament concluded its revision of French law in response to the European regulatory framework, and approved a new set of powers and reorganization for the ART, which by 2005 concluded its transformation into the current regulator, ARCEP.<sup>179</sup> ARCEP’s characterization of its own history places a substantially lower emphasis on the EU intervention, and points to a range of actions the ART took that were effectively implementing unbundling before the EU directive passed. Krafft (2006) seems to suggest there is some truth to both claims, emphasizing both alignment with Europe and a change in leadership in early 2003

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174 OECD Measuring the Information Economy 2002, p. 39.

175 OECD Regulatory Reform in France: Regulatory Reform in the Telecommunications Sector (2003). In its comments to our draft report, the French current regulator, ARCEP, noted that the litigation did not have the power to delay implementation. ARCEP Comment, FCC Docket 09-47. 11/02/2009. While we do not presume to challenge the understanding of the French regulator of its own law, we note that “delay” in this case means not legal formal delay, but level of uncertainty for entrant investment. Our assessment here relies on the contemporaneous OECD regulatory reform review, as well as on the fact that pre-2003 France performed poorly on the ECTA regulatory reform card, whereas after 2003 France’s position as a well-regulated environment, at least from the perspective of entrants, improved dramatically. That observation is indeed consistent with the OECD’s version of events, more so than the French regulator’s assessment of the degree to which the litigation indeed did deter entrants from entering the market as long as as the regulatory decisions were under litigation clouds.

176 2002/12/EC.

177 OECD Regulatory Reform in France, Table 3.

178 OECD Regulatory Reform in France, Figure 2.

179 ARCEP timeline, <http://www.arcep.fr/index.php?id=13&L=1#11131>.

and influence from Japan and South Korea as causes for the increased emphasis of the French regulatory system on effective implementation of unbundling. As a practical matter, from the perspective of lessons for the US, how much of the change was driven internally and how much was externally imposed is less important. The fact is that on ECTA's regulatory scorecard, which suggests at least the degree to which the regulatory framework is seen as effective from an entrant's perspective, France rose from 8<sup>th</sup> to 3<sup>rd</sup> position between 2003 and 2005.

Today, FT holds 47% of the French broadband market, has two major competitors, Iliad (Free) (24%) and SFR (with Neuf Cegetel) (22%), and one significant minor fourth, Numericable-Completel (5.5%).

Free built its business primarily through use of unbundled loops, and now combines both its own broadband service and that of Alice, originally Tiscali (a company that built unbundled services in several of the countries we studied), which it purchased from Telecom Italia in 2008. Free began to build its own network in 2000, but took off when it was able to roll out unbundled services in 2003, soon after effective regulations were put in place. It introduced a EUR30 offering, and has since kept that price while extending the quality of the offerings and making that the reference price of competitive broadband services in France. In 2007, Free announced a municipal partnership with the city of Valenciennes, rolling out a 100Mbps down / 50Mbps up network. More recently, as part of a Paris fiber project announced earlier, Free formally announced in May of 2008 a collaboration with the real estate industry association in Paris Ile-de-France to promote Free's FTTH in buildings. Faced with the fast development of fiber, and with the importance of connections at the building and home level, in August of 2008 the French parliament passed a law requiring new building operators and co-owners to install fiber throughout the building, and to open this fiber plant to any FTTH provider that wishes to reach residents. In existing buildings ARCEP has required that FTTH providers cooperate to assure minimal disruption in construction while assuring equal access to the last fiber drop to all FTTH providers. Free has announced its intentions to invest EUR1 billion by 2012, connecting 4 million French households to its FTTH network.

Where it has rolled out fiber, Free offers a triple-plus play package that includes 100Mbps upload/50Mbps download, HDTV (including the ability to upload your own content onto a TV channel that can then be watched by family or friends in other cities), and unlimited voice calling nationally and to 70 international countries for EUR29.99 per month, or about USD32.59 PPP. Customers it reaches over unbundled networks rather than fiber networks receive the triple play offer with 28Mbps service, for the same price. In addition to the triple play packaged recognizable to Americans, Free subscribers also have as part of their package access to Wi-Fi hotspots whenever they are within reach of another Free subscriber's home, because the home Freebox that connects each subscriber to the service also acts as a hotspot for any Free subscriber. The Wi-Fi nomadic capabilities were added to what originally was an innovative workaround to the fact that Free had not won any of France's original 3G wireless licenses, and refused to pay the government's reservation price in a later spectrum auction intended to give Free the opportunity to become another mobile broadband provider. In 2006, Free made it possible for users who owned Wi-Fi-enabled cellular handsets to make free calls as long as they were within reach of a Free Wi-Fi hotspot. Another workaround that Free has tried to pursue was its 2005 purchase of Altitude Telecom, the owner of the sole 3.5GHz WiMax license in France.

SFR is a mobile operator, owned by Vivendi Universal and Vodafone. In 2008 it took control of the primary wireline telephony competitor to FT, Neuf Cegetel, which in turn is the result of a 2005 merger between Neuf telecom and Cegetel. A January 2005 report on Neuf's then-proposed introduction of IPTV over DSL, Industry newsletter Light Reading reported: "Talking to Light Reading at last week's

TVoverDSL 2005<sup>180</sup> event in Paris, François Paulus, director of the operator's networks division, says Neuf trialed TV-over-DSL in September 2002, but 'we wanted to own the customer, so we waited for unbundling,' which took off in France in 2004."<sup>181</sup> Neuf was described in that publication as "the most aggressive unbundler of the French local loop, having installed its own access equipment in more than 700 local exchanges, covering the majority of the French population." Perhaps the most interesting innovation that the new combined SFR is currently offering as its path to fixed-mobile convergence is its iPhone app, which allows customers to switch seamlessly from its 3G network to Wi-Fi boxes of SFR fixed broadband subscribers. While this may not do much for customers—who subscribe to unlimited data plans anyway—it appears to allow the company to reduce the load on its cellular data network. Neuf Cegetel launched its first fiber offering in 2007, and, like Free, now offers it for EUR29.99.

Numericable is the major cable telephony and broadband company in a country where cable penetration is low. While it covers almost 100% of the cable-served households in France, its share of the broadband market is only 5.5%. In 2008 it sought to expand its broadband coverage by using the Completel unbundled network (the two companies were bought a few months earlier by the Carlyle Group). It now offers broadband speeds of up to 100Mbps over its cable network for EUR19.90, and up to 20Mbps, bundled with television and free unlimited voice calls nationally and to 45 international destinations, over Completel's unbundled network, for EUR29.90.

France Telecom has responded to all this activity with higher investment and lower prices. Its prices are still higher for its triple-play offers than those of Free and SFR (USD48.70PPP for up to 100Mbps) (it also adds a EUR3 per month box rental and a EUR49 deposit on the box). It has increased its announced investment plans in fiber rollout from EUR270 million to between 3 and EUR4.5 billion, but hedged that it would not invest more than 2 billion if it did not attain sufficient market share. Like Free, FT too reached agreement with a major multi-unit building owners association to install FTTH in 800,000 French homes. At least one market analysis credits FT's broadband response as an important part of improving FT's financial performance, stating that "The success here has been attributed in the main to the rapid development of ADSL access, increased revenues gained from unbundling broadband lines and more recently, its commitment to fiber-based ultra-high speed technologies."<sup>182</sup>

### *Germany*

Like France, Germany too was initially reluctant to regulate Deutsche Telekom (DT). As in France, after the formal enactment of access requirements, DT balked and resisted. Germany's regulatory reform occurred several years after France's, and has never clearly realigned the relative power of the regulator and the incumbent. Current market analyses of German entrants read very differently than do market analyses of French or Nordic entrants. DT was privatized in 1995, although as recently as 2004 the German government still held over 40% of the company's shares, and continues to be the company's second largest shareholder, owning just under 15% of the shares. The German 1996 Telecommunications Act created a somewhat more powerful regulator than France's original ART, particularly in that the German regulator, RegTP, was independent of any veto power by the Ministry of Economics and Labor. Despite this formal independence, a 2004 review of Germany's policies repeatedly reports concerns by competitors of conflict of interest between the government's interests as a shareholder and its power as regulator. Moreover, as in the United States, DT used judicial review to challenge and delay or prevent most major regulations related to access by, or prices charged to, competitors. In 1998 the RegTP enacted implementing regulations on network access, based on the 1996 Telecommunications Act.

180 <http://www.upperside.fr/tvodsl2005/tvodsl2005intro.htm>

181 [http://www.lightreading.com/document.asp?doc\\_id=66872](http://www.lightreading.com/document.asp?doc_id=66872).

182 TeleGeography, *GlobalComms Database*, Company Overview (emphasis added).

Actual implementation was mired in lack of transparent accounting, pricing games (e.g., charging competitors per-minute interconnection charges while offering its own customers low flat-rate DSL services), and long delivery times on competitors' orders (the longest in Europe in the early 2000s, 90 days in Germany to 21 days in France in 2001, which the French ART then required be further reduced to 14 days). When the European Commission brought action under the EU law to force clearer implementation, the German national courts blocked or delayed efforts by the RegTP to bring DT into compliance. Despite the existence of a legal requirement to offer unbundling since 1998, therefore, DT did not actually publish a reference offer until 2002, and then only in response to an enforcement action by the European Commission. The regulatory technique used to determine the rates, however, resulted in DT charging its competitors 13% more for wholesale leased access to its lines than it charged its own retail customers.<sup>183</sup> Again, it took more than another year before DT addressed this imbalance—by raising its retail rates.

In 2005, the German regulatory framework was reorganized, and the new Federal Network Agency, BnetzA, was formed.<sup>184</sup> At that point unbundled and shared access loops accounted for slightly over 13% of all DSL lines, when, for that same period, unbundled and shared access lines accounted for over 23% of broadband connections in France. Since then the number of unbundled lines has grown up to 35%, by comparison to France's 38%. BnetzA also moved Germany towards implementing bitstream access, the cheapest method of allowing competitors into the market, in September 2006. By that point, the debate had largely shifted to next generation networks, and the question of whether DT would be required to open access to its VDSL facilities. As a recent market analysis report states: "The German parliament passed the bill in December [2006], stating it was necessary to protect domestic business interests and make DT's investments possible."<sup>185</sup> The European Commission sued the German government in the European Court of Justice after the bill became law in February of 2007. The European Court of Justice ultimately invalidated the German regulatory holiday in December, 2009. BnetzA's new access rules, announced after the decision, require DT to offer access to ducts for competitors to run their own fiber; access to some dark fiber, and requires DT to install DSLAMs in its VDSL network points. As of this writing, it is too soon to tell how effective these new rules will be.

Nothing captures the German regulatory experience better than comparing the language in two independent reviews from 2004 and 2008. In 2004, an OECD report on German regulatory reform diplomatically complemented RegTP, but then added: "However, RegTP has been less effective in seeing its decisions implemented and has been reluctant to investigate important issues such as wholesale mobile termination rates. DT has successfully used judicial review of regulatory decisions to delay, indeed block, the enforcement of regulatory decisions. While unbundling of the local loop was mandated back in 1997, through delays in the provision of leased lines, price-squeeze tactics, artificially low retail prices for DSL services, etc., DTAG has virtually precluded competition and retained or even recently established a dominant position such as in broadband services." In September of 2008, an independent review for the British Government, commissioned as part of its next generation planning process, described the experience of next generation access deployment in other countries. It opened its description of France with: "In France, fibre deployment is happening as result of fierce competition in current generation broadband services." The description of Germany in the same report opens with: "In Germany, Deutsche Telekom has been engaged in a debate over regulatory forbearance."<sup>186</sup>

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183 OECD Regulatory Review, p. 29.

184 Communications Outlook 2007.

185 TeleGeography, *GlobalComms Database*, DT Company Overview.

186 Francesco Caio, *The Next Phase of Broadband UK: Action now for long term competitiveness* (September 2008)

On the facilities-based competition side Germany has only recently begun to take advantage of its large installed cable plant, passing over two-thirds of homes. A number of factors slowed the entry of cable into German broadband markets. First, most of the cable plant was owned by DT. It was not until 2003, four years after the European Directive requiring national telecommunications incumbents to divest their cable holdings, that DT in fact sold off its cable holdings. Even then, however, the German regulatory regime for cable continued to impede the creation of effective national competitors over the cable plant. Nonetheless, cable subscriptions have risen over the past couple of years in Germany and now comprise almost 10% of broadband connections. This is expected to rise, as 30% of new broadband subscriptions are cable.

A review of DT's primary competitors suggests that the need to build a facilities-based alternative from the ground appears to have limited entry to large, locally-anchored networks, and hampered their expansion beyond their original core regions. Two of DT's three primary competitors grew out of regional networks: Vodafone-owned Arcor (13% of the market) originated as a Stuttgart network, and expanded to several other major cities building out its own facilities as it went along. HansNet Telekomunikation (10%) began, and has largely remained, a Hamburg-based regional competitor, and is now owned by Telecom Italia. Arcor launched its own network for voice competition in 1998, and was bought by UK-based mobile carrier Vodafone in 2000. Its strategy had largely been to deploy its own network, and pursue only interconnection agreements, not unbundling agreements, with DT. In 2000-2001 it tried to roll out wireless broadband networks in 243 license areas, but abandoned the project as infeasible in 2002. In 2004-2005 the company upgraded its DSL facilities to allow faster speeds, and in 2005 re-started an experiment with WiMax in Kaiserslautern, to test whether it could extend its DSL offerings in parts of the town that its network could not reach. In late 2007 Arcor announced plans to invest billions in building its own VDSL network, and at the same time sued DT for its refusal to open up its last mile network. BnetzA found that the delays were a backlog caused by an increased demand among competitors that DT was managing, and then announced that it was abandoning the case because under the threat of suit DT had eliminated the backlog. In late 2008 Vodafone/Arcor began to pilot experiments for a VDSL network in two small towns in Thuringia. In June and July of 2009, DT and Vodafone apparently reached agreement to roll out pilot networks in cooperation in two towns. Vodafone/Arcor announced, however, that it was putting plans to roll out VDSL in other German cities on hold because it was not able to reach agreement with DT on access to DT's local networks in those areas.

HansNet is anchored in Hamburg, where it is a successful regional provider launched in 1995. In 2005 it rolled out broadband in eight major western cities and Berlin, but then abandoned plans to also expand to three eastern cities, citing DT's refusal to open up its nationwide VDSL network to competitors. Since 2006, HansNet has tried to compensate by contracting with other, smaller business oriented networks, Telefonica Deutschland and QS Communications, to buy unbundled parts of their networks instead. Various public announcements suggest that DT's competitors were discussing combining to build an alternative VDSL network. It is difficult to assess, however, whether these are efforts to pressure DT to open its network, at least on a wholesale basis, and whether DT's announcement in the second quarter of 2009 that it would open its VDSL network on a wholesale basis is a way of staving off alternative investments or diffusing the regulatory pressure from the European Commission. Perhaps as part of its new strategy to share and spread risks of next generation deployment, perhaps in anticipation of the ECJ's invalidation of the regulatory holiday, DT had entered into access agreements to its VDSL network with Vodafone/Arcor and United.

DT's final major competitor, United is the second largest broadband provider. It became so purely by reselling DSL that it bought under very favorable terms from DT between 2004 and 2006. While it is

difficult to know with greater precision, the circumstances suggest that DT created those terms so that it could reduce its above-90% market share in the face of potential regulatory pressure. The timing of DT's initial offer of wholesale rates to United is consistent with the negotiations over the German revision of the telecommunications law. The facts that two years later, in 2006, BnetzA found that DT's terms to United were discriminating against smaller competing ISPs, and that when the discrimination was eliminated United began to shrink, while unbundling-based offers took off, are similarly suggestive. Today United is trying to expand again by reaching resale agreements with Arcor as well as continuing to resell DT services, and by buying up smaller resale ISPs.

### *Lessons from France and Germany*

Germany and France present markedly different stories on the role of regulatory engagement and open access obligations, although recent changes in Germany suggest that they may be converging for first-generation broadband technologies, but diverging on next generation connectivity. Both countries had politically powerful, entrenched incumbents. Both countries began the 2000s with relatively weak performance in broadband. Both were prodded into action by the European Commission in 2002-2003 (although there is good reason to believe that this was also internally driven in the French case). France in fact turned around and created an effective regulatory regime that forced FT to open its networks to competitors. These innovative entrants—Free and Neuf Telecom in particular—entered the market aggressively, investing in multiple access technologies, building customer base quickly, and rolling out innovative marketing packages. Germany faltered, permitting the incumbent to delay through court actions and bureaucratic foot dragging. This appears to have created investment uncertainty for its competitive entrants, and limited the primary entry possibilities to relatively large regional providers. Germany began the year 2002 with double the level of broadband penetration per 100 inhabitants that France had. By 2006 France had slightly overtaken Germany by that measure. France is among the countries in the first tier of speed availability, with 100Mbps service available from four firms. Germany is in the second tier, with offerings of 50Mbps characterizing the top range available to residential subscribers. More generally, advertised and actual speeds, as measured from the end-user side (though not using Akamai's measurements), are higher in France. Average advertised prices in Germany are substantially higher across every category of service, from very low speeds to very high speeds. While the countries' regulatory framework began to converge for first-generation broadband technologies, it remains quite distinct for next-generation connectivity. On the other hand, Germany appears poised to take advantage, after long delay, of its much larger deployed base of cable penetration in a way that France is not. Whether Germany's current stance on open access for next generation facilities will survive EU challenge, and if so, which of the two effects will dominate—the access approach in France, where cable plays a very small role but access is being transposed to the next generation, or the facilities-based approach that Germany appears to be favoring for the next generation transition—remains to be determined and merits observation over the coming years.

Let us be clear: Germany is not in a crisis. Its size and wealth allow it to grow and expand its Internet capabilities nicely relative to much of the rest of the world. Indeed, Germany's penetration levels have grown to a point that in 2007 it outpaced the United States in penetration per 100 inhabitants. Germany's fast Internet residential offerings are every bit as fast as those available in the United States, and prices in Germany are lower than in the United States in every category of service except the very slowest speeds. Together these have meant that Germany's standing in our benchmarking study is better than in the penetration rankings more often used. Looking at the first generation transition, however, France presents a more attractive profile of competitive entry than does Germany, which it outperforms in every category of interest, and considering next generation transition, the two countries continue to serve as an important point of observation.

In conclusion we can summarize the core lessons:

1. Contrary to arguments occasionally made in the United States, former government monopolies, just like private companies, have resisted regulations intended to ease entry by competitors likely to compete away their rents. This resistance comes from both management and unions.
2. Formal adoption of a given regulatory arrangement is not the end of the story. Effective engagement by a regulator, and effective implementation, are critical.
3. Lowering entry barriers by requiring the sale of facilities seems to enable different kinds of entrants than a purely facilities-based market. As in the case of Softbank, the French arrangement attracted entrepreneurial entrants that introduced radically new service models. The German approach, which limited entry to companies able to build their own facilities, seemed to produce more conservative entrants, which had a smaller impact on the market.

#### **4.8.2 United Kingdom: From access to functional separation**

In 2001, the United Kingdom's per household and per inhabitant penetration was one-seventh the level of penetration in the United States at that time. Starting from a low level, it is unsurprising that Britain's growth rate was faster, but in the first half of 2005 Britain still had slightly lower levels of penetration than the United States. Since the beginning of 2006 Britain has overtaken the United States in penetration, and is now ranked in the second quintile in both per 100 inhabitant and household penetration. On the negative side, while BT is planning investments in new, next generation fiber infrastructure, currently the UK does not have significant fiber to the home or very high speed DSL service. Its sole source of very high speed service is its sole major cable provider, Virgin Media, at 50Mbps.

The UK began its liberalization process earlier than any other country except the United States. Under the government of Prime Minister Margaret Thatcher in the 1980s, Mercury Communications Limited was licensed as a competitor to British Telecom (BT) two years before AT&T was broken up here. For the next decade, Britain had a formal duopoly. The theory behind this arrangement was that having only one competitor to the incumbent BT would allow it to build market share and develop the force necessary to challenge an incumbent as powerful as BT. A more open market would, it was thought, result in several new entrants, none of which would have the necessary scale. In 1984 Oftel, Britain's first independent telecommunications regulator, was created. In 1991 the duopoly policy was reviewed and abandoned. In 1995 Oftel reached an agreement with BT for accounting separation and interconnection, which had their most immediate effect on international calls competition based on access to BT's facilities in 1996. Between 1998 and 2000, Oftel issued a series of reports, and managed a series of consultations, related to the terms under which BT would offer wholesale access and unbundling. Initially, Oftel and BT were planning to include only wholesale access, but in response to the EU process that later produced the 2002 Directives discussed in the context of France and Germany, Oftel expanded the process to encompass local loop unbundling as well.

The unbundling process initially involved substantial consultation and negotiation. First, a one-year process of consultation from late-1998 to late-1999 resulted in an Oftel policy statement on access to bandwidth, slated to take effect 18 months later, in July 2001. The interim period was used for industry groups to meet and negotiate terms, locations, and methods of managing orders, with Oftel's apparently intensive engagement in facilitating the process. During 2000, the operators tried to negotiate the pace and locations at which collocation and unbundling would occur; BT invited offers, and then firm offers, and negotiated prioritization and locations of servicing these offers. Despite this persistent effort to

facilitate agreement, industry actors in fact failed to agree on the program. Oftel found that it was forced to step in and make specific determination on points of disagreement. When some of the promised entrant offers did not materialize, the industry groups, with Oftel's active engagement, tried to restructure the locations targeted for roll out so as to assure a sufficient level of offers at relevant locations. By April 2001, the managed process of introduction of unbundling was suspended.

Oftel had found itself drawn in to levels of intervention in unbundling that it had not experienced or needed in other matters since the mid-1990s.<sup>187</sup> In 2002 and 2003, the British parliament passed two laws to reform British telecommunications law and its regulatory structure, creating the new Ofcom and defining its powers.<sup>188</sup> Ofcom began a process entitled the Strategic Review of Telecommunications in December of 2003, which it concluded in September of 2005. Its conclusion radically changed the legal demands on BT.<sup>189</sup> At that point, BT signed a binding undertaking that placed the United Kingdom in a class of its own in terms of regulatory strategy. The undertaking imposed functional separation between BT's wholesale inputs business—that is, the business of selling those aspects of its network that are only used by telecommunications carriers—and its retail operations. The undertaking created Openreach, whose operations were separate from BT's, and which was under the obligation to deliver equal access under a concept called: “Equivalence of Inputs” (EOI). When Openreach delivers inputs—such as network elements—to other parts of BT, it must do so using the same systems, under the same terms, with the same timescales, as they provide them to all other non-BT carriers. This strategy is now being widely considered in Europe, and has since been adopted in New Zealand, Sweden, and Italy, has been functionally implemented in the Netherlands, and more recently was announced in Australia.

Functional separation is intended to serve two functions. First, it creates a discrete unit whose incentives are simply to sell network inputs to whoever wants them. Because of the separation, it is expected to be neutral—in the business interest sense—among its customers, and should have less incentive and latitude to favor BT over the competitors. Second, it is easier to monitor and benchmark its transactions, because these all occur at arms length—both with non-BT parties and with BT. The combined effect of the shift in incentives and ease of monitoring is expected to make a functionally separated network management unit a good remedy for a recalcitrant incumbent.

Following and in anticipation of this decision, several ISPs moved to increase their broadband capabilities relying on unbundling. In 2005, TV giant BSkyB bought the Easynet Group, offered free broadband to all its satellite TV subscribers and began to invest in and expand its LLU-based offerings. By 2009, it had close to 12% of the UK market, which it served by using close to 1200 unbundled exchanges. Tiscali UK began to migrate its wholesale broadband customers to unbundled networks in 2005 as well. In 2007 it expanded by buying Pipex Communications, and now has over 8% of the British market, and is in the midst of being purchased by Carphone Warehouse, a deal which will make the latter Britain's largest competitor to BT. Carphone Warehouse, as its name suggests, began its way as a reseller of mobile phone products, and later expanded as a reseller of fixed telephony capacity. In December of 2005 Carphone Warehouse bought Onetel, a broadband provider owned by a British energy company. It also bought the UK assets of Tele2 from Sweden. In October of 2006, Carphone Warehouse bought out the UK operations of AOL. Throughout this period Carphone Warehouse had been investing in building up unbundled local loop capacity, and by March of 2009 78% of its customers

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187 All this from the 2002 OECD paper on regulator reform in telecomms in UK.

188 The Office of Communications Act of 2002 created Ofcom, and the Communications Act of 2003 defined its powers.

189 Indeed, the former director of Oftel was quoted at the time as having said that “had 'he realised earlier that BT was playing a long game' he would have 'handled local loop unbundling differently,’” and would have been “more directive” (Fransman 2006, p. 189).

were served using combinations of its own investments and unbundled loops. In total, Britain's competitor-entrants who based their service on unbundled elements make up the largest components of the British market, for a total of over 36% of the broadband market. Moreover, the initial expansion of competition, followed by consolidation to a smaller number of more sustainable entrants, follows precisely the pattern that the Schumpeterian model of competition in this kind of a market would identify as desirable. BT is second with 27%. Another 23% are served by Virgin Media, which consolidated several cable competitors and offers coverage to about 50% of UK homes over its cable system.

In its May 2009 review of the results of functional separation, Ofcom underscored several results it viewed as pertinent.<sup>190</sup> At the most basic level, the price of a basket of residential broadband services decreased by 16% per year between 2005 and 2007. Local loop unbundling became much more efficiently provisioned. In the third quarter of 2005, just before the introduction of functional separation, competitors were leasing 200,000 lines under LLU. By the end of 2008 that number had risen to 5,500,000 and accounted for one-third of all fixed broadband connections in Britain. LLU, which, recall, is the mode of sharing infrastructure with competitors that calls for more co-investment on the part of the competitors than wholesale or bitstream access, grew in part at the expense of bitstream access. During that three year period the number of houses in Britain that had access to at least one competing LLU-based operator rose from 40% to 83%, and these competitors were investing more in being able to take advantage of the newly-available network elements. BT, in turn, had announced new investments of 1.5 billion GBP in upgrading its network to next generation access services to deliver 40Mbps service to 40% of British homes by 2012. The Ofcom review is comprehensive and professional. It addresses consumer and business market uptake and satisfaction, as well as investment patterns by both incumbents and entrants. Given these results, Ofcom decided to retain the core features of its 2005 decision, with continuous monitoring and relatively small-scale course corrections and targeted adjustments.

From the perspective of the potential role of cable as a source of market competition, the British example provides an interesting contrast to the experiences of the U.S. and France. Unlike France, Britain has a significant cable network. It could, in principle, have been a candidate for regulatory abstention in the name of an effort to support intermodal competition between cable and telephone infrastructure. Instead, Ofcom chose a "both" approach. It enabled competition over the telecommunications/telephone network through unbundling, implemented by functional separation, while also preserving an opening for cable competition. The result has been a three- or more way competition in parts of the country covered by Virgin Media, and a two to three way competition in other parts where BT competes with one or two unbundled providers. Britain's other major cable company, Cable and Wireless, had a couple of false starts in cable broadband, but has not emerged as a major source of broadband alternative service in its service areas. It is unclear to what extent Virgin Media is emphasizing services over Cable and Wireless facilities in those parts of the country in which it did not own cable plant, relative to upgrading its own infrastructure for higher speeds, although it appears to be doing some of both.

The UK experience raises various questions. It is fairly clear that aggressive investment to build capacity to use unbundled loops followed the introduction of functional separation in the third quarter of 2005. It is clear that this period of investment introduced new competitors, increased penetration, and decreased prices. It is also clear that cable offered a competitive alternative as well, although the UK firms have been late, by comparison to other countries, to introduce very high speed services. Whether the application of a similar open access regime to the cable infrastructure would have encouraged cable

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190 Ofcom. Impact of the Strategic Review of Telecommunications. May 2009.

to expand earlier, or whether it would have deterred investments, remains a matter of speculation. It is also a matter for speculation whether BT's failure to invest in fiber infrastructure until the most recent announcements and the relative unavailability of very high speed services in the UK are vindication of the theory that unbundling deters investment, or whether Virgin Media's and BT's current investments in the face of very robust competition from entrants vindicate the idea that robust competition from entrants drives the facilities-based players to seek to differentiate themselves with even higher-capacity offerings. What is clear is that, while BT opposed unbundling and functional separation until it was forced to separate, the company has become a convert—supporting the benefits of functional separation as an affirmative business case, allowing it to be more flexible and free of utility-like lumbering as far as the more dynamic, services portion of its business goes, while freeing the utility portion from the pressures of the more competitive parts of the business at the same time.<sup>191</sup>

### *Lessons from the United Kingdom*

- Unbundling and open access are difficult to enforce
- Functional separation is a potential solution to this difficulty. It requires less direct monitoring of, and intervention in, the day-to-day operations of the dominant incumbent
- The introduction of functional separation had a much more significant effect than the introduction of formal unbundling without effective enforcement

### **4.8.3 Italy: Low penetration, low prices, high mobile broadband**

Italy has been relatively slow in achieving wide broadband adoption. It has among the lowest penetration rate per 100 inhabitants in fixed lines, and even lower standings in terms of per household penetration. On the other hand, it has low prices in every category of service, according to both the OECD price study and our own independent study, except that there are no very-high speed offerings in Italy. The difference may reflect the highly regionalized development of Internet service in Italy, with the highly urbanized, wealthy centers of the Northwest and Rome having higher levels of penetration and competition, and the majority of the country having poorer access.<sup>192</sup> Italy also has the highest rate of mobile phone penetration in the OECD (although this number is skewed by the high use of pre-paid accounts, which are counted on a per-account as opposed to a per-person basis, and there is therefore well over 140% penetration). It has the fifth highest level of 3G penetration, although it was fourth in 2008, overtaken by Iceland this year, and the several countries right behind it had 3G penetration growth rates that were much higher than Italy's.

Italy has no cable market to provide a source of facilities-based competition. Telecom Italia has 60% of the broadband market. Swisscom subsidiary FastWeb (13.4%), and independent entrants Wind (12.6%) and Tiscali (4.8%) are the other competitors of discernible size. Italy introduced unbundling formally in 2001, but revamped its structure, improved enforcement, and allowed for partial unbundling with the passage of the Electronic Communications Code in September of 2004, which was Italy's effort to implement the EU Framework Directive and other access directives. The regulated rates for unbundling in Italy are among the lowest in the world, and are almost as low as the rates in South Korea and Denmark, in terms of PPP. Wind explicitly emphasizes its reliance on unbundled loops. It accounted for

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191 Cecilia Kang, *British Telecom Chairman Says Open Access Key to Broadband Growth* (2009), [http://voices.washingtonpost.com/posttech/2009/05/british\\_telecom\\_chairman\\_rake.html](http://voices.washingtonpost.com/posttech/2009/05/british_telecom_chairman_rake.html).

192 Antonelli and Patrucco (2006).

1.04 million unbundled DSL lines out of the 1.38 million unbundled DSL lines that Telecom Italia sold in 2008. Wind has its own national fiber-optic network, and metropolitan area fiber networks in 39 cities. Although Wind currently provides no fiber-to-the-home services, it has announced plans to invest in fiber-to-the-home service. It is less clear what the precise mix of own- and unbundled facilities is for Tiscali. FastWeb has concentrated on building an alternative infrastructure, focusing on business customers first (who accounted for 60% of its total sales in the first quarter of 2009). It had rolled out infrastructure in 100 towns in Italy by the end of 2006, where it offers DSL and FTTH. It is unclear how much of its subscriber base is served by using Telecom Italia's infrastructure. Its core model relied on cherry-picking the highest density areas, and doing so with fiber to the home in particular.

The Italian regulator began to consider whether to impose functional separation on Telecom Italia in 2006, in order to improve the quality of competitors' access to its facilities. In February of 2008, Telecom Italia announced its plans for functional separation to preempt regulatory action.<sup>193</sup> It was not until the end of 2008 that Agcom approved the details of the proposed separate division, Open Access.<sup>194</sup> At the same time, Agcom approved an increase in the rates for unbundling, although even these new, higher rates, remain among the lowest in the OECD. It is therefore too soon to tell whether the new arrangement will have any effect, and if so, in what direction. Looking forward to next generation deployment, FastWeb has indicated that it has agreed with Telecom Italia to build out in coordinated fashion, and to share their networks rather than install redundant capacity. This is consistent with Swisscom's strategy in Switzerland, as we describe below. All of these announcements and changes are, however, too recent to permit measurement of their effects.

Italy, then, presents an interesting case study with mixed results. Facilities-based competition is coming not from a relatively low-cost incumbent that already has access to ducts, like an incumbent cable or electric company, but from the cherry-picking strategy of FastWeb, which focuses on serving businesses and high-density urban areas. Price competition in residential markets is therefore more likely to be coming from the lower cost competitor, Wind. This level of competition seems to be enough to keep prices at a low level, although penetration remains low as well. The other interesting story about Italy is on the wireless side, to which we will return in the next part. A major puzzle remains why Italy's levels of penetration are so low despite its low prices. Clearly, low prices are not enough and other demand side factors are important. One likely possibility is that the national numbers mask highly differentiated outcomes in a country with regions with very different levels of economic development and urban concentration. One might speculate that mobile broadband is more consistent with Italian culture of urban street life, which would account for both the high uptake of mobile broadband and the low uptake of fixed. This would also be consistent with Spain's similar pattern of low fixed, high mobile, broadband penetration. But such a conclusion, without further research, is mere speculation.

#### **4.9 Regulatory abstention (and hesitation): Switzerland, New Zealand, and Canada**

The major alternative path to implementing some form of open access or unbundling was to explicitly commit to abstain from doing so. Regulatory abstention would be justified on the basis that it secures investment incentives for incumbents, who would know they can invest in building out their networks without risk of being forced to share the benefits of their investments with competitors. This has been the path taken in the United States since the fall of 2001. This was the path taken, most aggressively and purely, by New Zealand from the late 1980s until 2006. More tentatively, but with greater success, this

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<sup>193</sup> <http://www.globalinsight.com/SDA/SDADetail11538.htm>.

<sup>194</sup> TeleGeography, *GlobalComms Database*, country profile: Italy.

is also the path that describes the Swiss experience. Neither Switzerland nor New Zealand implemented unbundling throughout most of the first generation transition to broadband. Both switched to unbundling and some form of open access in 2006-2007. In New Zealand's case, this was from a sense of failure of the policy. In Switzerland's, the move was the culmination of a long regulatory battle, which ended in introduction of unbundling after Switzerland had already done well, under its first generation policy, along dimensions of penetration and pricing. Switzerland has now implemented unbundling, and Swisscom has now developed an innovative model for sharing the costs and benefits of investing in upgrading to fiber-to-the-home, in some measure it seems in response to new municipal fiber efforts in several municipalities and cantons, and in some measure in response to investments by some of the smaller cable companies that seem to be transitioning to fiber, rather than to DOCSIS 3.0. We include a discussion of Canada in this section, even though Canada is not a case of regulatory abstention but of regulatory hesitation. In Canada's case, this meant that unbundling was originally introduced with a limited time horizon and with regulated rates that favored the incumbents. In 2008, the same policy was extended to fiber, but again, with a limited time horizon. During the first generation transition and to this day, Canada has had some of the highest regulated rates for unbundling anywhere in the OECD. Because of these features, Canada looks like a case where the concern for incumbent investment incentives, without quite reaching to the level of abstention, resulted in a weaker version of unbundling than was implemented in many of the other countries we reviewed here.

#### **4.9.1 Switzerland**

Switzerland has the fourth highest level of penetration per 100 inhabitants; its position in per household penetration is lower, at 8<sup>th</sup> for 2007, the last year for which there are full numbers. It has relatively low prices for medium and high speed, but higher prices for low speed offerings and a middling price for its very high-speed offering. Switzerland ranks in the second quintile of OECD countries for median measured speeds. In mobile cellular broadband, 3G penetration is in the third quintile. Switzerland is a leader in nomadic access and hotspots, sharing with Sweden a much higher level of penetration than their next-best competitors, the UK and France. In our aggregate measure, Switzerland ranks 5<sup>th</sup>.

Broadband was launched in Switzerland by Cablecom, which currently occupies 19% of the market. (Other local smaller cable companies constitute 1% of the market.) Cable's entry into broadband forced Swisscom to introduce DSL technology in 2001. Cable continues to be the main source of competition to the incumbent in broadband markets. The only other significant competitor, with just under 10% of the market, is Sunrise Communications, which is a reseller of Swisscom DSL. Sunrise is the composite of what until recently were the two primary resellers of Swisscom service: TDC Switzerland and Tele2. After unbundling was introduced in 2007, Sunrise, now owned by Denmark's TDC, began to invest in building unbundled local loop capacity, but between 2001 and 2007 the two companies that make up Sunrise relied exclusively on reselling wholesale broadband capacity from Swisscom. Over the years Swisscom has been highly effective at blocking efforts to require that it open its network up to competitors beyond the wholesale access it was making available to Sunrise and similar, smaller resellers. The history of cable entry, the relatively good performance in all but speed, and the long period during which Switzerland had not adopted unbundling, makes the Swiss case the best evidence in support of the argument that competition between cable and telephone incumbents is sufficient to drive investment, penetration, and a modicum of price competition.

There are two wrinkles in this story of success without unbundling. First, Swisscom is majority-owned by the Swiss Federal government. While the government does not intervene in management decisions, it is very hard to separate out what role the discipline of the market played, and what role the discipline of

potential policy decisions play for a company in which the government holds a majority stake.<sup>195</sup> Second, Swisscom operated under steady efforts to impose unbundling for several years before unbundling was actually introduced. Under those circumstances, it is hard to tell *a priori* whether an incumbent would dig its heels in, resist entry, and extract rents for as long as it is able to hold out, or whether it would provide greater openness to competitors and better services, so as to establish the point that the proposed regulation is unnecessary. Our other case studies mostly suggest that the incumbent can be expected to resist entry, rather than try to behave more competitively, but it is at least possible that some of Swisscom's strong performance is explained by efforts to reduce the pressures to regulate it. Such behavior would be consistent with, for example, Deutsche Telekom's apparent offers of unusually good wholesale rates to reseller United, which helped DT reduce its market share during consideration of the new telecommunications law in Germany, and DT's touting of its current VDSL network voluntary agreements with Vodafone/Arcor and United as part of the German debate over open access to next generation networks. Despite these potential confounders, in particular the unusually large stake the Swiss government continues to hold, Switzerland does represent the one significant example of high performance under inter-modal competition not complemented by open access during the first broadband transition.

Swisscom's current plans to invest in upgrading to fiber seem to be driven not by the introduction of unbundling in 2007, which is not applicable to fiber, but by a combination of DOCSIS 3.0 upgrades by cable companies, fiber investments by some of the smaller cable companies, and early decisions by municipalities to raise funds publicly and build FTTH networks in Zurich over the state-owned utility, ewz network (March 2007), in St Gallen (February 2008 pilot, February 2009 final approval), and in several smaller localities, which are designed to offer Internet service providers an open access FTTH infrastructure. This version of the story of next generation investment in Switzerland lends qualified support to the theory that intermodal competition is sufficient to spur investment, insofar as it relates to the DOCSIS 3.0 and cable investments in fiber, but adds the nuance that competition from public investment also has a potential role to play. However, given that extension of unbundling to fiber is very much a live regulatory debate in Switzerland, and that part of the debate also encompasses expanding the powers of the regulator more generally, it is again somewhat less clear cut of a case than it otherwise would have been. It is possible that Swisscom's current fiber strategy in some measure represents an effort to preempt further municipal investment; it may be an effort to reduce the risk of regulation by presenting a more attractive profile as a responsible dominant player that acts cooperatively without the need for direct *ex ante* regulation.

Irrespective of what combination of forces precisely is driving it, Swisscom's response to the challenge of transitioning to next generation connectivity has been an innovative and interesting one. While it has not been implemented yet, it has been announced and is apparently being piloted and negotiated currently. The idea is to share the large part of the cost—the civil engineering and fiber laying part—by pulling four fibers to every home over the same civil engineering project. Swisscom would keep one or two fibers and provide access to the others in one of four ways. First, owners of ducts, like cable companies and the municipal electric utilities, could each role out similar four-fiber plants in different areas, and then exchange capacity so that each one would own and control a fiber into each home

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195 For example, when Swisscom was moving towards acquisition of Eircom Group in 2005, the Swiss Federal Council instructed its representative on the Board of Directors to vote against this acquisition, and it was abandoned; Swisscom may not issue shares that would dilute the government's share to below 50%; and as part of its strategic goals, Swisscom is required to create specifically long-term shareholder value. All these mean that, at a minimum, Swisscom operates with much more "patient" money than do fully private companies responsive to pressures for shorter-term shareholder returns. Particularly in the context of long-term investments like Fiber-to-the-Home, this makes Swisscom's position quite different from that of other telecommunications firms that are historically private, or were more completely privatized in the recent past.

throughout all of the areas connected. If the networks were of largely similar size, they would not pay each other—much like peering arrangements in Internet carriage. Second, companies without their own ducts and construction capacity would have the option of sharing the deployment risk by paying up front for a fiber into the home which, upon completion, would become theirs. Third, companies without ducts or up-front cash could later buy access on a distinct passive fiber, which would give them control equivalent to what they would get from unbundled access over copper. And fourth, companies that didn't want any of this could just buy active fiber high speed connectivity capacity wholesale, and resell it to subscribers. The critical idea here is that by pre-positioning distinct, excess passive infrastructure, competitors could credibly commit to share the highest fixed-cost, most future-proof elements in an architecture that would then be hard for them to manipulate anticompetitively. They would then use this architecture to draw investment and spread the cost and risk of next generation deployment. Needless to say, this is not a test that has been run, but it does present an interesting model that is distinct from both the public private partnerships we see in some Swedish and Dutch municipalities, and the functionally-separated single platform provider based on the UK model. Because the Swiss case presents particularly interesting possibilities for transposition to the US context, as with the Dutch model, we offer a more detailed and complete case study of the Swisscom four-fiber model at the end of this chapter, as part of the section on transposing access to next generation connectivity.

#### 4.9.2 New Zealand

The other country that self-consciously chose not to impose unbundling regulations was New Zealand. New Zealand completed privatization of its nationally-owned incumbent in 1989, and decided not to impose sector-specific regulation, relying instead on general competition law to prevent anticompetitive abuses. Because of its unique approach, it was cited in the late 1990s as a unique example of right-thinking regulatory policy, which depended on the idea that market-driven competition would deliver the goods once regulators simply got out of the way.<sup>196</sup> The desired beneficial results of competition in a liberalized market were not quick to follow. By 2001 New Zealand did decide to implement a sector-specific regime. This new regime, however, was a very reticent one. As late as December 2003 the Commerce Commission in New Zealand explicitly decided not to impose unbundling on Telecom New Zealand, arguing that the cost and risks outweighed the benefits. The only source of competition was TelstraClear, the New Zealand subsidiary of Australian Telstra, which depended on developing its own hybrid fiber-coaxial plant—that is, on cable—and on a non-regulated resale agreement it reached with New Zealand Telecom that allowed it to expand its coverage from its cable customers to a national footprint. The results of this market structure and regulatory approach were not spectacular. From 2001 up to and including the end of 2006, New Zealand's broadband penetration ranked 21<sup>st</sup> or 22<sup>d</sup> in the OECD, ahead of Mexico, Turkey, Greece, the states that had joined the OECD after being set free of the communist bloc—Poland, Hungary, the Czech Republic and the Slovak Republic—and Ireland.

In April of 2006 the New Zealand parliament decided to change direction, proposing new legislation that would impose unbundling requirements on New Zealand Telecom. In November the legislation was further revised to require that the company functionally separate its carriage from its retail services. The new telecommunications law implementing these requirements passed in December of 2006. The network now is subject to unbundling, and Telecom New Zealand has separated into three divisions: Chorus, which is responsible for network infrastructure and upgrading to next generation connectivity, and Telecom Retail and Telecom Wholesale. In anticipation of this legislation, TelstraClear reversed its 2005 statements that it would withdraw from its plans to invest beyond its existing service areas. (One might assume that the 2005 announcement was itself intended to add political pressure to change the

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196 E.g., Bell, Tom and Solveig Singleton, eds. *Regulators Revenge: The Future of Telecommunications Regulation* (Cato Institute 1998).

regulatory regime.) While TelstraClear originally worked with cable infrastructure, by December of 2008 about 70% of TelstraClear's customers were DSL subscribers. Vodafone, New Zealand's largest mobile phone provider, acquired iHug, a competitive DSL provider, in October of 2006, and began to offer triple-play bundles (fixed, broadband, and mobile) at discounted rates with its mobile offerings. In January of 2008 TelstraClear concluded a new fiber ring on South Island, connecting the island's main towns with its fiber backbone.

These investments by Vodafone and Telstra along with the improvement in New Zealand's penetration ranking suggest that the regulatory shift had its intended effect. Between December of 2006, when the new law was enacted, and December of 2008, when the OECD last reported penetration levels, New Zealand's ranking in penetration per 100 had jumped from 22<sup>d</sup> to 18<sup>th</sup>, surpassing that of Austria, Italy, Spain, and Portugal. We do not have similarly fresh data on changes in per-household penetration, although in 2006, when New Zealand was 22<sup>nd</sup> in the per-inhabitant ranking, it was 16<sup>th</sup> in per-household rankings, just behind the United States. We do not have sufficiently comparable household penetration data to establish whether New Zealand saw a similar relative improvement in its ranking in per-household penetration, although one market analysis suggests that it did not.<sup>197</sup> During the period between 2006 and 2008, New Zealand also had by far the largest increase among OECD countries in speeds offered by an incumbent.<sup>198</sup> Prices, on the other hand, dropped only very slightly. We do not have sufficient historical data to compare New Zealand's current performance on our more balanced, multidimensional benchmarks. Like the UK in 2005, separation of network from information services was a critical component of New Zealand's strategy for dealing with a recalcitrant and politically effective incumbent that successfully resisted competition over its network. And, as with the UK in 2005, performance relative to other OECD countries that had not made a similar shift at the same time improved appreciably, at least along the dimensions of penetration per 100 inhabitants and advertised speed.<sup>199</sup>

### 4.9.3 Canada: Regulatory hesitation and a robust facilities-based alternative

We close our access-related case studies with Canada, a country that appears to have made a half-hearted commitment to unbundling. It was a very early broadband adopter, relying primarily on facilities-based competition between cable and incumbent telephone companies. As early as 2000, broadband subscriptions were already 31% of all Internet subscriptions.<sup>200</sup> As of December of 2003, Canada had the second highest level of Internet penetration both per 100 inhabitants and per household in the OECD, second only to South Korea. At that time, there were 1.3 cable broadband subscribers for every DSL subscriber.

Upon declaring that it is imposing unbundling in 1997, the CRTC announced that it would phase out unbundling by 2002. The theory was that the pending removal of the regulatory crutch would lead competitors to invest in their own facilities, but would not deter them from entering the market in the first place. The CRTC also used a price determination method that was different than the approach used by other regulators, relying not on long run incremental cost, but on incremental cost plus a 25% markup to allow the incumbents to make a profit on their unbundled loops. The theory was to avoid investment disincentives to the incumbents. By 2001, however, unbundling was not being adopted. The CRTC then

197 <http://www.reuters.com/article/pressRelease/idUS153081+18-Jun-2009+BW20090618>.

198 OECD Communications Outlook 2009, Figure 7.12.

199 On our more diverse set of measures, New Zealand does not show up as a particularly strong performer; because we do not have a pre-2006 measurement, however, it is hard to use our measures to show movement between 2006 and 2008, and the relatively old data on households would also tend to mask positive effects of the policy change.

200 CRTC Communications Monitoring Report August 2009). pages 213-226.

extended unbundling indefinitely. In 2002, it cut back the markup on pricing to 15%, keeping the same price setting methodology. In 2008, the CRTC completed a comprehensive review and decided to extend its unbundling rules, and apply them to fiber as well. Again, this determination was intended to be phased out, just as the original implementation had been.<sup>201</sup> In December 2009, the Federal Cabinet sided in favor of the incumbents on two appeals from prior CRTR decisions. The Cabinet confirmed one CRTR decision and overturned another, taking decisions that appear to effectively exempt next-generation networks from unbundling requirements.<sup>202</sup>

The Canadian market is largely typified by facilities-based competition, not by unbundled access. The major players are the former telephone incumbents: Bell Canada (22.4% of the market) and Telus (12.1%), and the major cable companies: Rogers (17.7%) and Shaw (17.8%) in different parts of the English speaking provinces, and Videotron (11.5%) in Quebec. In recent years both the residential and business markets for Internet access seem to have undergone consolidation, with incumbent telecommunication service providers and large cable companies picking up market share at the expense of both new entrants and early efforts reportedly made by incumbents to operate outside of their traditional geographic regions.<sup>203</sup> In August 2009 the CRTC reported that revenue shares for all Internet access captured by all entrants (including residential and business; dial-up and broadband; and non-incumbents and out-of-territory incumbent TSPs) declined from 23% in 2003 to 12% in 2008.<sup>204</sup> While out-of-territory incumbent TSPs have never had a presence in the residential market for high-speed Internet access and only a small presence in the market for residential dial-up access,<sup>205</sup> their revenue share in the business market for Internet access declined from 13% in 2004 to 10% in 2008.<sup>206</sup> During this same time period, the revenue share of non-incumbent TSPs in the business market also declined, from 31% to 24%.<sup>207</sup> The share of residential Internet access subscribers, both dial-up and high speed, captured by all entrants, both non-incumbents and out-of-territory incumbents TSPs, has also declined, from 16% in 2004 to 8% in 2008.<sup>208</sup> The entrants' share of high-speed access (at or above 128kbps) in 2008 was even smaller at 5.5%, though had risen slightly from 4% in 2004.<sup>209</sup> These numbers seem to suggest that as dial-up access phases out, some subscribers of entrants are remaining with non-incumbent broadband, but some are shifting to incumbent telecommunications and cable companies, resulting in greater overall market and subscriber shares in the residential market relative to new entrants, and incumbent providers operating out-of-territory. This consolidation in the residential market

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201 CRTC 2008 decision.

202 CBC News, December 11, 2009. "Open Access Rules Take Hits"

<http://www.cbc.ca/technology/story/2009/12/11/clement-internet-access-bell-telus-mts.html>

203 Jerry A. Hausman and J. Gregory Sidak, Did Mandatory Unbundling Achieve its Purpose: Empirical Evidence from Five Countries, MIT Econ. Working Papers No. 04-40, where the authors note the ILEC entry into each other's territories as a hopeful direction for investment in facilities based competition. See at p. 60

204 CRTC Communications Monitoring Report 2009, p. 214

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

205 See CRTC Telecommunications Monitoring Report 2006, p. 59, Table 4.4.7

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2006/tmr2006.pdf>); CRTC Communications Monitoring Report 2009, p. 218, Fig. 5.3.1

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

206 CRTC Telecommunications Monitoring Report 2006, p. 58, Table 4.4.6

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2006/tmr2006.pdf>); CRTC Communications Monitoring Report 2009, p. 218, Fig. 5.3.1

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

207 See CRTC Communications Monitoring Report 2009, p. 217, Table 5.3.1

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

208 CRTC Communications Monitoring Report 2009, p. 215

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

209 CRTC Communications Monitoring Report 2009, p. 219, Table 5.3.2

(<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

has its parallel in the business market, as incumbent telecommunications providers, who had ventured out of their traditional areas at least for business connections, seem to be retrenching in their own historical territories, while other entrants have lost market share, largely to cable companies.<sup>210</sup>

It is not entirely clear why Canada, despite its implementation of local loop unbundling, has seen so little competitive entry by comparison to other countries that we studied. It is certainly possible that the very early market presence of strong incumbents, in two technologies, crowded the market and deterred investors. It is also possible that Canada's rate regulation approach made a difference. Looking at 2008 data as reported by the OECD, Canada's commitment to a cost-plus-markup approach is uncharacteristic of other countries, where long run costs as well as less crisply defined concepts like “cost orientation plus reasonable profit” (Netherlands) are used. The result, in any event, is that by comparison to high performers for which the OECD reported data in the Communications Outlook 2009, Canada's rates for local loop are high. As of September 2008, the monthly price of an unbundled local loop in Canada, excluding prices for remote areas or the most dense downtown areas, in terms of PPP, was roughly 70% higher than in South Korea and Denmark, almost 50% higher than in Italy, 30% higher than in Japan, France, or Norway, and 25% higher than in Finland or the UK. Indeed, Canada has the highest monthly charge for access to an unbundled local loop of any OECD country. Combined with the presence of strong incumbents and the Canadian regulator's practice of promising to sunset the requirement of opening access to core facilities—originally copper loops, now fiber—it is possible that the investment environment is too expensive and too uncertain for entrants.

The presence of strong facilities-based competition should have, however, obviated concerns about the state of Canadian broadband policy. The CRTC indeed opens its August 2009 Communications Monitoring report with a self-congratulatory reference to the fact that Canada has the highest level of penetration of all the G7 countries. While factually true, an alternative view of Canada's performance might look at several factors. In December of 2003, Canada had the second highest level of broadband penetration per 100, second only to South Korea. By September of 2008, it ranked 10<sup>th</sup> by the same measure. Its numbers on speed and price are worse. In terms of top speeds available, Canada ranked 19<sup>th</sup> in the OECD. In terms of prices, Canada ranks 21<sup>st</sup> for the lowest speeds and 23<sup>d</sup> for middling speeds. It ranks next to last in prices of high speeds (only the Slovak Republic has higher prices in that tier of service), and it does not appear in the OECD rankings for prices of very high speeds, because there were no offerings of service speeds of 35Mbps or higher in Canada in September of 2008. Our own, broader pricing study with some more recent updates, shows that both Videotron and Rogers do now offer next-generation level speeds, at 50Mbps speeds, and that Rogers's offer is similar to the high US prices, while Videotron's is more in line with the mid-range prices of the Netherlands and Denmark.<sup>211</sup> Our company-level pricing study for the highest-speed offers in the countries we observe here locates all of the Canadian companies but one in the cluster with the slowest speeds and highest prices. Given these benchmark measures, the lessons of the Canadian experience do not seem as positive as the CRTC report presents them. On our composite measure, Canada occupies the 19<sup>th</sup> spot. Early aggressive facilities-based competition certainly made Canada an early starter, but it does not seem to have enabled it to maintain its standing. Indeed, the decline in its standing in its best-performing measure, penetration per 100 inhabitants, was worse over this period (2<sup>nd</sup> to 10<sup>th</sup>) than was the decline of U.S. performance by that measure over the same time period (10<sup>th</sup> to 15<sup>th</sup>).

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210 *Compare* CRTC Report to the Governor in Council: Status of Competition in Canadian Telecommunications Markets 2005, p. 62, Figure 4.4.1 (<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2005/gic2005.pdf>), with CRTC Communications Monitoring Report 2009, p. 218, Figure 5.3.1 (<http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2009/2009MonitoringReportFinalEn.pdf>)

211 The Videotron offer appears in our firm-level study of next generation oriented offerings at the end of this Part, but is not part of the benchmarking exercise because Videotron is not a top-4 provider in the Canadian market.

#### 4.9.4 Lessons from Switzerland, New Zealand, and Canada

- Switzerland's experience suggests that, under the right conditions, a country can do well without enforcing open access regulations. This conclusion is somewhat muddled by the fact that Swisscom is majority owned by the Swiss government, and to some extent by the fact that it operated throughout much of this period under the threat of regulation.
- The purest form of regulatory abstention was attempted in New Zealand for over a decade and a half. It was considered a failure there, and was reversed 180 degrees in 2006. Early results of the reversal seem to have been quick and positive.
- Both countries that have been the longest standing proponents of regulatory abstention, Switzerland and New Zealand, have now shifted to adopt unbundling.
- In looking forward to the next generation transition, New Zealand is relying on functional separation, while Switzerland's incumbent has developed an innovative voluntary arrangement to share the cost and risk of fiber deployment while securing to competitors access to the new facilities. This approach depends on joint investment in the civil engineering side of the deployment, building substantial over-capacity (four separate fibers to each home) which can then be physically divided among the participating carriers, and virtually divided with later-introduced competitors.
- The Canadian experience suggests, consistent with the experience of the larger European countries, that formal adoption of unbundling is insufficient to achieve competition. In Canada, formal unbundling was coupled with regulatory uncertainty introduced by the threat of sunset, and high regulated rates.
- Like the United States, Canada relies primarily on its strong cable/telecom facilities-based competition, rather than on unbundling-based entry. Its performance has lagged over the past few years, and it is now a third and fourth quintile performer in speed and price, and dropped from first to second quintile on penetration between 2003 and 2008.
- The Canadian experience suggest that reliance purely on competition between strong cable incumbents and strong telephony incumbents may be insufficient to sustain high penetration or achieve high capacity and low competitive prices in the long term.

#### 4.10 Firm-level price and speed data for next generation offerings

Our focus throughout this qualitative analysis of the effects of open access has been on the role of particular firms: incumbents, open-access-based entrants, or cable and other facilities-based competitors. We emphasized the ways in which different firms responded to different regulatory interventions, and how each affected the other firms in its market. Here we offer another look into the behavior of firms, through objective measures of price and speed offered. We particularly focus offerings that are farthest along in the transition to next generation connectivity: the highest-end speeds offered by 78 firms in the OECD, primarily in the 15 countries whose experience we described in detail in this part.

We use company level data reported in the Communications Outlook 2009, as we did in Section 3.6. To these data we add independent pricing data obtained from the *GlobalComms Database* maintained by TeleGeography and the Point Topic dataset, as we did in Section 3.6. (For a more complete methodological description see the pricing annex to this Part). We analyze these data sets at a firm-level

resolution. In our benchmarking measurement we took the best prices for the highest-speed offerings in each country, restricting our observations to the four largest providers by market share. This allowed us to identify what the majority of subscribers in these countries in fact see as the range of prices for high-speed offerings available to them. Here we expand our observations to include all companies offering very high speed offerings (that is, over 35Mbps), from both the OECD and our own datasets, and added from our own research the best, highest speed offerings from all U.S. providers with more than 2 million subscribers. We did this because the datasets included a relatively sparse set of US-based offerings, and these were very high priced, and given our particular focus on the US lessons we wanted to make sure that we were comparing other prices to real US prices. This biases the results somewhat in favor of the U.S. providers, because we were able to include offers from more US companies, and to find better offers, than those that were available purely from looking at our datasets. Although the results are therefore somewhat biased in favor of the U.S. companies, they nonetheless allow us to offer a more fine-grained comparison of the relative speed and price offerings of individual companies, which together make up the aggregate. Moreover, the scale is skewed against showing the extraordinarily high performance of K-Opticom, and had we used the method we used for the U.S. firms, we would have a similar offer, slightly lower priced, from KDDI. So the graphic presentation of our data understates the degree to which the low-price, high-speed characteristics of the Japanese market's best offerings outperform the other firms in our dataset.

The data is presented in a graph so that the bottom left hand corner is where slower, more expensive offerings will arise. The upper right hand corner is where faster, cheaper offers are found. These are the two diametrically opposed basins of attraction. The upper left hand corner is where companies that compete primarily on price, not on price-speed combinations, will show up. However, this portion of the graph masks the fact that many of the companies that appear in the upper right hand corner would also appear as very competitive on the upper left hand corner, if we included their lower-tier, slower offers as well as well as their highest-speed offerings. In other words, being “higher” on the left hand than on the right does not mean you really are cheaper across all offerings, only that you do not even have a very high speed offering, and your best speed offering is cheaper than the best very-high speed offering elsewhere.

What we find is, unsurprisingly, that companies, rather than technologies, compete. And companies compete against their national competitors, not against hypothetical best performance feasible given a technology. Even though we use newer U.S. data, we find that if we draw a line running from the Y-axis to the X-axis through the offers of Time Warner Cable and Cox, we find to the left and below that line almost all North American companies, except Telus, which has cheaper moderately-high speed offers, Videotron, which has a moderately priced 50Mbps offering, and Cablevision, which has a high-priced 101Mbps offering. AT&T, Verizon, Qwest, Comcast, Charter, Time Warner, and Cox, from the U.S., and Bell Canada, Shaw, and Rogers, from Canada are joined by the Norwegian companies (except NextGenTel), KPN, the Dutch incumbent,<sup>212</sup> and M-Tel, the Hungarian incumbent, in the lower left triangle that marks high prices and low speeds. All the North American companies below and to the left of that line are incumbent telephone companies and incumbent cable companies functioning in a regulatory system that relies exclusively or primarily on inter-modal competition.

At the other end, we see a natural separation between a middle swath of performers and the cluster of firms that offer high-speed, low-priced offerings. The latter group, in the upper right hand corner, includes several countries that have most of their major players in that corner: Japan, France, Finland,

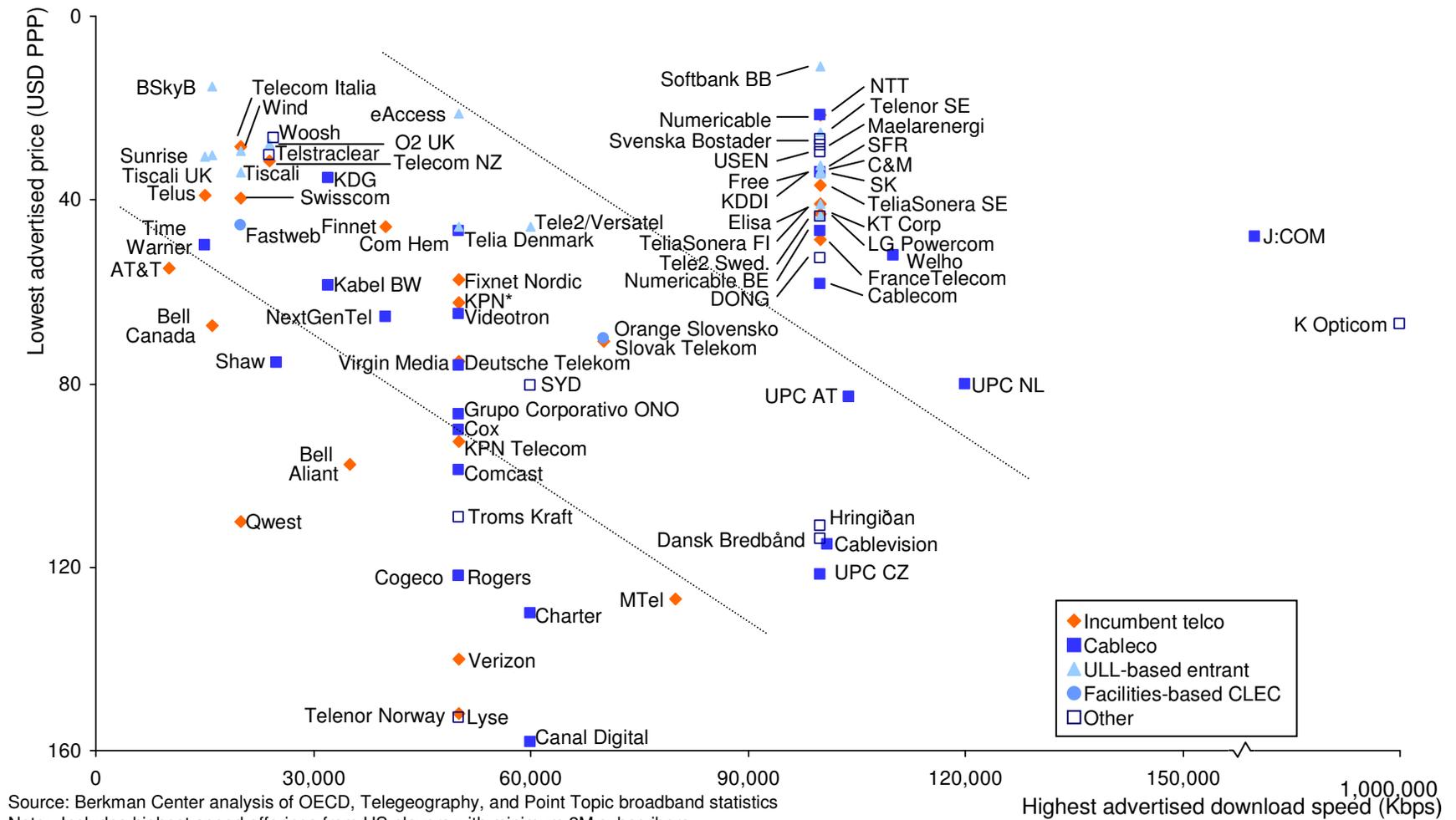
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212 This is a clear instance where our methodology biases the result in favor of US companies. Looking at KPN's current offerings over Reggefiber, as we did for US companies, would have resulted in KPN's shifting locations to roughly where Cablevision is on Figure 4.4, outside the bottom left triangle.

Sweden, and South Korea, as well as countries that have one representative company each in that quadrant: the Swiss, Dutch, and Belgian cable broadband companies, and a Danish power company. For France, we see unbundling-based providers Free and SFR alongside their incumbent provider France Telecom and cable competitor Numericable. For Japan, we see unbundling-based Softbank offering identical offerings to its incumbent, NTT, joined by KDDI and Usen that seemed to mix existing infrastructure (electric utility and cable, respectively) with unbundling, cable company J:COM offering 160 Mbps and K-Opticom offering 1GBPs at moderate prices. Next we see unbundling-based Telenor Sweden and Tele2 Sweden, and although in our dataset TeliaSonera Sweden does not join them, using the same technique we used for the U.S. firms, TeliaSonera Sweden would have showed up, in its offerings through buildings and municipalities, roughly where TeliaSonera Finland appears. Incumbents TeliaSonera Finland and Elisa are collocated in that corner, as is Finnish cable provider Welho. South Korean entrants SK, LG Powercom, and cable provider C&M all show up in the upper right hand corner, although KT appears not to be meeting their price/speed offerings.

The pattern appears to be clear: Firms compete in national markets. The majority of companies that offer the highest prices for the lowest speeds in our dataset operate in countries that rely on inter-modal competition: the United States and Canada, alongside most of the Norwegian companies. Companies that are in the upper right corner of the graph hand all function in countries that either clearly enabled some of these particular competitors through effective enforcement of open access—Japan, France, Sweden, and Finland—or in South Korea, which enforces open access but where the companies making the offerings do not rely on it. There is also a single offer from each of Switzerland, the Netherlands, Denmark, and Belgium, but although these countries all have an open access regime, none of the offers are from open access-based providers, and they are the most expensive within this set of high performing companies (e.g., the Dutch cable broadband offering from UPC, the fastest among these, is almost twice the price of the faster Japanese cable broadband offering from J:COM; the 100Mbps offering from Numericable Belgium is twice as expensive as Numericable’s French offering of the same speed, and it is the lowest-priced cable broadband offering among the Belgian, Dutch, and Swiss cable companies each of which is the sole representatives of its country in this part of the graph.). The open access countries saw firms adopt unbundling as an entry strategy, and these firms today continue to exist, directly or through successor firms, and continue to offer high speeds at low prices. The difference between offerings of telecommunications and cable providers France Telecom and Numericable, or NTT and J:COM, on the one hand, and Verizon, AT&T, and Qwest, and Comcast, Charter, and Time Warner, on the other hand, may well be the catalytic role played, as we describe in the case studies, by access-based providers like Free and SFR (Neuf Cegetel), or Softbank and KDDI.

Figure 4.4. Best price for highest speed offering



## 4.11 Looking forward by looking back: Current efforts to transpose first generation access to the next generation transition

Several assumptions about the next generation transition and how it is different, and solutions to transposing the experience of the last transition to the next, are emerging in Europe, Japan, and South Korea. In Europe, the need to share a coherent view, so as to coordinate regulatory responses across national agencies that are independent of each other, has resulted in a particularly crisp analysis by the European Regulators Group (ERG). The ERG is an EU-created body of national regulatory agencies (NRAs) that coordinates among all the national regulatory bodies of the member states, as well as those of the non-EU EFTA countries and countries on the EU accession list. It produces annual best-practices reports, and its decisions inform the European Commission's implementation and enforcement decisions on questions of communications policy. In other words, although it is not itself a regulator, its decisions reflect the collective experience of its members, and have direct influence over the body that does have enforcement power over the national regulators. The need to communicate among the regulators and with the Commission requires the ERG to produce explicit, coherent analyses, and make its work a particularly valuable source of insight. We anchor our description of current lessons being learned and applied by other countries in the ERG report on Next Generation Access from June of 2009, and supplement it with particular national examples as well as with, in particular, the Japanese and South Korean experience on mobile. Note that this section describes current thinking in these countries. We do not offer our own opinion as to the substance or desirability of these assumptions or solutions. We include and emphasize in this description two voluntary models for sharing risks and costs of deployment of Fiber-to-the-Home, those of Swisscom and KPN-Reggefiber in the Netherlands. We do so because we think that from a US perspective, models that rely on voluntary infrastructure sharing offer a particularly attractive model, at least for initial exploration.

### 4.11.1 Assumptions

Following is a list of assumptions that are currently stated in the ERG and several of the European national reports, with additional focus on ubiquity from Japan:

- a) The costs of deploying will be high; and investment will entail risk. The shift to next-generation networks, in particular fiber-to-the-home, underscores that the high fixed cost characteristics of physical communications networks have not been repealed. The temporary relaxation of that assumption caused by the relatively low cost upgrade paths of copper and cable networks is no longer descriptive of FTTH networks.
- b) Facilities-based competition is good, but even where it exists should be combined with service/wholesale and mixed (unbundled-like) models of investment and service competition to impose market discipline on network owners.
- c) Fiber networks have several diverse topologies, some more conducive than others to “deep” competition, that is, competition based on investment in electronics connected to physical infrastructure on the unbundled model. Where topology is not conducive to such deep competition, service-level, or wholesale models of access, like bitstream access, must be assured, and potential abuse curbed.
- d) Finding models of spreading risk, sharing costs, or absorbing it publicly are productive avenues for pursuit in the construction of next generation networks. This might include public investment, particularly of the form of local level public private partnerships, or various

approaches to sharing investment and infrastructure among competitors.

- e) Ubiquity requires integration of fixed, mobile, and nomadic networks. This supports permitting greater vertical integration between fixed and mobile networks, coupled with greater access regulation.

#### **4.11.2 High cost**

Putting new infrastructure in place, particularly replacing current copper plant with fiber is expensive. Much of the expense is in relatively low-tech “civil engineering” work: digging trenches, locating ducts; getting into homes. The cost of the fiber itself, and of the electronics, is minuscule relative to the cost of the low-tech, high labor components. Coupled with the extremely high capacity of fiber networks, European future-oriented analyses are concerned that economies of scale and scope make investment in multiple redundant networks risky and potentially unjustifiable even in many urban areas. The concern is more starkly expressed for higher-cost areas, with a potentially smaller number of subscribers to justify the cost. This suggests in current analysis by the ERG that, while facilities-based competition is in principle desirable, because it limits the dependence of competitors on another's infrastructure and the relative effectiveness of regulation to prevent abuses, competition over shared facilities will play at least as important a role in next generation networks as it did in the first transition. For example, as we see below, Reggefiber’s actual cost of deployment is relatively cheaper than in other countries, because of the low cost of digging in Dutch soil, and nonetheless requires a 45% penetration to return the investment over a period of 8 or more years. Such a cost structure is inconsistent with having both a competitive market and a market occupied solely by players who can afford the price of building their own facilities. Even where 45% penetration, rather than, say, 60%, is necessary to justify the investment, markets will not support more than two players. The ERG therefore suggests that the benefits of competition, even over an incumbent's facilities, are considered sufficiently important to justify the potential dampening effect on the rate of roll out. Ofcom reached a similar conclusion in its super-fast broadband report. Given the high entry barriers on the one hand, and the benefits of service-level competition on the other hand (whether or not one considers the case for unbundling and access regulation established by the studies presented here, European regulators quite clearly do treat the case as established), European countries are aiming their sights on how to extend the same basic lesson they learned in the first generation transition from dial-up to broadband to the transition from broadband to next generation networks.

#### **4.11.3 Topologies**

Current European plans focus on three topologies used to roll out networks that count as “next generation.” The difference between them depends on (1) how close to the home the fiber gets, and (2) the extent to which capacity is shared among multiple subscribers.

Where fiber is drawn from the local exchange only to a cabinet in the neighborhood, and the rest of the way is distributed by copper, this topology is called Fiber-to-the-Cabinet (FTTC). Its maximum speeds are slower, and it is effectively a version of DSL with the fiber pulled closer to the home, and the copper loops shortened. It offers the architecture that is cheapest for the incumbent to deploy, provides the lowest speeds, and is the least future-proof. The degree to which it is hard or easy to open up to competition on an unbundled basis depends on certain physical features, such as the size of the neighborhood cabinet. To the extent that it is physically difficult to locate the equipment of an entrant in the neighborhood, this architecture leaves entrants in a position more akin to resale than to unbundling in terms of their ability to invest in the network and retain control over critical aspects of the subscriber's

experience. It is in large measure seen as an interim measure, to pull higher-speed capacity closer to the neighborhood and the home, as part of an incremental, long-term upgrade to fiber all the way to the home.

Two topologies already pull fiber all the way to the home. The first is point-to-point, where each home has its own dedicated fiber optic cable to the point of presence (POP). In Amsterdam, for example, this means that 10,000 homes are connected to a single POP, each by its fiber, with symmetric capacity. (This may change as Reggefiber takes over from Amsterdam CityNet, because Reggefiber has been deploying point-to-point networks connecting about 3000 homes per pop.) This is the most flexible architecture in terms of deploying future network upgrades, because it allows electronics to be changed in a single location, without additional civil engineering expenses, both for large numbers of households at a time and on a per-household basis. It is also the most competition-friendly for the same reason, because it allows competitors to connect at various places and add their own innovative electronics more readily, for each individual subscriber, at a relatively central location. The second is passive optical network (PON), where shared fiber capacity is again pulled to the neighborhood, but instead of distributing it through copper, the shared capacity is fed into an optical splitter in the neighborhood and then split into individual fibers going into each home. Each splitter might serve anywhere from as few as 8 to as many as 128 homes. It is seen as an intermediate solution between FTTC and point-to-point full fiber connections. PON networks are more difficult to unbundle because the optical splitters are usually buried in the neighborhood, making the cost of collocation and unbundling at the relevant point much higher per-subscriber (distributed between 8 or 32 subscribers, instead of among 10,000). An October 2009 study conducted by Analysis Mason for Ofcom identifies seven different models of making GPON architectures amenable to unbundling, and finds several of these either immediately feasible or feasible within three to five years, given expectations about developing standards.<sup>213</sup> The European discussions, influenced by a September 2008 report to Ofcom by Britain's Broadband Stakeholders Group, generally assume that PON networks are about five times more expensive to deploy than FTTC networks, while point-to-point networks are yet an additional 15% more expensive than PON networks.<sup>214</sup> Experience with the Amsterdam CityNet network suggests that the difference in price between PON and point-to-point networks is more contingent on the particular availability and history of existing plant, and that the British report was based on assumptions about reuse by Openreach of certain BT facilities. We have not made an independent cost analysis to distinguish between these claims, although we do note that the important difference—the much higher cost of FTTH over FTTC—is not disputed, and that a difference of 15% in cost may be insufficient to change a policymaker's preference between two topologies, if the one that costs 15% more is indeed a thirty-year infrastructure that is both more competition-friendly and more future-proof.

As we describe below, Reggefiber is built on a commercial real-estate model, whose revenue is optimized by making it easily accessible to as many “tenants” as possible. It is therefore deploying a point-to-point topology. Both Reggefiber’s own experience and that of Amsterdam CityNet confirm the British Broadband Stakeholders Group report explanation that the overwhelming portion of the cost is in the physical, lower-tech portions of the work. That project calculates that the cost of fiber was about 8%-9% of the total costs, other materials, such as for ducts, were another 18%, and the remainder were labor. Unsurprisingly, in more densely populated, multi-dwelling units areas, like city centers, the proportion of labor for indoor wiring is higher, and the inverse is true in less dense areas for smaller houses. In France, where deployment is primarily in urban areas, and the in-building wiring is to be shared between competitors, France Telecom has chosen to deploy a GPON topology. Iliad/Free, on the

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213 Analysis Mason. GPON Market Review: Competitive Models in GPON, Initial Phase. 26 October 2009 Report for Ofcom.

214 ERG (17) 2009, pp. 7-8.

other hand, is deploying point-to-point topology in very similar geographic areas, lending support to concerns that the choice of PON topology may be driven in part by efforts to hamper competitors' use of the incumbent's network; although it may also be explained by a different time horizon that the companies take in how future-proof to make their networks.

The core points on topology are:

- Fiber-to-the-home, whether PON or point-to-point, is about five times more expensive than FTTC, VDSL, or hybrid fiber coaxial cable architectures
- Which topology is chosen affects the relative ease of permitting competitors to enter with their own electronics, as opposed to by depending more heavily on active components owned and managed by the incumbent
- FTTC and PON are both architectures that are less amenable to sharing facilities over time; the cost difference between PON and point-to-point likely exists, but does not appear to be large.
- It appears that, in the short to medium term, PON, like point-to-point, will be technically amenable to unbundling, so while the choice is significant, it does not appear to be irreversible.

#### **4.11.4 Reducing or sharing the costs of future proof, more competitive topologies**

An important part of the discussion in Europe revolves around how to reduce redundant investment in the civil works aspect of fiber deployment—the digging up of streets and the like. The UK study for the Broadband Stakeholder Group estimated that street works account for 75% of the cost of PON deployments, and 80% of point-to-point deployments.<sup>215</sup> A major part of European efforts is aimed at reducing or sharing those costs and the risks associated with investing such large sums in a new technology with unproven (though predicted) demand. (In South Korea and Japan, this problem was approached in part through substantial government subsidies. Japan in particular also enjoyed entry by electric utilities, whose existing infrastructure was characterized in the UK report as reducing the civil works costs of fiber to the home deployment by 23%.<sup>216</sup>)

##### *Public-private partnerships.*

An important part of the strategies for investment in fiber infrastructure has been the implementation of public private partnerships. In Sweden, government funds in municipalities support requisitioning of open access networks, with a preference for private provisioning and services over municipally-requisitioned dark fiber and ducts, but with a safety valve for municipal investment in case no companies want to light up the fiber. A similar model is developing in many places in France, not least following the example of Hauts de Seine, whose then-Chairman of General Council, Nicolas Sarkozy, proposed subsidies for a public-private rollout in that wealthy part of Greater Paris. A similar public-private model, Amsterdam's CityNet, is on track to become more private than public when Reggefiber will buy new shares in the project that will bring its share in the project to 70%.

An avenue used in Sweden and the Netherlands is a form of customer pre-commitment through local cooperatives, which reduces up-front investment as well as take-up risk. One example described in the UK report is of the town of Neunen, in the Netherlands. Each household in the cooperative pays a one-

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<sup>215</sup> Caio at Figure 2, page 18, and at page 13.

<sup>216</sup> ERG (17) 2009, p. 8.

off commitment/membership fee (20EUR). Each household can then decide whether to buy a connection, which cost 2100 EUR in the original deployments, and whose price was later decreased to 1500 EUR. With a government subsidy of 800EUR to each connection fee, the up front cost to a subscriber was 700EUR, or about \$810 PPP. The government also subsidized the full cost of a subscription for one year. The community contracted with Reggefiber to provide the fiber to the home network. Thereafter, a triple play package cost 39.39 EUR per month. The model aggregates demand, reduces risk to the developer, speeds uptake of subscribership, and directs the rate and direction of rollout to where there is ability and willingness to pay for it. Needless to say, given the role of government subsidies, a different decisional model about where to roll out could be influenced through a subsidy policy. Reggefiber apparently is pursuing similar strategies in the smaller Dutch markets.

*Private joint ventures on an open access model.*

Two primary models are being explored in Europe for joint private investment. We provide more detailed case studies of each of these in the Annex to this chapter. As we saw in the discussion of the Netherlands above, the Dutch model effectively creates a general-purpose separate joint venture for deploying fiber, which would result in a single open access network that would gain its return on investment by selling capacity to competitors. The Swiss model relies on independent players (at the moment, primarily Swisscom and publicly-owned municipal electric utilities) overbuilding complementary parts of the network and then sharing their overbuilt, four-fiber networks between them and with other entrants.

Swisscom is laying out four separate fibers with each deployment, and is inviting three kinds of complementary investments from competitors. The first are in the form of reciprocal four-fiber deployments by other competitors who do have ducts (effectively, the public municipal electric utilities, like those in Zurich and St. Gallen, that have already decided to deploy FTTH networks, and the cable companies that have begun to invest in fiber). These would then be exchanged in a straight, no-cash “my second fiber for yours” trade, allowing each competitor access to its own fiber over the other's deployed infrastructure. If there is substantial imbalance in relative contributions, Swisscom assumes that there can be additional adjustment payments. The second type of competitor investment is in the form of up-front cash contributions by competitors who do not have ducts, but who help reduce Swisscom's exposure in exchange for a fiber of their own. The third entails long-term commitments by competitors who want unbundled access, again, reducing the risk inherent in the investment in exchange for lower wholesale rates over the period agreed. Competitors who want to provide none of these risk- and cost-sharing participations will be able to buy capacity at higher, short-term commitment rates. Enabling this kind of collaboration requires both approval from competition authorities, and oversight to assure that the joint investors do not exclude others, but the over-provisioning is thought to ease that task. The October 2009 Analysis Mason study for Ofcom discusses in some detail the costs and benefits of multi-fiber to the home strategies versus single-fiber to the home strategies, with switchover in a local exchange point rather than at the home. These involve upfront capital costs (slightly higher for multifiber in the home) relative to somewhat higher continuing labor costs and potential for human error with single fiber and switchover at exchange points). Deutsche Telekom too has announced several cooperative ventures with regional competitors along similar lines, although without any claim of making the infrastructure available on an open access model, but strictly sharing it among the original companies deploying the infrastructure. With EWE Tel it will deploy in 4 cities, EWE TEL in 5, and each company will have access to the other's network in all nine cities. Similar projects are under way with local competitors in Aachen and Cologne.

*Regulated deployment and open access for the last drop and in-building wiring.*

The French regulation of the past year has been focused on the cost of the final drop, or last 100 meters, rather than on the cost of middle mile or last mile. Up to the final drop, competitors have access to France Telecom's ducts, pursuant to a regulation passed in July of 2008 by ARCEP.<sup>217</sup> Moreover, France decided to support the move to fiber in its urban areas, Paris in particular, by opening up its sewer system to providers to pull fiber, thereby avoiding much of the civil engineering cost.

In August of 2008, the French legislature passed a new law about final drops. The first part of the law requires developers of new construction to deploy fiber throughout the building or construction, and to make that fiber plant available to all competing operators on a non-discriminatory basis. This takes advantage of the fact that the incremental cost of pulling ducts through a house when it is in construction is much lower than opening walls and pulling wire when the construction is completed. This part of the law is similar to the practice that has been common in South Korea, as we saw, and that the South Korean government facilitated by offering formal public certification programs that certified buildings as “connected” when they were wired for high speed connectivity available to operators. The second part of the law, which has been the subject of consultation and implementation by ARCEP since, involves structured cooperation between competitors. The idea is that the disruption of running multiple fiber plants, at different times, through a building is too great. As a practical matter, that would mean that whoever gets to a building first would have a monopoly over that building unless required to share the facility, because owners would not permit the disruption repeatedly. Building owners in existing buildings therefore have a responsibility, when they contract with a given provider, to provision access to that in-building fiber plant to competitors on a non-discriminatory basis. The competitors share the in-building plant of whichever provider the building owner selected to implement the internal wiring.

**4.11.5 Access for non-investors: Passive and active**

Part of the task of transposing a regulatory regime from copper networks to fiber involves abstracting what it was about the old regulatory regime that worked. As part of this analysis, the Europeans have emphasized the distinction between active and passive access.<sup>218</sup> “Passive” elements are inert pieces of equipment that just carry electronic or optical signals powered, generated, and directed elsewhere. This includes duct access, dark fiber, fiber unbundling in PON and point-to-point networks, in-house wiring and cables, and, where copper is still used for part of the network, copper loops. “Active” services are like wholesale and bitstream access—electronic or optical signals over the passive networks. As with bitstream and unbundled access, a competitor using active components will need to invest less to get up and running, but will have less flexibility to innovate in services and technology. A competitor using passive components will need greater investments, but gain greater flexibility and independence to innovate.

Ofcom's statement on superfast Internet suggests that active access will play an important role in next generation connectivity.<sup>219</sup> Because Ofcom is regulating a functionally separated incumbent, it appears to express less concern with monitoring for abuse, and emphasizes the importance of defining the range of services that need to be included as open access components. These will, according to Ofcom's plans, include a wider range of active products, and Ofcom has used its convening power to get industry players together to negotiate the kinds of active services they need in order to permit and facilitate competition. Furthermore, Ofcom sees passive fiber access and duct access as important elements of a next generation competitive environment. Ofcom gives the companies the freedom to negotiate rates for

217 ARCEP Decisions no. 08-0835 and no. 08-0836 of 24 July 2008.

218 ERG(17) 2009; Next Phase of Broadband in UK;

219 Ofcom Superfast statement pp.

these services, but monitors these negotiations to assure that they permit reasonable rates of return reflecting the appropriate level of risk, as the UK regulator puts it. This idea of a “risk premium” in rates imposed on active and passive elements sold to competitors is more widely considered in Europe as an important consideration in implementing access to next generation networks.<sup>220</sup>

The Dutch regulator OPTA is the first in Europe to impose unbundling of the fiber loop as a regulatory requirement. It also used its power to shepherd through a joint venture of KPN and Reggefiber that would roll out open access networks. The joint venture is the only one outside of Slovenia to aim to roll out a fully point-to-point national network. As we mentioned, this is the topology most conducive to open access and passive product unbundling as well as active product wholesale services, and is most conducive to the commercial real estate development model led by Reggefiber’s majority shareholder, which is indeed a real estate company. France, Portugal, Germany, and Spain have all imposed on their incumbents, but not their entrants, a requirement to offer access to ducts, although current European efforts are to make these obligations symmetrical between incumbents and the newer companies.<sup>221</sup> Spain, like France, has required building owners and the providers they contract with to share in-building wiring. Denmark for now has no separate next generation regulatory treatment, but because the incumbent seems to be rolling out a FTTC or VDSL service, its infrastructure is subject to unbundling like the copper plant built on the same architecture, and it is required to provide access to backhaul services as well.<sup>222</sup> The approach in France and Germany has been to change little for now, but include fiber in the definition of the markets as to which unbundling and bitstream access are required. Vodafone now plans to compete using Deutsche Telekom's VDSL platform on an active-product, or wholesale basis.

Another concern in Europe that is of less concern in the United States involves the transition from unbundled copper loops to fiber. These involve recognition that entrants made substantial investments based on being able to connect to copper local loop, and these investments will be stranded once the incumbent moves to fiber and ceases to maintain the loops. These are treated as transition problems focused on how long the incumbent would be required to maintain the loops and main distribution frames so as to allow the competitors to migrate. Most European countries have required the incumbent to phase out exchanges slowly, giving advance notice, and to provide clear plans to competitors about future roll outs so these can adjust their investment and reinvestment appropriately.

#### **4.11.6 Functional separation.**

Several European regulators have considered functional separation as one potential approach to deal with the likely increased need for access to active components, where competitors' dependence on the provider is potentially high. The UK's positive experience prompted reconsideration of the costs and benefits of such an approach, and not only in New Zealand. The German regulator undertook one such review, but has not adopted it. The ERG issued a cautious opinion on the subject in 2007, cautioning European regulators to consider local conditions, incumbent recalcitrance, and potential effects on investment.<sup>223</sup> In June of 2007 the Swedish regulator decided to follow the example of the UK, and imposed functional separation on TeliaSonera, which has been functioning with a separate access subsidiary since January 1, 2008. The Italian regulator, Agcom, leaned on Telecom Italy to functionally separate its wholesale from retail divisions, and TI indeed, after over two years of negotiations, created a separate open access division. And we have seen that the Dutch incumbent, KPN, has entered into a

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220 ERG (17) 2009 at pp 19-20.

221 ERG(17)2009 p. 23-24.

222 ERG (17) 2009 p. 59.

223 ERG (07) 44.

joint venture that effectively separates it from the point-to-point fiber, open access network that it will build and use. The changes in Sweden, the Netherlands, and Italy are too recent to have yielded observable results, positive or negative. Similarly, it is of course too soon to evaluate the September 15, 2009 announcement by the Australian government of a new law requiring Australia's incumbent, Telstra, to undertake structural separation voluntarily, or force it to undergo functional separation.

#### **4.11.7 Fixed-mobile convergence and access to mobile networks**

The shift to ubiquitous access has, to a substantial degree, led to mergers between fixed broadband firms and mobile broadband providers. In France, SFR, the mobile provider, bought Neuf Cegetel, the fixed broadband service. Free, on the other hand, did not bid on a 3G license, and has instead expanded its reach through its innovative nomadic access sharing approach—where the network interface devices it furnishes its consumers serve also as nomadic access points for all Free subscribers who come within range of each other. In the Slovak Republic, the major investment in Fiber comes from Orange, France Telecom's mobile subsidiary which is the largest mobile player in the Slovak Republic. In Germany, Deutsche Telekom owns T-Mobile, which deploys not only 3G networks but also an extensive network of hotspots. Similarly, in Sweden, Telenor, one of the entrants, has rolled out substantial nomadic infrastructure through its local Glocalnet subsidiary, called Glocalzone. Telenor now bundles access to hotspots in Sweden's 20 largest cities with its mobile broadband offerings on the cellular side. Telenor also bought nationwide WiMax licenses in the 3.6-3.8GHz and in the 2.6Ghz bands in 2007 and 2008.

In Japan, KDDI made this move first, anchored in their au Corp mobile brand and expanding through purchases and alliances to offer fiber and high-speed DSL services as well. Softbank Yahoo!BB bought Vodafone Japan in 2006, creating Softbank Mobile, and recently the MIC is permitting NTT East and West to cooperate with NTT DoCoMo. Similarly, in South Korea, in only the last year the same move occurred in both directions: the largest mobile provider, SKT, purchased the successor of Hanaro; and very soon thereafter, KT, the incumbent fixed telecommunications provider and leader in the fixed broadband market, merged with KFT, the second largest mobile player. Between them the two firms have over 80% of the wireless market and over 70% of the fixed-broadband market. On a more aspirational model, the most recent annual report from ARCEP, in France, sets as one of the rights to be offered to a fourth 3G licensee, should one emerge (earlier efforts to get a 3G fourth provider failed, when Free/Iliad was the only bidder, and it refused to pay the government's reservation price), would be to give the new fourth provider access to the facilities of the existing three 3G operators in France for purposes of collocating its 3G network equipment. In Italy, two of the three major mobile data players, Telecom Italia mobile and Vodafone, have a six year agreement to share access sites for existing and future mobile networks, sharing poles, cables, electrical, and air-conditioning equipment. In Australia, Optus and Vodafone reached similar agreements, as did Telstra and H3G. These latter market-based agreements suggest that infrastructure sharing is valuable even in the lower-cost setting of mobile networks. They raise the question, however, as to whether there is need for regulation to achieve these kinds of sharing benefits in less competitive mobile broadband markets than Italy or Australia.

How one treats this trend depends on whether one focuses purely on high capacity to the home or on ubiquitous connectivity. From the high-capacity only perspective, the trend is worrisome. It would mean that potential competitors are being eliminated through consolidation. In South Korea, for example, the dominant mobile and fixed broadband providers were prevented from bundling their offerings until 2007, because of the concern with reducing competition. If, on the other hand, one is focused on ubiquitous, seamless connectivity, then one sees fixed, mobile, and nomadic access as complements, and sees the kinds of integrations occurring as desirable moves in that direction. No single program reflects that trajectory more clearly than SFR's, which allows SFR subscribers to connect

to data seamlessly, either over their own home network when at home (an approach increasingly used under the term “femtocells” by mobile providers more generally, to avoid the high landline connection charges where wireline providers still charge them), or over their 3G network where no SFR subscriber is within reach, or over the Wi-Fi box and fixed line of any other SFR subscriber, when they are in reach. All of this allows the subscriber to receive unlimited data service over whichever portion of SFR's network is most readily available.

The potential problem, of course, arises when a new entrant faces not only the physical costs of implementing a fixed network, but must effectively bundle mobile data connectivity as well. Japan and South Korea now appear to have extended the solution of open access from the fixed to the mobile arena, although the solution is in an ad hoc mode. In Japan, it mostly took the form of a MIC-arbitrated arrangement between NTT DoCoMo and Japan Communications, allowing the latter to lease circuits and capacity on its mobile network. The MIC has since required NTT DoCoMo to publish standard leasing fees for entrants, although these are largely wholesale entrants, not unbundling-like entrants. In South Korea, because both acquisitions involved dominant players—one in wireless, the other in fixed—the open access requirements were imposed as part of the merger approvals. As a condition of merger approval, both companies must now open their mobile data networks to competitors.

The core lesson from these cases suggests that the shift from a policy focus on high-capacity fixed broadband to the home, to ubiquitous, seamless access, requires two seemingly opposite moves. The first would tend to reduce potential competition by permitting vertical integration between fixed and mobile service providers, thereby removing one avenue for facilities-based competition in high capacity data to the home. The second would tend to increase competition over the small set of discrete facilities-based channels to each subscriber, both fixed and mobile, by opening the entire converged fixed-mobile network to access by competitors: to both the fixed and mobile components.

## 4.12 Annex: Pricing

This annex details the two pricing studies that we carried out: the first as part of the benchmarking exercise in this report (Part 3) and the second as part of our evaluation of the effects of open access policies in Part 4 (Competition and Access). Our benchmarking pricing study sought to validate, complement, and complete the results of the OECD pricing data set using an independent market data set.<sup>224</sup> We found that the data sets are somewhat correlated, but due to the thinness of the data, the analysis is very sensitive to variations between the two sets. As a result we combined the sets to present a fuller picture of the data and compared the results to the original. Our firm-level pricing study for the highest-speed service tier sought to identify the prices and speeds of offerings, throughout the OECD, that are furthest along toward next generation networks in their capacity.

### 4.12.1 OECD pricing data set

The OECD pricing data set includes 631 consumer broadband offerings surveyed in September 2008 from broadband providers in OECD countries.<sup>225</sup> These offerings are categorized based on the speed of the connection: low (256Kbps to 2Mbps), medium (2.5Mbps to 10Mbps), high (10Mbps to 32Mbps) and very high (greater than 35Mbps). We prefer using this approach to describe the pricing data because the OECD measure of price-per-megabit-per-second includes speed as an endogenous factor and, therefore, double-counts the availability of high speed service tiers within the pricing benchmark. Breaking down prices based on tiers provides a more direct representation of the price-to-performance tradeoffs that consumers make than the composite totals do.

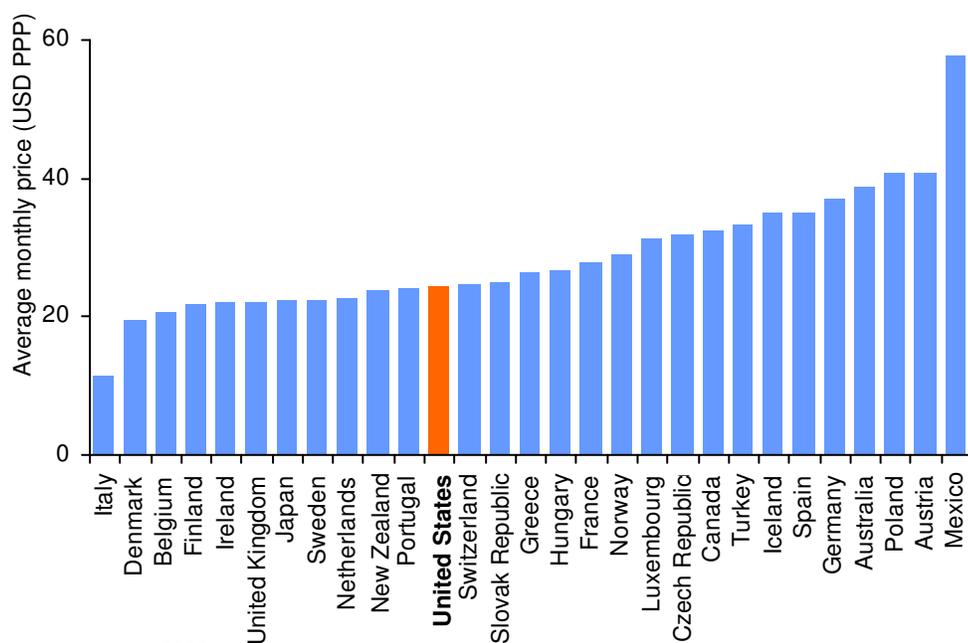
Graphs of the average price from the OECD pricing data set are shown in Figures 4.5 through 4.8. These results are computed using a simple average of all the offerings in the data set for that country in that tier.

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224 TeleGeography *GlobalComms Database*, Point Topic Standalone Tariffs

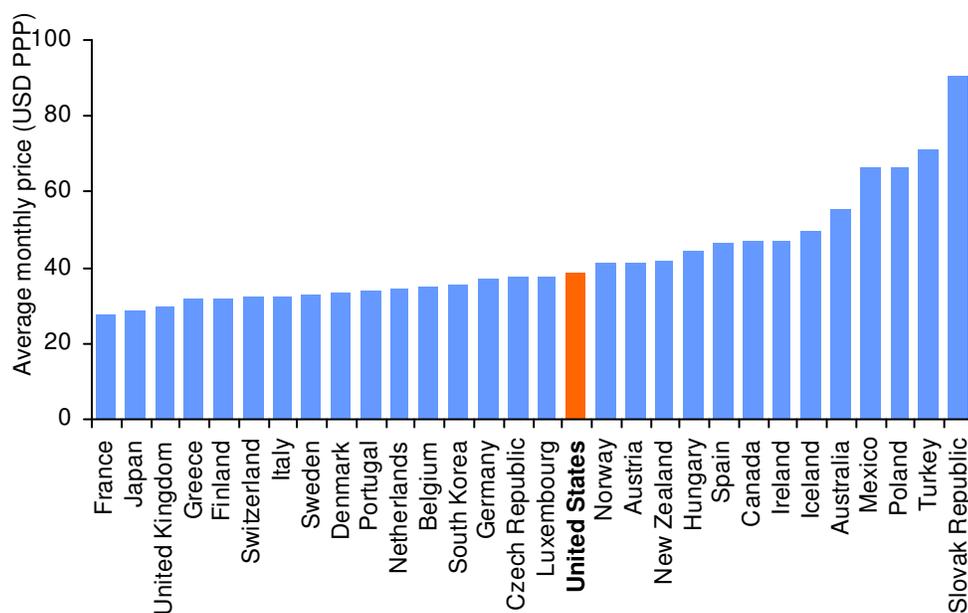
225 OECD *Communications Outlook 2009*. Table 7.4, p 302-309.

**Figure 4.5. Average monthly price for low speed tier, OECD**



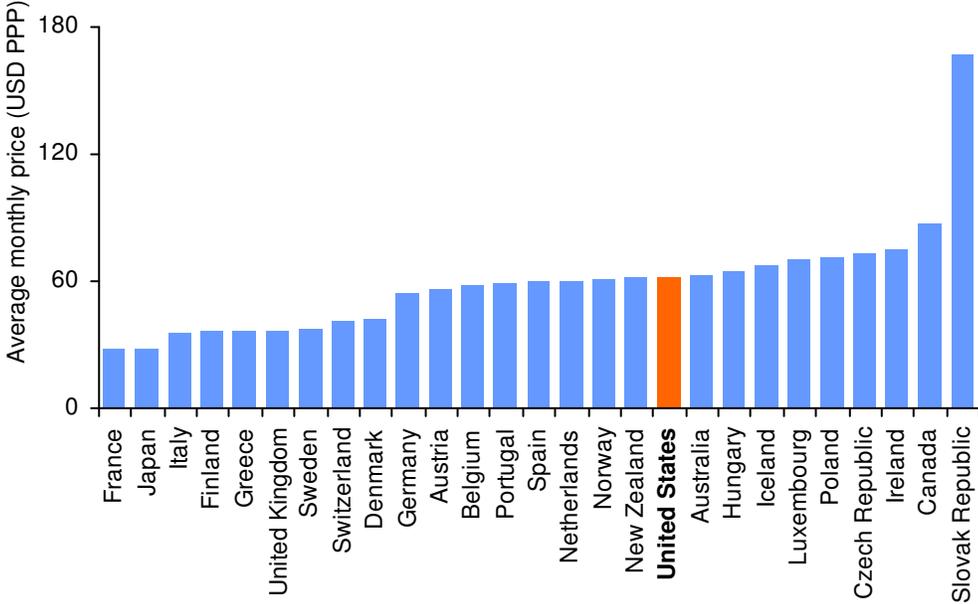
Source: OECD, 2008

**Figure 4.6. Average monthly price for medium speed tier, OECD**



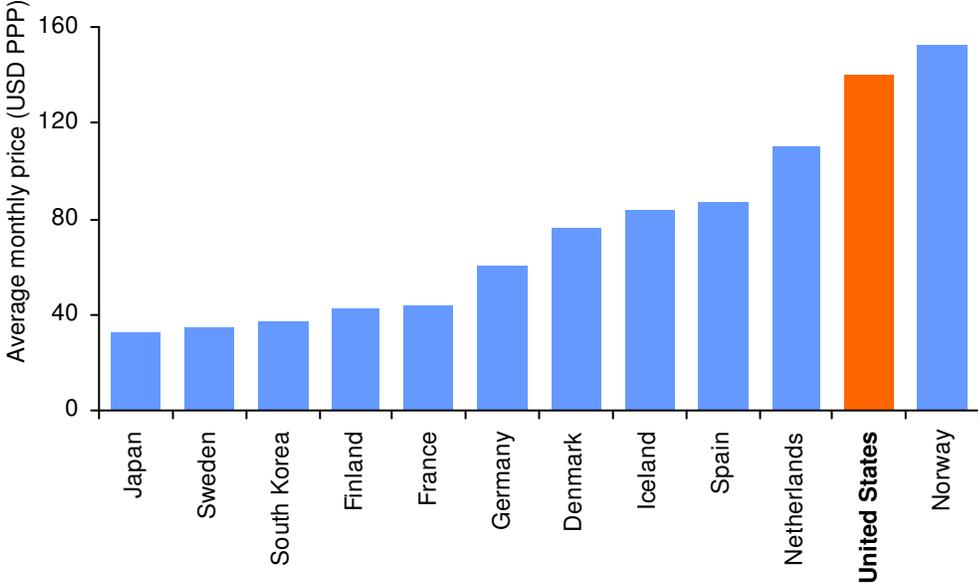
Source: OECD, 2008

**Figure 4.7. Average monthly price for high speed tier, OECD**



Source: OECD, 2008

**Figure 4.8. Average monthly price for very high speed tier, OECD**



Source: OECD, 2008

#### 4.12.2 Berkman study using the TeleGeography data set

##### *Methodology*

The objective of this analysis is to examine, validate, and complement the results of the OECD data set, starting with a review of their methodology and then comparing OECD measures with an independent study. The OECD includes a wide range of providers in their data, regardless of size and market share. Close inspection of the data reveals that firms with a small share of the market have a disproportionate influence on the average price than most consumers would expect based on the number of subscription plans available to them. We constructed an alternative measure that considers only the top four providers from each country. On average these top four providers combined have 80% of their local markets. The United States had the lowest percentage of market covered by those top four at just under 60% of market share.<sup>226</sup> Our analysis takes a straight average of offerings from only those top four providers and disregards the rest.

The second change we made to the OECD methodology was to remove any offerings with data caps of less than 2 GB per month. We chose 2 GB per month as the lower bound because that was the lower end of the data usage rates quoted by U.S. cable firm Comcast as the median monthly usage of its subscribers.<sup>227</sup> The impact of this change in methodology was clear in countries, such as Australia and New Zealand, where caps are a common way to address the low-price market. In these countries we saw entry level prices rise over the original OECD average price, but we believe that these prices are more comparable to prices from other countries where data caps are not prevalent.

We applied this new methodology to the TeleGeography *GlobalComms Database*. This database is a regularly updated set of international broadband statistics, maintained by the widely-cited and long-time industry analysis group TeleGeography, a division of PriMetrica, Inc. The firm states that the data comes from primary sources wherever possible (e.g., the operators), and secondarily from national regulatory agencies, international statistics organizations, and other sources. It covers both wireline and wireless services and is used by companies worldwide to perform market analysis. The data set we constructed out of the TeleGeography database contained 529 offerings from February 2008 to July 2009. We also added to this database a recent offering in the very high speed tier from Comcast in the United States, based on our own research, to reflect the introduction of new offerings based on DOCSIS 3.0 from U.S. cable providers, which were not otherwise reflected in either of the data sets we examined. Including this offering lowered the average price in the United States in the very high speed tier.

##### *Results*

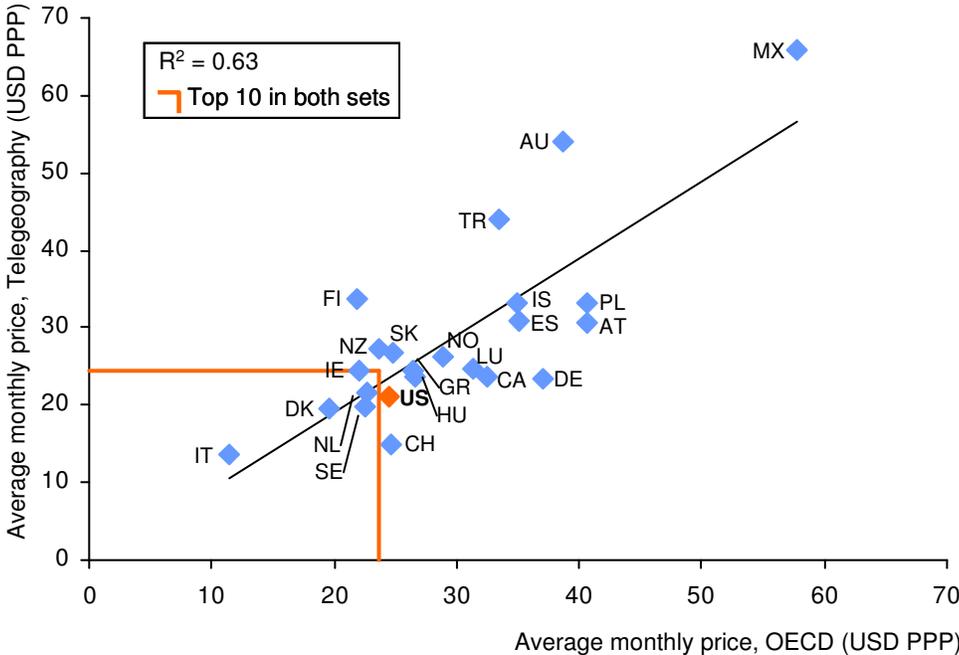
We graphed the two data sets to see how similar or different the resulting averages are, and the results are shown in Figures 4.9 through 4.12.

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226 If we include all the U.S. providers in our dataset, we do get to roughly 80%. Doing so increases the prices for the cheapest and medium tiers by \$11 in each case; and increases the price by \$8 for the high speed tier. It does, however, decrease the price for next generation speeds by \$8. The price decrease does not affect the U.S. standing in the next generation speed tier, as even the lower price is still higher than the next worst country in this tier, Canada. Moreover, if we apply the same methodology to Canada, then prices for Canada also improve, leaving the U.S. trailing further behind in terms of prices for next generation speeds.

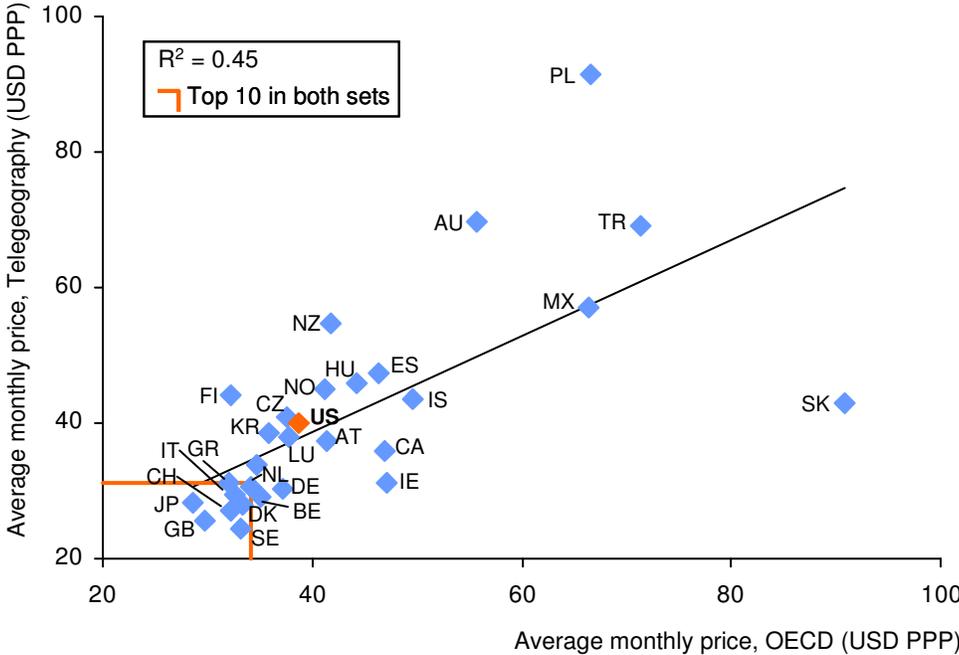
227 <http://www.comcast.net/terms/network/amendment/> (last visited Sept 4, 2009)

Figure 4.9. OECD versus TeleGeography pricing in low speed tier



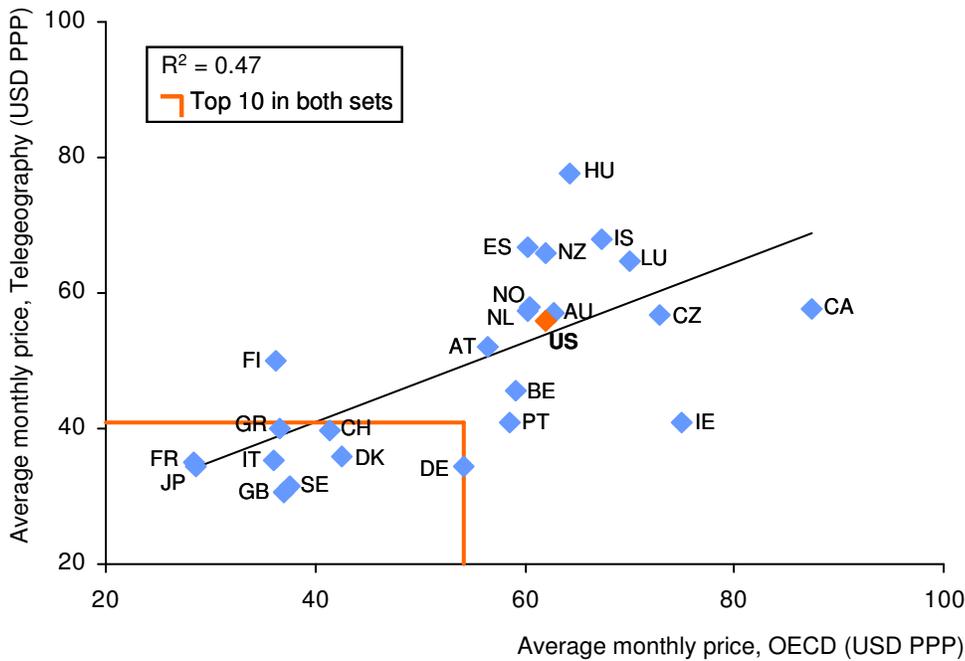
Source: Berkman Center analysis of OECD and TeleGeography broadband statistics  
Note: Belgium, UK, Japan, Portugal are top 10 players in OECD dataset but are not displayed because they lack data in TeleGeography

Figure 4.10. OECD versus TeleGeography pricing in medium speed tier



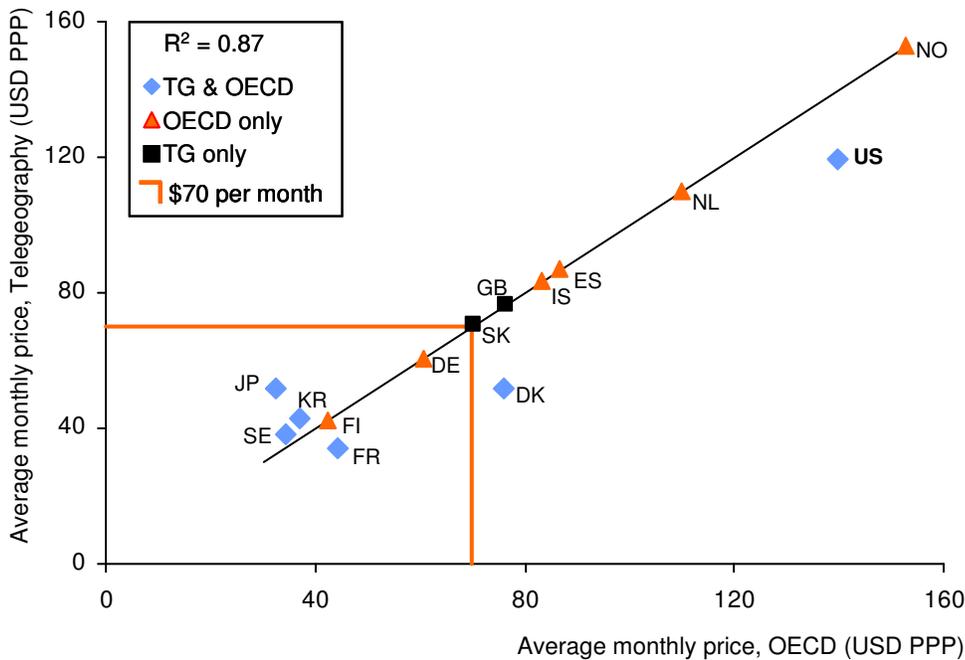
Source: Berkman Center analysis of OECD and TeleGeography broadband statistics  
Note: France is the best ranked player in the OECD dataset but is not displayed here because it lacks data in the TeleGeography dataset

**Figure 4.11. OECD versus TeleGeography pricing in high speed tier**



Source: Berkman Center analysis of OECD and TeleGeography broadband statistics  
 Note: Slovak Republic and Poland excluded as outliers

**Figure 4.12. OECD versus TeleGeography pricing in very high speed tier**



Source: Berkman Center analysis of OECD and TeleGeography broadband statistics

In the low, medium, and high speed graphs, if a country did not have a data point in both data sets, then it was not displayed. For example, Belgium is ranked third in the low speed tier for price, but it does not appear on the low speed correlation graph because, although Belgium does have three data points in the

TeleGeography data set in that speed tier, none of them is from a top four provider. The orange box in the lower left hand corner of each graph indicates the cut-off point for the top ten countries on each axis. In the very high speed graph, because there are so few data points, all of the data points from both sets are shown, and the orange box was drawn at \$70 per month.

Each of these graphs shows differing degrees of significant correlation. The significance of the correlation across the tiers gives us some added measure of confidence in the quality of each of the pricing studies. Some of the variation between the data sets may be accounted for by price changes throughout the time period. Furthermore, although each of these data sets has many data points, with 30 countries and 4 tiers, the average number of points per result in each data set is between 4 and 5. Variation in even a single offering can have a large impact on the resulting average.

Looking at a few countries in particular highlights the sensitivity of this analysis. Finland has a consistently higher average price in the TeleGeography data set than the OECD data set. The OECD data set has many more offerings listed for Finland than does the TeleGeography data set. This includes several offerings at lower speeds and lower prices which pull the OECD average down relative to the TeleGeography average. Additionally, some of the offerings appear to be for the same service but at a higher price in the TeleGeography data set. Poland presents similar difficulties. The TeleGeography data set includes several providers with much higher price points than the OECD data set, which pulls the TeleGeography average up relative to the OECD average. In Switzerland, TeleGeography has a low speed offering at just \$3 per month which drops the average from \$20 to \$14.

#### *Key take-aways*

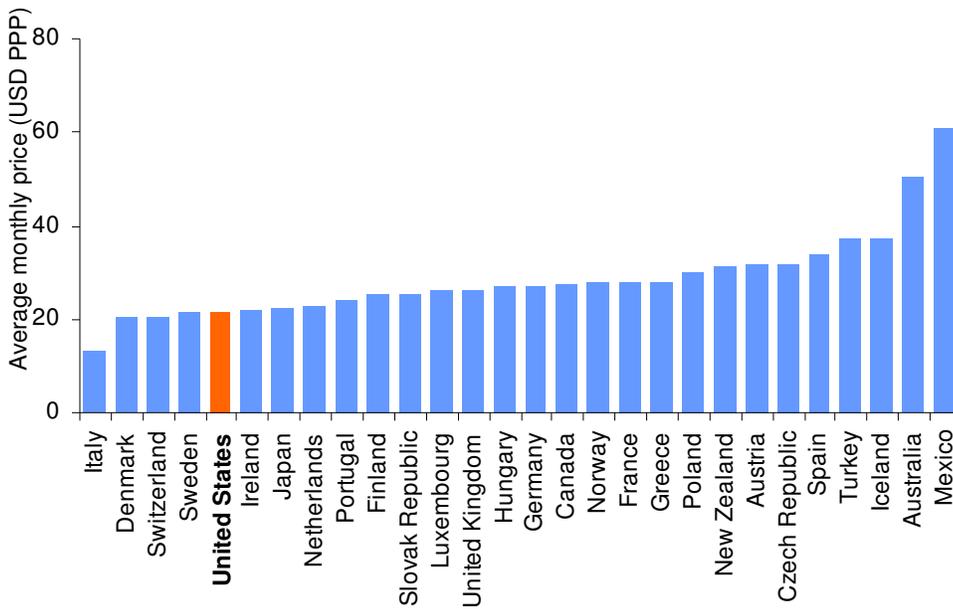
There are two key findings from this analysis. First, a country that has been identified in the top ten in both data sets (those that fall within the orange box), can confidently be labeled as a high performer in that speed tier. Denmark, Ireland, Italy, the Netherlands, and Sweden all reside in the top ten in both data sets for the low speed tier. Denmark, Italy, Greece, Japan, Portugal, Sweden, Switzerland, and the United Kingdom are all in the top ten for the medium speed tier. Denmark, France, Germany, Greece, Italy, Japan, Sweden, Switzerland, and the United Kingdom are all strong performers in the high speed tier.

Second, there is no clear optimal data set between these two. Both the OECD and TeleGeography data sets are similar in their aims and methods, and though they are clearly correlated, they also clearly have some distinct data within them. Given this, we decided to combine both data sets to yield a set with many more samples on which to apply our methodology.

#### **4.12.3 The combined data set**

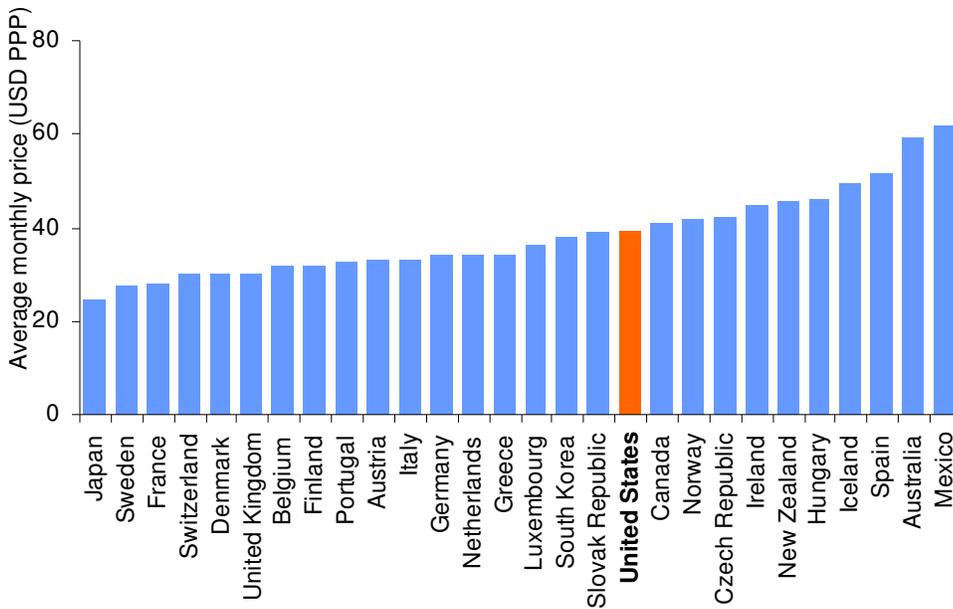
The combination of the OECD and the TeleGeography data sets revealed nearly 150 duplicate offerings which were manually tagged and removed from the combined set. Where there was duplication, we kept the OECD offering. The resulting set had nearly 1000 entries. Of those, 277 were excluded in our methodology for being from a non-top four provider or having a data cap of less than 2 GB. The results of this data set are shown in Figures 4.13 through 4.16.

**Figure 4.13. Combined pricing set in low speed tier**



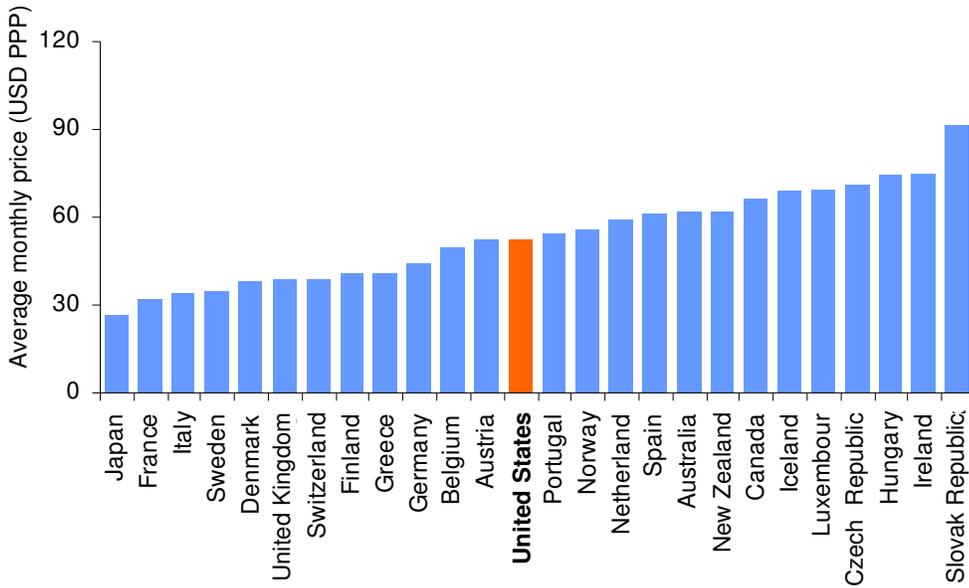
Source: Berkman Center analysis of OECD and TeleGeography broadband statistics

**Figure 4.14. Combined pricing set in medium speed tier**



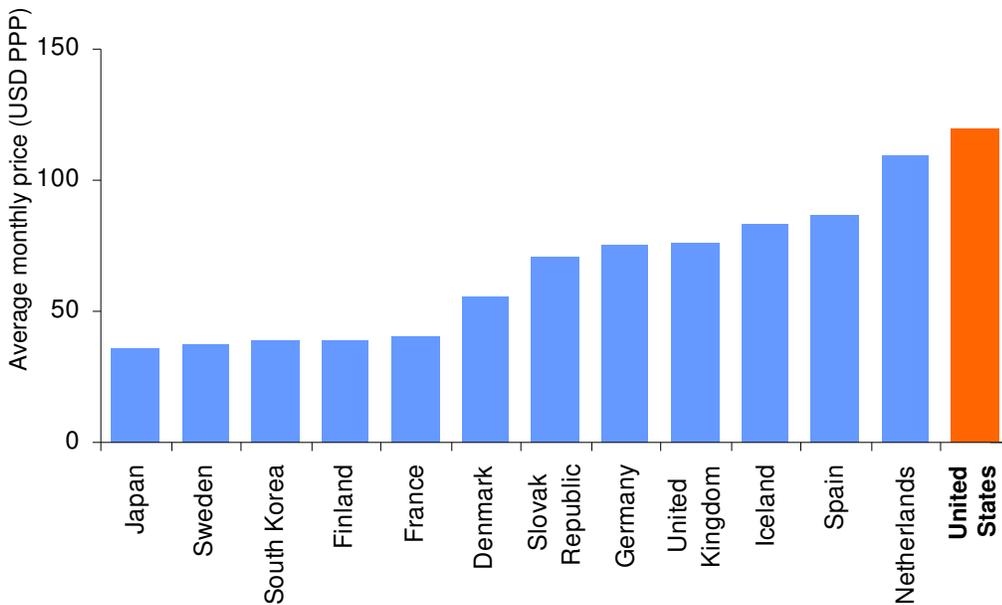
Source: Berkman Center analysis of OECD and TeleGeography broadband statistics

**Figure 4.15. Combined pricing set in high speed tier**



Source: Berkman Center analysis of OECD and TeleGeography broadband statistics  
 Note: Poland not displayed

**Figure 4.16. Combined pricing set on very high speed tier**



Source: Berkman Center analysis of OECD and TeleGeography broadband statistics

In the low speed tier, the United States moves up seven places, from 12<sup>th</sup> ranked in the original OECD ranking, to 5<sup>th</sup> here. This is due primarily to the methodological change that excludes some higher-price, smaller-competitor offerings, which results in a drop in the average price by \$3. We see many other big movers, including New Zealand which falls by eleven places, Germany and Switzerland which both improve by ten places, Luxembourg and Poland which both improve by seven places and the United Kingdom which falls seven. New Zealand is impacted by the removal of the low-price, sub-2GB cap

offerings. Adding the TeleGeography data set results in two new lower price options affecting the German average. The OECD data set includes only two offerings from Luxembourg in this tier. The TeleGeography data set adds another three unique offerings from two other carriers at more competitive prices. Poland adds some more competitive offerings from top four carriers and removes some less competitive offerings from non-top four carriers. The United Kingdom still suffers from a lack of data in the low speed tier. This may be a factor of the sparseness of the data sets or could be a sign that there are fewer options in the United Kingdom in this speed tier.

In the medium speed tier, merging the data sets has little impact on the United States, moving it from 17<sup>th</sup> to 18<sup>th</sup>. There are fewer big movers at this speed; however, the Slovak Republic improves by thirteen places, Austria improves by nine, and Greece falls by ten. Both the Slovak Republic and Austria, similar to the United States in the low speed tier, have offerings in the OECD data set from a few smaller providers with higher prices that are excluded in our methodology. Greece's change in rankings is more due to other countries' movement than its own. Greece's average price increases slightly (from \$32 in OECD set to \$34 in the combined set), but it suffers a large fall in the rankings as several other countries improve their average prices.

In the high speed tier, the United States' average price falls by \$10 resulting in a five place improvement in the rankings. This change in price is mostly a result of excluding higher price options from the 7<sup>th</sup> largest provider, Qwest. In this tier, we do not see any countries shift more than a quintile in one direction or the other.

In the very high speed tier, the United States falls two spots as the Slovak Republic and the United Kingdom are added to the mix of countries with very high speed offerings. Norway is notably missing since its one offering in this tier was from a non-top four carrier, Lyse.

In conclusion, we found that both the OECD and TeleGeography data sets suffer from sparse data as we cut by country and speed tier. Combining the two data sets yields a somewhat more robust set, but further work into a more comprehensive data set that accurately represents the options available to consumers and is less sensitive to variation would be necessary to further delve into this question.

#### **4.12.4 Even more independent data sets**

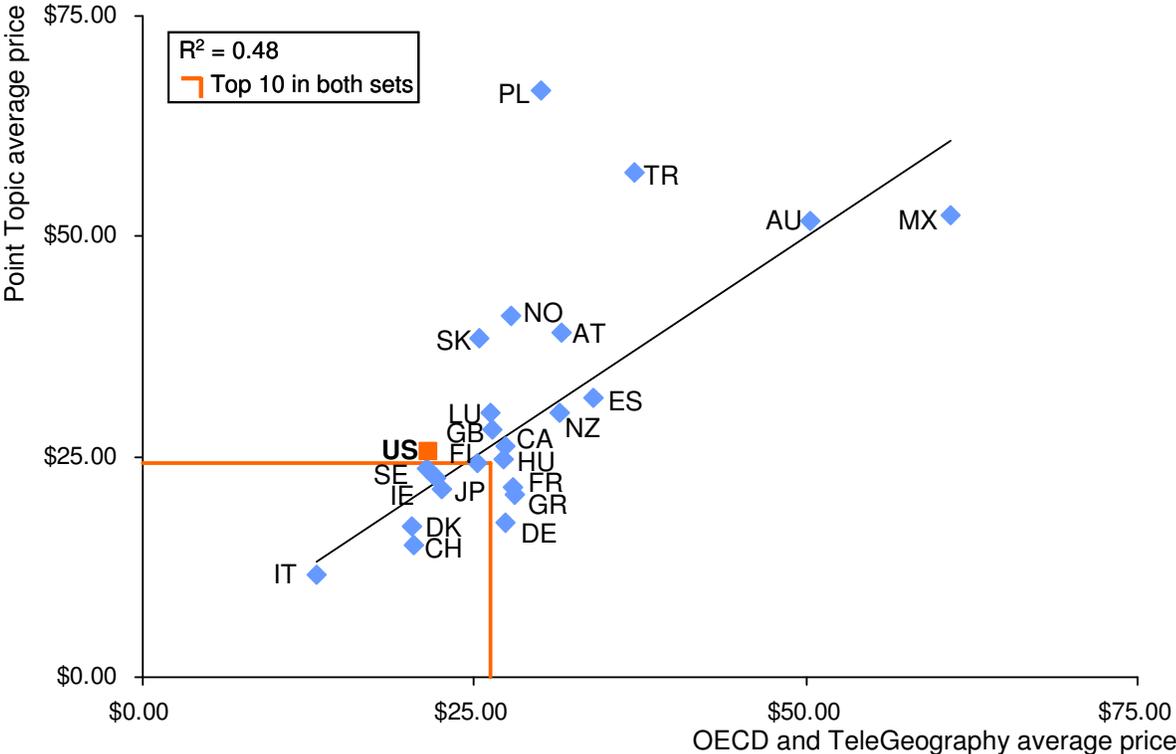
After the release of the first draft of the Next Generation Connectivity report, we sought to further refine and improve our pricing data set. We believe that each of the data sets we have used presents a separate draw from a noisy data set; thus, the larger the aggregated set, the better view we have. To this end, we have analyzed and included the standalone tariff set from Point Topic.

##### *Point Topic*

We downloaded the standalone tariff data from Point Topic in November 2009, so this set included prices collected during Q2 and Q3 2009, both overlapping and extending the coverage from the TeleGeography data set. We also collected a select set of bundled offers where key players were missing coverage (e.g., Free in France who only offers bundled service).

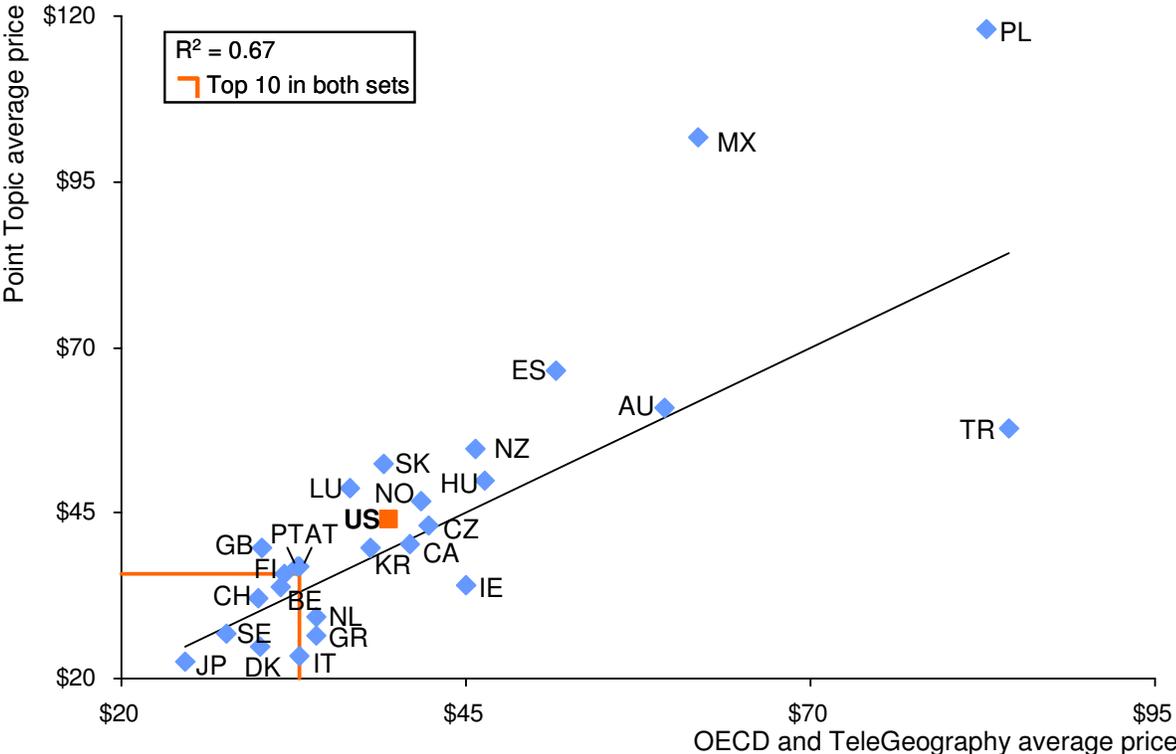
The resulting Point Topic data set included 825 offerings, covering 29 countries (Iceland was not covered). Of these 757 included all the necessary data (e.g., pricing and speed). These offerings were coded with the rank of each of the providers and evaluated based on their bit cap. Once only the top four providers with offers of more than a 2GB cap were considered, there were 438 offerings to evaluate. We then ran similar bivariate analyses of the Point Topic data set against the combined OECD and TeleGeography data set.

Figure 4.17: Point Topic versus combined pricing data set, low speed tier

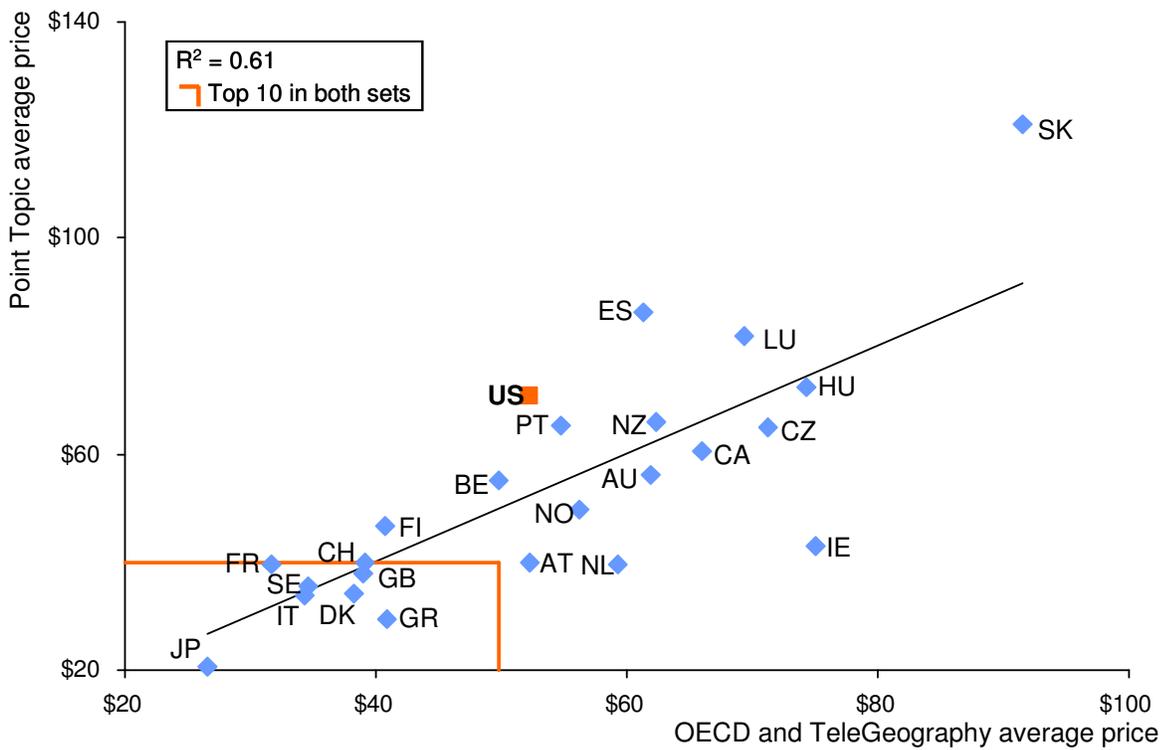


Note: removal of outliers (i.e., Poland, Turkey) results in an  $R^2$  of 0.70

Figure 4.18 Point Topic versus combined pricing data set, medium speed tier

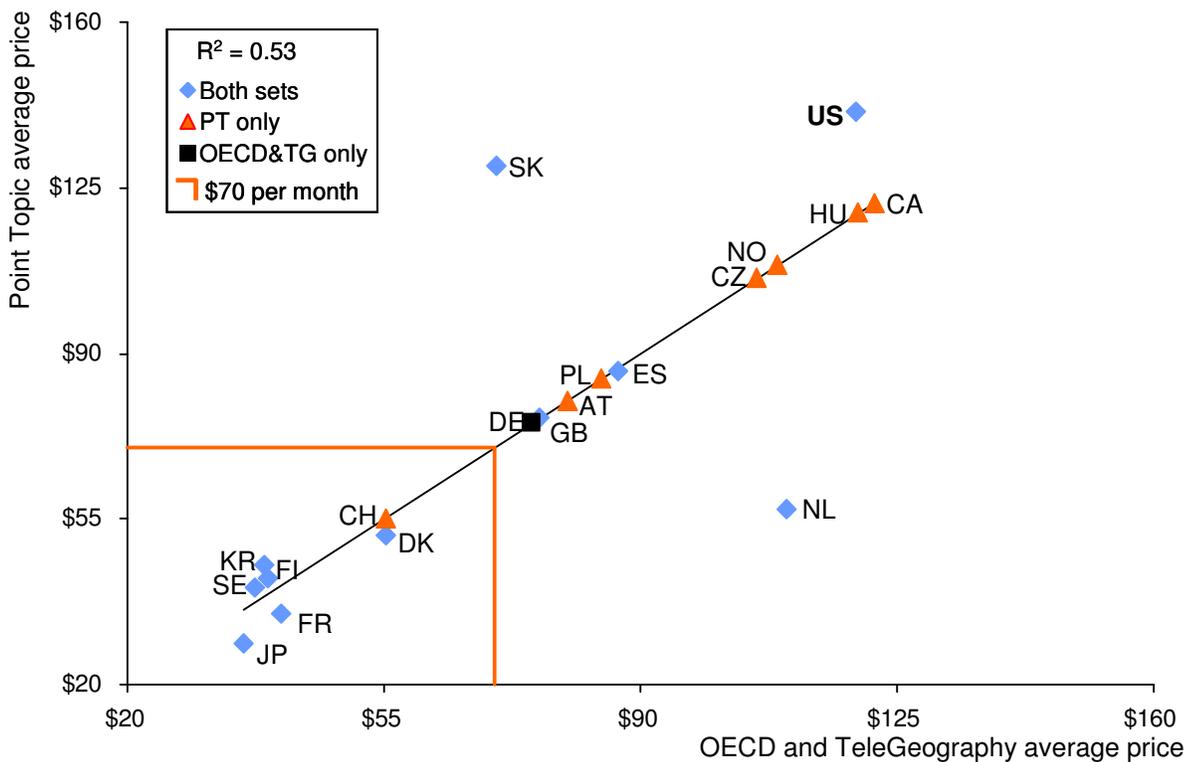


**Figure 4.19: Point Topic versus combined pricing data set, high speed tier**



Note: Poland not displayed at an OECD average of \$210, PT average of \$122

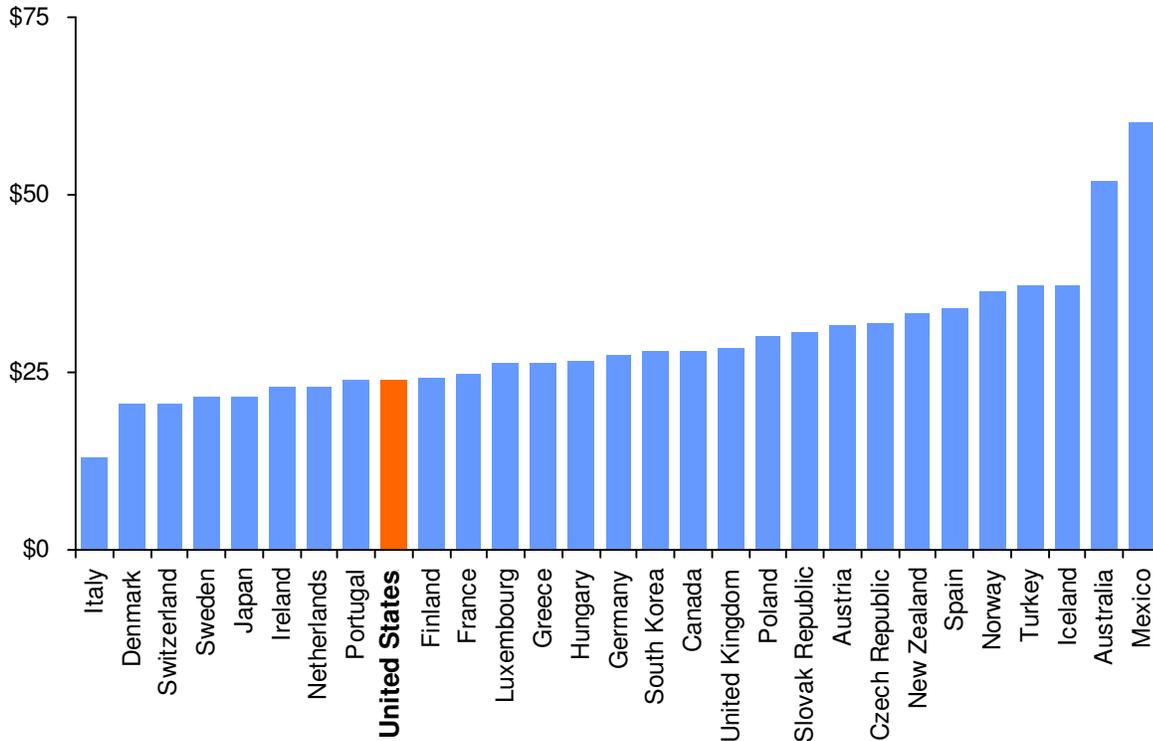
**Figure 4.20 Point Topic versus combined pricing data set, very high speed tier**



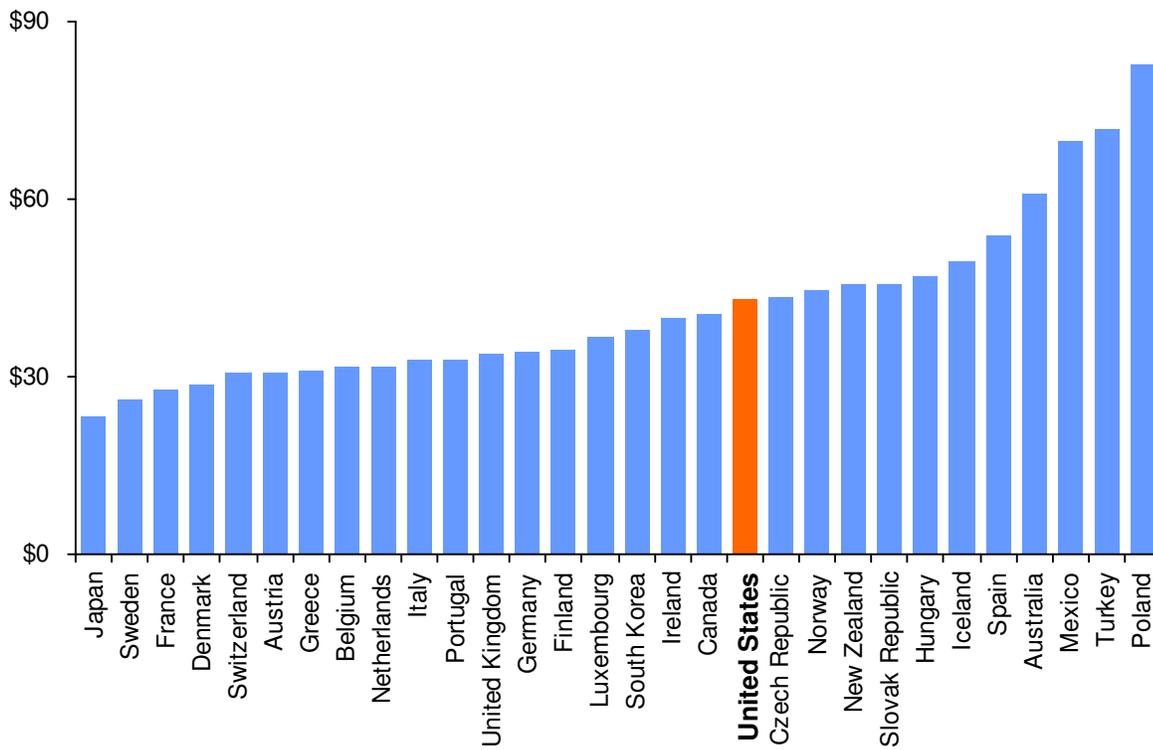
In each of these we found that there was significant correlation between the two sets, but that there was also additional data in the Point Topic data set not found in the combined set of OECD and TeleGeography. Consistently, Poland was an outlier amongst each tier. Although we could not determine the cause of this, we decided to exclude the Point Topic data on Poland in the combined set.

We then aggregated the Point Topic data into the combined data set, removing duplicate offers and regenerating our rankings based on this set. This combined data set now includes 950 offerings that meet the criteria of our study.

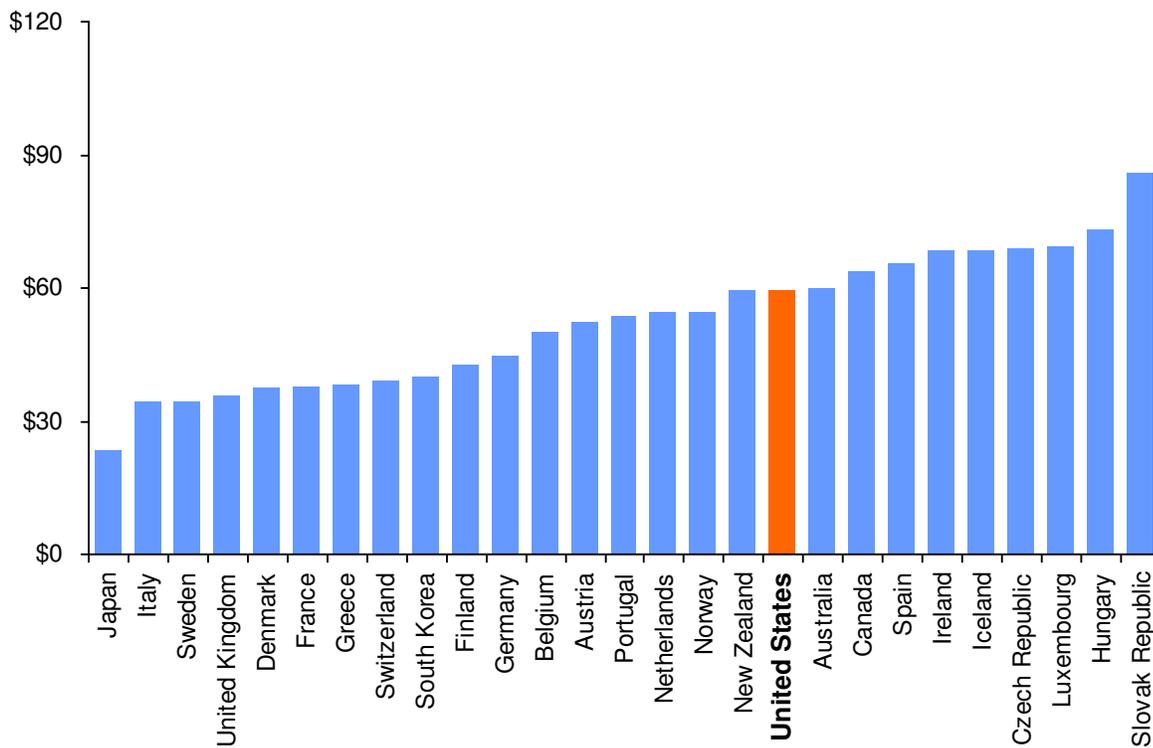
**Figure 4.21: All three data sources, low speed tier**



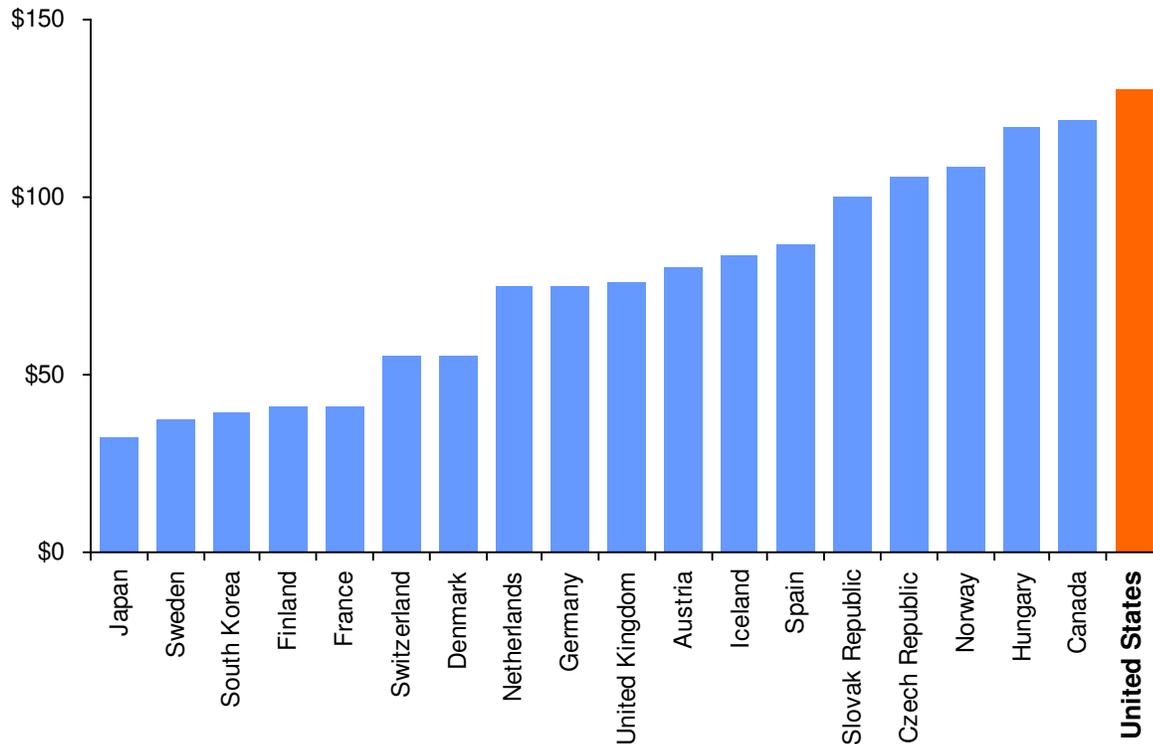
**Figure 4.22: All three data sources, medium speed tier**



**Figure 4.23: All three data sources, high speed tier**



Note: Poland not displayed

**Figure 4.24: All three data sources, very high speed tier**

In the low speed tier, the US drops from 5<sup>th</sup> to 9<sup>th</sup> with the addition of the Point Topic data set, returning it to a similar position as with the OECD set alone. The Point Topic data set includes low speed tier offers from Comcast which are not present in the other two data sets. The increase in the average price from \$21 per month to \$24 per month leads to other countries surpassing the US.

In the medium speed tier the US ranks 19<sup>th</sup> when all data sources are combined, dropping one place. Additional offers from Comcast, AT&T, Time Warner and Verizon at different upload speeds account for the increase in average price from \$39 to \$43 per month.

In the high speed tier, the US fairs slightly worse with all data sources than just with the OECD and TeleGeography. The increase in the average US price from \$52 to \$59 is attributable to new offerings from providers at higher speeds such as Comcast's 22Mbps offer and Verizon's 25Mbps offer.

In the very high speed tier, the US remains at the back of the pack. No other country in any of the data sets has prices as high as the US at next generation speeds.

#### *The FCC's data set*

We also investigated the data set that the FCC has collected on pricing. This data set includes 726 offerings from 35 countries. This includes several countries absent from the OECD data set: Bulgaria, Cyprus, Estonia, Hong Kong, Latvia, Lithuania, Malta, Romania, Singapore, and Slovenia. It also lacks several players: the United States, Canada, Mexico, New Zealand, Switzerland, and Turkey. Reviewing this data for the countries in common between the two sets revealed that there was significant correlation (~50%) with the OECD data set, and some correlation with the TeleGeography and Point Topic data sets. Looking at several key countries (Sweden, Finland, Japan, South Korea, and France), the averages

are reasonably close. We have opted to not roll this data set into our aggregated set due to the mismatch in coverage.

#### **4.12.5 Firm-level offerings at the highest-speed tiers**

As part of our analysis of competition and access regulation, we used our combined data set to identify specifically the discrete prices and speed offerings made by firms in OECD countries at the highest speeds. The source was the combined data set from the OECD, TeleGeography and Point Topic. From this data set we selected all offerings that fell into the very high speed tier, that is, offerings above 35Mbps, anywhere in the OECD. Where a firm had multiple offerings in this tier, we selected the lowest price for the highest speed offering. For this analysis we did not restrict offerings to only top four firms.<sup>228</sup> To these we added the highest available speed offered in each of the countries for which we focused on in Part 4 (Competition and Access), where there were no offerings in the very high speed tier (Canada, Germany, Italy, New Zealand, Switzerland, and the United Kingdom). To these we added the results of our own independent Web-based search for what were the best prices, at the best speeds, available from all U.S. broadband providers that were identified in the TeleGeography data set as having over 2 million subscribers. For these we included the lowest-priced, highest-speed offering we could find from either the firm's Web site or news reports about a firm's launch of an offer.

Because our initial examination identified the offerings of U.S. firms as among the lowest speed and highest priced, and because we have a particular interest in understanding prices in the United States, we decided to complement our initial findings with these additional, independent searches to assure that we were not missing much better offerings available in the United States. As a result, we indeed include more offerings at the highest speeds, and substantially better-priced offerings than were available purely by examining our combined data set as described in Part 4 above. The results, as we describe them here, are therefore highly biased in favor of U.S. firms. We found, for example, that were we to use the same methods in Japan, we would have to include another offering from KDDI that is as fast as K-Opticom's 1Gbps offer, at an even lower price, and TeliaSonera Sweden would join the group of highest-speed, lowest-price offerings. We, nonetheless, chose to report the more expanded U.S. set because even with the strong bias in favor of U.S. firms our initial important finding, of high prices and low speeds, holds, and because the few discrete observations we made for firms elsewhere also tended to cohere with observations we found in the data set.

Our methodology resulted in 78 observed offerings. We then used the company profiles and our own research to characterize each firm in our data set as an incumbent telephone company, a cable company, an unbundling-based entrant, a facilities-based telecommunications provider, that is, a provider that came in and built its own telecommunications facilities not based on existing infrastructure like cable or power, and "other," which includes primarily power companies. For companies like Telenor, Norway's incumbent, we characterized offerings from Telenor in Sweden as made by an entrant, not an incumbent, because that is its role in the Swedish market. Where a firm uses mixed approaches, but we knew precisely how it provided the particular offer, we characterized the firm using that technique. Numericable in France, for example, is characterized as a cable company in our findings here, because although it also offerings unbundling-based DSL services at the high speed tier, using its newly acquired Completel unit, the offering we report here, in the very high speed tier, is available only over its cable lines.

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<sup>228</sup> Some comments to our initial draft release seemed to have missed this methodological difference between this part of the study and the general pricing benchmark. For Canada in particular, Videotron, which does have a very high speed offer, is not a top 4 provider on a national basis.

*Conclusion*

Our complete findings are described in the main text. In brief, we found the very highest prices in Norway, and the highest prices to lowest speed combinations occur in North America. These findings are notable in that both the United States, formally, and Canada, practically, have come to rely on inter-modal competition, in most cases between at most two regional competitors in any given regional market. All Norwegian offers but one at the very high speeds are provided by facilities-based competitors, not the access-based competitors that occupy high-speed tiers and lower: Lyse, a power company in Southern Norway, Telenor Norway, the incumbent, and Canal Digital, the Telenor-owned cable broadband provider. The sole offer offered by an entrant using unbundled access, NextGenTel, has a 40Mbps offer at \$65US PPP. Conversely, the lowest prices and highest speeds are offered by firms that occupy a market with unbundling-based entrants alongside incumbent telecommunications companies and facilities-based competitors, both cable and power. Furthermore, the very tight clustering of offerings in France, Japan, Sweden, South Korea, and Finland suggests highly competitive markets that are functioning at more or less the frontier of the feasible, particularly given the tight clustering of price/speed offerings across firms in these many different markets. This becomes particularly obvious when compared to the more scattered offerings by U.S. firms ranging from the bottom left to top left quadrants. The presence of the French firms, where there is so little facilities-based competition, all in the top right hand quadrant suggests that open access and, in particular, unbundling, rather than facilities-based competition, is a major driver of the effect. But the national character of markets is also observable from the tight clustering of Swisscom, Fastweb, Cablecom, and Sunrise in the top left hand quadrant for Switzerland, the near-identical offerings by Orange Slovenska and Slovak Telecom, and the emphasis of British firms BSkyB, Tiscali UK, and O2 UK on lower speeds.



## 4.13 Annex: Voluntary Access Models: The Dutch and Swiss Cases

### 4.13.1 Reggefiber FTTH: Business Case Brief

Reggefiber FTTH is the primary provider of Fiber to the Home (FTTH) infrastructure in the Netherlands. It was founded as a subsidiary of Reggeborgh, an investment vehicle of one of the wealthiest real-estate business families in the Netherlands, the Wessels (who have the second largest real-estate holdings in the Netherlands). As such, it was conceived from the start on a commercial real estate model: long-term returns, maximizing the number and diversity of tenants. In communications infrastructure terms, this translated into a passive network that was, from the start, built to be open access so as to maximize the number of potential rent-paying tenants offering services over the network. In 2008, after Reggefiber had already connected 200,000 homes in southern and eastern Netherlands, KPN, the incumbent fixed, mobile and broadband operator, acquired a 41% minority stake in a joint venture. The remaining 59% was retained by Reggeborgh. KPN retains an option to increase its holding to 60% upon reaching certain volumes, but has indicated that it is unlikely to do so before 2012.<sup>229</sup> Reggefiber's immediate aim is to reach 1.3m homes with FTTH by the end of 2012, starting with 5 selected pilot regions<sup>230</sup> and expanding to other densely populated urban areas. In the medium term, Reggefiber aims to reach 30-60% of households in the Netherlands, selecting regions for expansion based on regional business cases. The estimated capital expenditures (capex) requirement for Reggefiber of this roll-out assuming coverage of more than 60% of Dutch homes is €6-7 million.<sup>231</sup> Reggefiber's network was always conceived as open access, on the commercial real estate model. This joint-venture (JV) business model was implemented as an agreement with the NMa (Dutch competition authority) and OPTA (Dutch telecom regulator). KPN's competitors are able to provide services over the fiber with a wholesale price ceiling of between €14.50 and €17.50 per line (two dark fibers to each customer) per month depending on the capex requirement of the corresponding geographical area, with discounts of up to 20% depending on total lines in a particular area.<sup>232</sup> The implementation of the business model in the regulatory framework is seen to provide assurances to customers (the entrant providers) and investors that the rates will remain stable and predictable over the payout period.<sup>233</sup>

The FTTH deployment plans and JV with Reggefiber should be seen in the context of a broader KPN strategy for Next Generation Access (NGA). KPN is in the process of migration away from a copper network to a NGN on the basis that FTTH "is the superior long term technology,"<sup>234</sup> but operates with a portfolio approach of "regional differentiation [of high speed network technologies] based on business case by region." Specifically, KPN also has a parallel Fiber to the Curb (FTTC) roll-out which has reached 450,000 households in 5 cities,<sup>235</sup> but has been temporarily suspended due to operational scalability issues. Independent from the fiber initiatives, KPN will have upgraded its existing copper offering to VDSL by mid-2010.<sup>236</sup> Within this portfolio, the FTTH strategy is aimed at users seeking higher bandwidths, higher quality TV, and TV as part of a triple-play package.<sup>237</sup> In effect, copper-based

229 Harm Lutikhede, "KPN: Full consolidation of Reggefiber unlikely before 2012", WSJ Online, 15 December 2009

230 Almere-Haven, Son en Breugel, Uden, Elburg, Haaksbergen are the FTTH pilot areas under KPN's 2x5 strategy for fiber roll-out

231 Analysys Mason, "Europe Looks on as KPN and Reggefiber plan nationwide FTTH services, Analysys Mason comments", 21 November 2008

232 Jaap Doeleman, "Digging for gold? Incentivising NGAs in the Netherlands", International Bar Association Legal Practice Division Communications Law Committee Newsletter, May 2009, p11

233 Personal communication, Jan van Rooijen, CFO Reggefiber, January 19, 2010.

234 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p4

235 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p14

236 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p7

237 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p32

infrastructure cannot compete in the long term with cable, and KPN likely sees FTTH as the only long-term approach to avoid being squeezed out of the fixed line Internet access markets over the course of the coming decade.

KPN currently offers 3 high-speed packages over Reggefiber's network, starting with Bronze (30Mb/s downstream, 3Mb/s upstream) for €65/month (inc. VAT), and rising to Silver (50Mb/s downstream, 5Mb/s upstream) for €80/month and Gold (100Mb/s downstream, 6Mb/s upstream) for €110/month, with the aim of all packages becoming downstream/upstream symmetric in 2010.<sup>238</sup> These packages are more expensive than KPN's own FTTC offerings or competing DOCSIS 3.0 cable offerings.<sup>239</sup>

By September 2009, Reggefiber had passed 462,000 homes in the Netherlands, connected 339,000 of those homes, and had 160,000 of those households as active FTTH subscribers.<sup>240</sup> In addition to its aim to pass 1.3m homes by 2012, Reggefiber also aims to lift its current 20-30% subscription rate in FTTH areas to a subscription rate of 60%. Its basic business case break-even point is 45%.

#### *Viability of the FTTH business model in the Netherlands*

In 2008, OPTA (Dutch telecom regulator) commissioned Analysis Mason (a leading telecom consultancy) to study the theoretical business case for KPN to construct a FTTH network in the Netherlands.<sup>241</sup> Analysis Mason (AM) concluded that the business case for construction was just positive if KPN passed 60% of households and achieved penetration in 60% of households passed, duct costs were €30/meter, and revenue per subscription increased by €13.40/month for users of the FTTH network.<sup>242</sup> This study provides the baseline against which to evaluate the actual performance of Reggefiber during the first year since the joint venture was consummated.

In developing this estimate, AM assumed that the capex to deploy FTTH to 60% of Dutch households was €6.3bn, amounting to €1566 per home passed or €2088 per subscriber.<sup>243</sup> KPN would pass 60% of Dutch homes, connect 80% of those (48% of total households), activate 60% of those (36% of total households), with 45% served by KPN retail and 15% served by the wholesale market.<sup>244</sup> The cost to KPN to provide fiber unbundling would be €17.99 per line per month.<sup>245</sup> The free cash flow from this roll-out was then modeled over a 10-year time horizon and discounted at KPN's regulated weighted average cost of capital (WACC) of 9.2%.<sup>246</sup> The free cash flow model suggests, as expected<sup>247</sup>, that the NPV and payback period of constructing a FTTH network is most sensitive to penetration and cost per

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238 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p31

239 Rudolf Van Der Berg, "UPC Fiber Power triumphant over KPN FTTH", Internet Thought Blog, 10 April 2009, <http://internetthought.blogspot.com/2009/04/upc-fiber-power-triumphant-over-kpn.html>

240 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p20

241 Analysys Mason, "The business case for fibre-based access in the Netherlands", Final Report for OPTA – Public Version, 24 July 2008

242 Analysys Mason, "The business case for fibre-based access in the Netherlands", Final Report for OPTA – Public Version, 24 July 2008, p4

243 Analysys Mason, "The business case for fibre-based access in the Netherlands", Final Report for OPTA – Public Version, 24 July 2008, p28

244 Analysys Mason, "The business case for fibre-based access in the Netherlands", Final Report for OPTA – Public Version, 24 July 2008, p26

245 Analysys Mason, "The business case for fibre-based access in the Netherlands", Final Report for OPTA – Public Version, 24 July 2008, p2

246 Analysys Mason, "The business case for fibre-based access in the Netherlands", Final Report for OPTA – Public Version, 24 July 2008, p16

247 Yankee Group FTTH Model, In: Yankee Group, "Fiber to the Home: Making that Business Model Work", Webinar Presentation, 30 June 2009, p7

home,<sup>248</sup> and that if only households in densely populated urban areas are passed, the required increase in per user revenue falls.

### *Evaluating the Reggefiber JV business case after 12 months*

The evidence from the first year of Reggefiber's operation since the JV suggests that its actual business case is overall positive, but KPN sees it as remaining relatively risky. KPN estimates an 8-year payback period for the average area of 1,000 homes passed (based on an initial average subscriber revenue of €60 / month and including a monthly fee to the JV for use of passive fiber, initial investments in the JV, and investments in customer activation by KPN).<sup>249</sup> FTTH still requires more capex (€1000 vs. €350), more risk, and a longer payback period (8 years vs. 4-5 years) than KPN's parallel FTTC deployment,<sup>250</sup> but the capex is off KPN's books and shared with a long-term investor and bank financing.

Reggefiber's actual capex of €1000 per home passed (€800 dark fiber + €200 fiber termination unit)<sup>251</sup> is much lower than AM's estimate of €1566 per home passed, reducing the costs which need to be recouped in higher subscriber revenue. It appears that AM overstated the costs of digging in part because digging in Dutch soil is easier and cheaper than in other places, and in part because Reggefiber, as a real-estate company, has seen reduced costs with scale through long-term commitments to construction companies.<sup>252</sup> Reggefiber has already achieved 20-30% penetration in its 5 pilot cities,<sup>253</sup> despite a poor initial offering which is uncompetitive in price compared to cable,<sup>254</sup> and so could reasonably be believed to be on track to reach AM's assumed 60% penetration. Further, both the lower capex and the plan to expand to densely populated areas (aiming for only 30-60% medium-term coverage) offset this lower penetration of subscribers in FTTH areas. KPN has observed an increase in blended monthly subscriber revenue of €8 in FTTH areas,<sup>255</sup> and the subscriber revenue gap between dual play (copper €40) and triple play (fiber €60) customers is €20, suggesting potential for an increase in average user fees in excess of AM's €13.40.

There are however, significant risks in KPN's FTTH business model which have not yet been eliminated in the 2x5 pilot (KPN has separate FTTC and FTTH pilot programs in five cities each). Penetration in FTTH areas may not follow KPN's projected adoption curve and instead remain in the 20-30% region currently observed. KPN's target is 60% penetration, at least one independent analyst believes that FTTH only becomes viable for the JV at a penetration of above 45% in FTTH passed areas,<sup>256</sup> and an early study of the economics of Sweden's FTTH network suggests a critical market share of 45%.<sup>257</sup> Penetration may remain low if KPN's offering continues to be uncompetitive with cable offerings, as the required increase of subscriber revenue in excess of €8 means that increasing penetration rates with lower prices is not a viable strategy. KPN's speed of operations may also impact upon the ability of Reggefiber to raise external financing. The 1.3m FTTH homes passed by 2012 implies an average increase in coverage of under 250,000 homes per year, limited by KPN's ability to activate new customers. It is unclear what impact this slower than planned expansion has on the JV's business

248 If duct costs fell to €20/meter, the business case becomes positive at an incremental monthly ARPU of €9.

249 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p24

250 "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p30

251 KPN Presentation

252 Personal communication, Jan van Rooijen, CFO Reggefiber, January 19, 2010.

253 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p20

254 Rudolf Van Der Berg, "UPC Fiber Power triumphant over KPN FTTH", Internet Thought Blog, 10 April 2009,

<http://internetthought.blogspot.com/2009/04/upc-fiber-power-triumphant-over-kpn.html>

255 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p22

256 Paul Budde, "KPN's focus on FTTC misses the broader picture", CircleID – Internet Infrastructure, 16 December 2009

257 WIK Consult, "The Economics of Next Generation Access: Results of a study for ECTA", 25 June 2008, p19

model.<sup>258</sup> Finally, retail competition may reduce subscription rates for KPN. Despite open access, there are not yet any other operators in the Netherlands buying dark fiber access from KPN and offering a service direct to customers, although Reggefiber is in pilot stages with broadband entrants, and entry would both generate additional earnings for KPN through the JV, and more importantly would likely increase marketing and reduce prices, thereby increasing levels of penetration. The driving force, and major concern, is competition from cable companies in a market where the most recent data (Q3 2009) suggests that new subscribers are choosing between cable and fiber, and KPN is at risk of losing customers migrating from DSL to higher speed offerings. In anticipation of this speed competition, Reggefiber's new deployments are intended to provide 200Mbps service and are installing gigabit capable equipment in anticipation of future scaling.

### *Explaining the Reggefiber JV: Beyond the business case*

Three factors beyond the business case and net present value analysis explain why the Reggefiber JV provided a strong opportunity for KPN despite the significant risks involved in constructing a FTTH network.

First, the JV structure keeps most of the capex required for FTTH network construction off KPN's financial statements. KPN has only a minority (41%) interest in Reggefiber, below the 61% holding which triggers NMa takeover approval and the threshold which triggers consolidated accounting under Dutch law.<sup>259</sup> This allows KPN to effectively outsource FTTH capex and use free cash flow for share buybacks to satisfy investors.<sup>260</sup> KPN only committed €174m in cash and €16m in assets to the JV initially,<sup>261</sup> and estimates that only €75m-150m per year in capex (related to customer activation) will appear on KPN's financials.<sup>262</sup> As a result, KPN is able to work within its 'Back to Growth' strategy which limits capex to €2bn and targets €2.4bn of free cash flow in 2010.<sup>263</sup> Further, the majority partner in the JV is Reggeborgh, a family-owned construction firm with long-term investment horizons and no external shareholders, facilitating an investment project with >8 year payback periods.<sup>264</sup> These conclusions about the JV structure are supported by the fact that KPN is not aiming to increase its stake in Reggefiber until after 2012 at the earliest,<sup>265</sup> and that Reggefiber aims to raise external financing in the first half of 2010.<sup>266</sup>

Second, investment in FTTH through Reggefiber should be seen as a competitive strategy against Dutch cable providers. The threat of losing customers to cable companies, particularly in areas where high-speed DOCSIS 3.0 services are offered, typically means that telecom operators can account in their business case for revenues from customers who would have been lost, rather than just the incremental revenues of existing customers migrated from dual to triple play.<sup>267</sup> This threat is accentuated in the Netherlands because of a strong cable presence, with >95% cable coverage and more than 80% of the country's 7.3m households subscribing to at least cable TV.<sup>268</sup> UPC, the second cable operator with 2.3m

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258 Tim Poulus, "Guidance, IT, hold back KPN's FTTH Ambitions", TelecomPaper, 16 December 2009

259 Harm Lutikhede, "KPN: Full consolidation of Reggefiber unlikely before 2012", WSJ Online, 15 December 2009

260 KPN, "Company Presentation: Investor Relations", May 2008, p10

261 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p29

262 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p32

263 Tim Poulus, "Guidance, IT, hold back KPN's FTTH Ambitions", TelecomPaper, 16 December 2009

264 Analysys Mason, "The business case for suburban fibre will be tough", 3 December 2009

265 Harm Lutikhede, "KPN: Full consolidation of Reggefiber unlikely before 2012", WSJ Online, 15 December 2009

266 KPN, "Update on KPN's fiber roll-out: Next phase in consumer strategy", Investor Presentation, 15 December 2009, p29

267 Analysys Mason, "The business case for suburban fibre will be tough", 3 December 2009

268 Jaap Doeleman, "Digging for gold? Incentivising NGAs in the Netherlands", International Bar Association Legal Practice Division Communications Law Committee Newsletter, May 2009, p11

customers, has recently launched its very high-speed Fiber Power offering which offers comparable service<sup>269</sup> at a lower price.<sup>270</sup> 2009 Q3 data on subscriptions seem to support KPN's fear of losing subscribers to high-speed cable if they cannot offer FTTH. Q3 2009 total subscriptions grew by 38,300 net, but cable added 32,500 subscriptions compared to fiber which only added 17,000. Most importantly, DSL lost 12,700 subscriptions,<sup>271</sup> suggesting that new subscriptions are essentially all cable and fiber and that DSL users face a choice between cable and fiber.<sup>272</sup>

Third, Reggefiber enjoys a relatively attractive regulatory environment in the Netherlands. KPN and Reggefiber had already committed to provide open access through fiber unbundling before OPTA formally proposed the inclusion of FTTH in its Significant Market Power (SMP) designation in market 4 (wholesale physical network access at a fixed location)<sup>273</sup> with the resulting remedy of fiber unbundling and wholesale price ceilings. KPN seems to favor open access because of what it perceives as mistakes made in negotiations over copper unbundling from 1996 and because according to their CEO, "if you allow all of your competitors on your network, all services will run on your network, and that results in the lowest cost possible per service. This in turn attracts more customers for those services, so your network grows much faster."<sup>274</sup>

KPN's acquisition was proposed in May 2008 and cleared on 19 December 2008 by the Nma (Dutch competition authority), subject to wholesale price ceilings.<sup>275</sup> This operator acceptance of the principle of wholesale access shifted the regulatory discussion to setting wholesale pricing to account for higher construction and regulatory risk than in copper networks.<sup>276</sup> Here, OPTA relied on Reggefiber's business model and internal rate of return (IRR), rather than a separately commissioned cost model.<sup>277</sup> This initial ex ante testing of pricing based on an operator's business plan is likely to favor Reggefiber, but is in line with European Commission guidelines.<sup>278</sup> Ultimately OPTA chose initially to set wholesale price ceilings in the range of €14.50 - €17.50 per subscriber per month, depending on the capex required for each geographical area, reflecting a reasonable IRR of 7-10%.<sup>279</sup> The rates will increase with inflation and a discount of up to 20% is available depending on the total (not just wholesale) number of lines in a particular area. In the future, the price ceilings will be reviewed every 3 years by comparing Reggefiber's IRR to an 'all risk WACC.'<sup>280</sup> This includes a risk premium to compensate for the extra risk of fiber (variable and decreasing over time) and a 3.5% premium to compensate for asymmetric regulatory risk.<sup>281</sup>

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269 At least until Reggefiber offers symmetric download and upload speeds

270 Rudolf Van Der Berg, "UPC Fiber Power triumphant over KPN FTTH", Internet Thought Blog, 10 April 2009, <http://internetthought.blogspot.com/2009/04/upc-fiber-power-triumphant-over-kpn.html>

271 TelecomPaper, "Dutch broadband grows 0.8% in Q3, despite drop in DSL users", 4 December 2009

272 Rudolf Van Der Berg, "Dutch cable grows faster than DSL and KPN is in trouble", Internet Thought Blog, 7 December 2009, <http://internetthought.blogspot.com/2009/12/dutch-cable-grows-faster-than-dsl-and.html>

273 T-Regs, "Netherlands: OPTA consultation on fees for unbundled fiber access", 16 January 2009

274 Ad Scheepbouwer (CEO, KPN), Cited In: Benoit Felten, "A World of Fiber", Yankee Group Presentation, 2007

275 Nma, "NMA conditionally approves joint venture of KPN and Reggefiber", 19 December 2008

276 KPN, "Fiber to the home in the Netherlands", WIK Conference FTTB/H in Europe, 23 March 2009, p14

277 OPTA, "Draft policy rules: Tariff regulation for unbundled fibre access", Public Version – Translated, 24 November 2008

278 Jaap Doeleman, "Digging for gold? Incentivising NGAs in the Netherlands", International Bar Association Legal Practice Division Communications Law Committee Newsletter, May 2009, p11

279 Jaap Doeleman, "Digging for gold? Incentivising NGAs in the Netherlands", International Bar Association Legal Practice Division Communications Law Committee Newsletter, May 2009, p11

280 Jaap Doeleman, "Digging for gold? Incentivising NGAs in the Netherlands", International Bar Association Legal Practice Division Communications Law Committee Newsletter, May 2009, p11

281 Rudolf Van Der Berg, "KPN/Reggefiber offer fiber for 12 Euro/month", Internet Thought Blog, 24 November 2008, <http://internetthought.blogspot.com/2008/11/kpnreggefiber-offer-fiber-for-12.html>

The combination of the extra risk premiums to compensate investors, and the fact that Reggefiber can to some degree control the wholesale price ceilings by choosing to invest FTTH construction in less profitable regions to lower their IRR<sup>282</sup> makes the resulting regulatory compromise attractive. More skeptical but well-respected commentators point to the regulatory arrangement as being more political than economic. Under this scenario, OPTA assigns SMP to Reggefiber FTTH to assert its role in regulating fiber, KPN accepts this to receive Nma approval for the JV and have influence on the wholesale price ceilings through use of its cost model, and in embracing open access KPN gains both a FTTH network to rival Dutch cable companies and a stronger position in lobbying for open access to cable networks.<sup>283</sup> While possible, there is however no public evidence to support this as a separate thesis.

#### 4.13.2 Swisscom Fibre Suisse

In the late 1990s Swisscom<sup>284</sup> started to provide fiber-optic networks to large companies in Switzerland. By the end of 2008, it connected 12,500 business premises via optical fibers. However, it was not before October 2008 that Swisscom started expanding its fiber network to small and medium sized enterprises (SME) as well as residential customers in Zurich, Basel, and Geneva, with the original goal of connecting 100,000 households with fiber-optic cables by the end of 2009.<sup>285</sup>

The earliest fiber-to-the-home (FTTH) pilot projects in Switzerland date back to 2003, when state-owned local utility company Services Industriels de Genève (SIG) launched its “Voisin, voisine” initiative with a triple-play offering to test the end-user market in the Charmilles district.<sup>286</sup> A radically more aggressive approach was taken by the city of Zurich, where a 200 million Swiss Francs credit was approved in a March 2007 public vote in order to build and maintain a fiber optics network based on the infrastructure of ewz Zurich, the state-owned local power utility company. Nineteen months later, companies such as Orange, GGA Maur, Init Seven, Translumina and Green are offering telecommunication services over the ewz network to their customers.<sup>287</sup>

Roughly at the time of the Zurich vote – and before Swisscom expanded its fiber network to residential customers – smaller local cable service providers started to offer fiber-to-the home (FTTH) services. One of the first significant FTTH-installations in Switzerland was reported in March 2007, when local CATV Satellitentechnik AG connected a 190-unit housing cooperative to the fiber network in the city of Basel.<sup>288</sup> Synchronously, the local cable network of Télévision Sierre SA started developing a FTTH

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282 Remko Bos, “Access pricing, a key element in effective NGN Access Regulation”, OPTA Presentation, WIK Conference, 23-24 March 2009, p12

283 Tim Poulus, “Possible ingredients of a Possible KPN/OPTA Deal”, Seeking Alpha Blog, 4 December 2008, <http://seekingalpha.com/article/109116-ingredients-of-a-possible-kpn-opta-deal>

284 Swisscom is Switzerland’s leading telecoms provider, with ~5,5 million mobile customers and ~1.8 million broadband connections. In the first three quarters of 2009, the company’s 19,704 employees generated 8,9 billion Swiss Francs in revenue. According to the latest press release issued by the Federal Department of Finance, the Swiss Confederation has a majority holding in the company in terms of capital and votes, amounting to 56.94% (up from 52%) of Swisscom’s share capital. See [http://www.swisscom.ch/GHQ/content/Investor\\_Relations/Aktionaersinformationen/Besitzstruktur/Besitzstruktur.htm?WBCMODE=presentationunpublished%3flang](http://www.swisscom.ch/GHQ/content/Investor_Relations/Aktionaersinformationen/Besitzstruktur/Besitzstruktur.htm?WBCMODE=presentationunpublished%3flang)

285 [http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2008/20081209\\_01\\_Mit\\_fibre\\_suisse\\_in\\_die\\_Glasfaserzukunft.htm?lang=en](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2008/20081209_01_Mit_fibre_suisse_in_die_Glasfaserzukunft.htm?lang=en)

286 <http://wapedia.mobi/en/Geneva?t=4>.

287 <http://www.portel.de/nc/nachricht/artikel/20715-openaxs-schweizer-staedte-bekaempfen-glasfaser-monopol-der-swisscom/>

288 <http://www.catv.ag/content.cfm?nav=16&content=50>

network to provide advanced IPTV services to its customers in early 2007;<sup>289</sup> in December 2009, TV Sierre reported that all households in the town of Sierre are connected to the fiber-optics network.<sup>290</sup> Another pioneer in the field is Stadtantennen AG Baar (STAG), which started to connect private households to its fiber network in summer 2007. There are similar examples from other areas of Switzerland as well, including the offerings by Télédistal, a small cable operator based in the French part of Switzerland near Lausanne.<sup>291</sup>

The next milestone in the FTTH history of Switzerland was a February 2008 decision by the parliament of the city of St. Gallen to support a FTTH pilot project proposed by the city-owned St. Galler Stadtwerke, a public utilities provider that outlined the vision of a next generation Internet infrastructure available to all St. Gallen citizens. The pilot project ran from July to October 2008, included 100 homes and 30 SMEs and a budget of 550,000 Swiss Francs. In December 2008, Swisscom for the first time announced interest in building a fiber-optic network in the city of St. Gallen and approached selected households with a free-trial offer as part of a marketing campaign.<sup>292</sup> In February 2009, residents of the city of St. Gallen voted by a clear majority of 82% in favor of a 78 million Swiss Francs investment in order to create a low-cost FTTH network based on the local public utilities network, which would serve 90% of all households within 10 years. In the context of the referendum, the city committed to competition and non-discriminatory access to its fiber network.

A few months later, in April 2008, AMB (Aziende Municipalizzate Bellinzona), EBL (Elektra Baselland), EKT AG (Elektrizitätswerk des Kantons Thurgau), Groupe E (serving Fribourg and Neuchatel), IWB (Industrielle Werke Basel), St. Galler Stadtwerke (SGSW) and Stadtwerk Winterthur launched an association called Openaxs, an initiative committed to the concept of open access and with the goal to promote fiber-optic networks in general and FTTH in particular based on the principles of fair competition and consumer choice.<sup>293</sup> Openaxs currently includes 11 full members and 6 associated members (including, for instance, Swisscom-competitor Sunrise).<sup>294</sup> It focuses on awareness raising and knowledge exchange and actively promotes open standards of fiber-optic networks and fiber-based service layers.

In July 2008, Swisscom invited “potential cooperation partners from the telecommunications, cable and utilities industries to work with it building fibre-optic networks, with the aim of implementing the network more quickly and cost-effectively in conjunction with several partners.”<sup>295</sup> In December 2008, Swisscom announced the launch of the “Fibre Suisse” initiative in a much-regarded press release and outlined what it has named a “cooperation model on the construction and operation of the fibre-optic network.” In order to “enable potential cooperation partners to expand their own fibre-optic infrastructure after the construction work has started,” Swisscom publicly announced that it “will be laying several fibres per household in all areas. One fibre will be used by Swisscom, while the others will be made available to the cooperation partners.” Swisscom’s press release (perhaps surprisingly) made the point that such an approach “will prevent the creation of a new network monopoly in

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289 <http://express-press-release.net/35/Sierre%20Energie%20deploys%20Anevia%20Flamingo%20gateways%20to%20retransmit%20TV%20Channels%20as%20part%20of%20its%20IPTV%20Service.php>

290 Presentation available via <http://www.fibre-suisse.ch/?p=769>.

291 [www.emc-web.com/emc/c/filepdf/anga2005-e-page02.pdf](http://www.emc-web.com/emc/c/filepdf/anga2005-e-page02.pdf)

292 <http://www.tagblatt.ch/lokales/stgallen/tb-ag/Swisscom-startet-Werbetour-und-eroeffnet-Glasfaser-Konkurrenzkampf;art197,1243979>.

293 <http://www.openaxs.ch/files/pdf/statuten-openaxs.pdf>

294 <http://www.openaxs.ch/home/verbandsmitglieder/>

295 [http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2008/20081209\\_01\\_Mit\\_fibre\\_suisse\\_in\\_die\\_Glasfaserzukunft.htm?lang=en](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2008/20081209_01_Mit_fibre_suisse_in_die_Glasfaserzukunft.htm?lang=en)

Switzerland and also meet competitors requirements for full access to the local loop (copper pairs) as stipulated by the Telecommunications Act.”<sup>296</sup> The press release sketched the following cooperation models aimed at “preventing duplication, saving costs and accelerating the introduction of broadband networks in Switzerland”:<sup>297</sup>

- “Construction partnership: This cooperation model is aimed in particular at partners with their own ducts, such as electrical utilities or cable network providers. One of the partners takes on responsibility for building the fibre-optic network in a defined region - for example a specific district or an entire city. Several fibres are laid, and when the network is completed each of the other cooperation partners is assigned one fibre. If all of the partners network regions which are the same size and are to be shared, no compensatory payment is required.
- Investment partnership: This form of cooperation is of interest to partners without their own cable ducts. Network expansion is jointly financed by all the partners. One partner builds the entire network and grants the investor usage rights to the fibres laid.
- Rental of individual fibres: Individual fibres are rented by partners who do not wish to invest in network expansion but want to decide themselves on the preferred technical level for controlling the fibre-optic network.
- Leasing of transmission services: As with DSL broadband technology, which has long been established on the market, Swisscom also provides reseller offerings for Internet service providers who do not wish to invest in their own infrastructure. These providers can use Swisscom's optical fibres and higher-level network technology.”

The December 2008 Swisscom press release also included the following:

- Swisscom stated that the FTTH deployment started in Zurich, Basel and Geneva and mentioned “the plan ... to further extend the network in the course of [2009] to include residential premises in the cities of St. Gallen, Berne, Fribourg and Lausanne.”
- Swisscom announced its intention to invest 8 billion Swiss Francs over the next six years in Swiss telecommunications and IT infrastructure, “with 35% of this sum earmarked for fibre-optic expansion.”
- Swisscom announced the launch of reseller offerings in March 2009 for Zurich, Basel and Geneva as a “pilot phase”, stating that the partners will check the technical implementation and market acceptance of the individual offerings and are free to design their own end customer and reseller offerings.

Since the launch of this cooperation model in December 2008, Swisscom has entered a series of collaborations across Switzerland and is in negotiations with additional parties, including the city of Basel. The successfully negotiated agreement concluded in December 2009 between Swisscom and the ewz proved to be particularly challenging due to technical complexities and in the light of the economic importance of the Zurich market. The following agreements based on Swisscom’s “Fibre Suisse” framework have been concluded:

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296 Id.

297 The following excerpt is a direct quote from the press release; id.

Bern: Swisscom reached an agreement with Energie Wasser Bern (EWB) in April 2009 (signed in December 2009),<sup>298</sup> which defines all key elements of the cooperation and paves the way “to set up a comprehensive high-speed data network infrastructure in Berne within five years” (as opposed to the 10-year plan originally presented by EWB.)<sup>299</sup> According to the agreement, Berne will connect 70% of the households to the fiber-optic network, Swisscom 30%. Swisscom will receive exclusive access to up to two fiber-cables. Depending on sources, the total investment appears to be somewhere between 140 and 200 million Swiss Francs. According to Swisscom’s press release, compensation has been defined base on Swisscom’s shares of the broadband market;<sup>300</sup> other sources indicate that Swisscom bears slightly more than half of the costs of investment.<sup>301</sup>

St. Gallen: In August 2009, in the aftermath of the public vote and after six months of negotiations, the St. Galler Stadtwerke and Swisscom reached an agreement to collaborate on the building of a local fiber-optic network. More precisely, “Swisscom and the St. Gallen Public Utilities have agreed that the utilities will be responsible for the laying and maintenance of the fibre-optic network.”<sup>302</sup> While the details of the agreement remain confidential, Swisscom announced that it will “contribute substantially to the necessary investments” in return for “exclusive long-term access to up to two fibre-optic cables per household and business customer.”<sup>303</sup>

Pfyn: In August 2009, the municipality of Pfyn and Swisscom entered into a cooperation agreement for the construction of a fiber-optic network. Pfyn is a small municipality in a rural area of the canton Thurgau. The focus of the cooperation is on a village called Dettighofen, which is currently an underserved area with regard to both TV and Internet services. The Dettighofen fiber-network will be built by the Elektrizitätswerk Pfyn and includes four fibers per household, two of which will be allocated to Swisscom. According to the press release, consumers will receive one connection box per household, enabling them to simply switch the connector cable to change to another provider.<sup>304</sup>

Lausanne: In September 2009, Industrial Services Lausanne (which provides, inter alia, cable TV to its citizens) and Swisscom entered a collaboration aimed at constructing a pilot fibre-optic network in the areas of Chailly and Praz Séchaud.<sup>305</sup> According to the letter of intent, Lausanne Industrial Services will build the fiber network in Chailly and Swisscom the fiber network in Praz Séchaud. In contrast to other models, only 500 buildings – and not the 3,000 individual households in the pilot area – will be connected to the four fibers, of which each partner will control two. Both partners committed to the standards of the Federal Office of Communications (OFCOM) regarding household connections. While the details of the deal remain confidential, Swisscom seems to bear a large portion of the financial investment.<sup>306</sup> Based on this pilot project, the city of Lausanne and Swisscom will later decide whether to extend the partnership across the entire municipality.

Fribourg: The canton of Fribourg, the electricity company Groupe E, and Swisscom launched a fiber network pilot project for the district of Torry in Fribourg and for parts of the village of Neyruz. According to the November 2009 press release, the district of Torry fiber-optic network will connect

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298 <http://www.ewb.ch/de/ueber-uns/medien/medienmitteilungen/2009/eckpunkte-vereinbart.html>

299 [http://www.swisscom.ch/GHQ/content/Media/Medienmitteilungen/2009/20091218\\_MM\\_Glasfaser\\_Bern.htm?lang=en](http://www.swisscom.ch/GHQ/content/Media/Medienmitteilungen/2009/20091218_MM_Glasfaser_Bern.htm?lang=en)  
300 Id.

301 “Glasfasern in der halben Zeit.” Berner Zeitung, 19.12.2009, p. 23.

302 [http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2009/20090901\\_MM\\_Glasfasernetz\\_St.Gallen.htm?lang=en](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2009/20090901_MM_Glasfasernetz_St.Gallen.htm?lang=en)

303 Id.

304 <http://www.1888pressrelease.com/municipality-of-pfyn-tg-and-swisscom-to-cooperate-in-the-c-pr-141396.html>

305 [http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2009/20090909\\_MM\\_SIL.htm?lang=en](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2009/20090909_MM_SIL.htm?lang=en)

306 <http://www.fibre-suisse.ch/?p=773>

2,600 households and 150 companies, while the Neyruz network starts with 300 households. Every household or company will be connected to a cable with four fibers; Swisscom will offer services to all of its residential, corporate, and wholesales customers, while Groupe E plans to offer “an information transport service to all interested service providers, which will allow them to distribute their services without having to invest in the infrastructure,”<sup>307</sup> in addition to using the fiber infrastructure for intelligent energy management services. The canton of Fribourg acts as an investor. If the pilot is successful, the model is expected to expand gradually until the entire canton of Fribourg is fully fiber-connected by 2025.

Zurich: After extensive negotiations (the announcement of an agreement has been delayed twice),<sup>308</sup> the ewz (Elektrizitätswerk der Stadt Zürich) and Swisscom announced an agreement to work together on a single city-wide FTTH infrastructure that will connect practically every building to the high-speed network slated for completion in 2017. Swisscom will continue its efforts in the districts of Albisrieden, Enge, Hirslanden and Limmat, while ewz will be responsible for construction in the other districts. According to the press release, existing conduit infrastructures of both partners will be used, allowing construction activities to be coordinated. They plan to jointly invest around CHF 430 million in the construction of the city's fiber network. As in other cities, the two parties will grant one another a long-term irrevocable right of use to one fiber per connection and provide competitors non-discriminatory access to the network. The framework includes a one-time payment between ewz and Swisscom in an amount that has not been made public. They will share operating and maintenance costs. The agreement between ewz and Swisscom will avoid the construction of two parallel networks in Switzerland's economically most important city, but changes the mandate from the March 2007 public vote (see above) and has therefore been criticized by some observers. It needs to be approved by the City Council, which has to modify ewz's business mandate and approve a new credit line. The electorate of the city of Zurich will have the final word.

Geneva: Another important milestone in the Fibre Suisse strategy is the recently announced agreement between Geneva Industrial Services and Swisscom, who will work hand-in-hand on the construction of a fiber-optic network that connects households and businesses in the city of Geneva, the suburbs and in surrounding areas.<sup>309</sup> To facilitate coordination of the construction work, taking into account technical reasons and population density, the canton of Geneva has been divided up into three zones. Swisscom will be responsible for construction in the city of Geneva, while Geneva Industrial Services will connect larger adjacent communities. A separate agreement will outline the cooperation for the rural communities surrounding Geneva. The majority of households and businesses in the canton of Geneva shall be connected within four years. The Geneva model follows by and large the conceptual approach taken in other cities and supports the standards of the Federal Office of Communications (OFCOM) relating to household connections.

In order to define a framework for cooperation in terms of network construction and the standardization of network access, the Swiss Federal Communications Commission (ComCom) launched a FTTH Roundtable Initiative in the summer of 2008, which facilitated some of the collaborations mentioned in the previous paragraphs. Since then, key decision-makers from both the private and public sector

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307 [www.swisscom.com/NR/.../20091130\\_MM\\_Pilotprojekt\\_Torry\\_en.pdf](http://www.swisscom.com/NR/.../20091130_MM_Pilotprojekt_Torry_en.pdf)

308 “Nach wie vor keine Einigung zwischen ewz und Swisscom. Verhandlungen ueber Kooperation beim Glasfasernetz-Bau dauern an.” *Neue Zuercher Zeitung*, 19.12.2009, p. 19.

[http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2010/20100128\\_MM\\_ewz\\_Swisscom.htm](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2010/20100128_MM_ewz_Swisscom.htm)

309 [http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2010/20100204\\_MM\\_Glasfasernetz\\_Genf.htm](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2010/20100204_MM_Glasfasernetz_Genf.htm)

involved in the construction of fiber-optic networks across Switzerland have met four times. These stakeholders have reached consensus regarding the following FTTH core principles:<sup>310</sup>

**Creation of one single fiber-optic network:** The stakeholders agreed to work together in a coordinated manner in order to avoid the parallel construction of new fiber networks. (Within this framework, however, some public utilities companies insisted on a parallel connection from the manhole to the respective operating centers of both the utilities and Swisscom.)

**Multiple Fiber Model:** All roundtable participants have committed to build a network with multiple fibers leading into every building. They agreed that at least four fibers are required to ensure access under non-discriminatory and reasonable conditions.

**Non-discriminatory access:** The stakeholder agreed that all providers must have access to the fiber-optic network under the same conditions. Access based on non-discriminatory terms will be granted to both the cable infrastructure layer (Layer 1) and the service layer for products and applications (Layer 3). In addition, Swisscom committed to make an offer for layer 2 if the market demands it and if the costs of platform modification can be split.

The conversations have been structured along four thematic tracks, which have been explored by dedicated working groups. Led by the Swiss Federal Office of Communications (OFCOM), the working groups have drafted recommendations for better coordination of household connection to fiber networks.<sup>311</sup> The first working group (“L1”) deals with the specification of internal domestic cabling. The second group (“L2”) focuses on the standardization of network access at the transport level of the network. A third working group (“L1B”) dealt with the definition of the transfer points where the operators’ and alternative providers’ networks are connected up. The fourth group (“AG3”) has drafted recommendations regarding the design of contracts between house owners and fiber-optic network operators. After the last round of negotiations, the following agreement has been reached regarding technical standards:<sup>312</sup>

**Uniform home installation:** In order to make it easier for customers to switch providers, the roundtable participants have drafted a series of technical recommendations regarding home installation.<sup>313</sup> In essence, the multi-fiber connection must ensure that various network and service providers have access to customers. In addition, the operators agreed on a single plug connector type for sockets in homes so that customers do not have to search for the correct adapter cable when they switch providers. On a separate, but related note, Swisscom recently announced that it reached an agreement with the Swiss Homeowners' Association (HEV) and the Zurich Real Estate Association (VZI) about the costs of in-house cable installation. According to the agreement, Swisscom will finance cabling inside buildings in order to foster its FTTH initiative and provide easy access for its customers. In the past, Swisscom has covered the costs of laying fiber-optic cables only up to building, but not inside the home. Swisscom, HEV and VZI agreed to draft a sample contract and have reached consensus on all of the main issues regarding in-house cabling. Most notably, homeowners who have already paid these costs for in-house FTTH cabling will be reimbursed.

**Access to the fiber-optic network for service providers:** Other recommendations are dealing with standardized network access for service providers. An open interface ensures that service providers will

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310 See FTTH-Roundtable vom 5. Oktober 2009 (unpublished).

311 <http://www.comcom.admin.ch/themen/00769/index.html?lang=en>

312 The following summary is based on

<http://www.comcom.admin.ch/aktuell/00429/00457/00560/index.html?lang=en&msg-id=29395>

313 [http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2010/20100203\\_MM\\_HEV\\_Schweiz.htm](http://www.swisscom.com/GHQ/content/Media/Medienmitteilungen/2010/20100203_MM_HEV_Schweiz.htm)

enjoy network access to customers at all times. This, for instance, will enable customers to opt for a different service provider on the same network without any technical complications. The companies involved in the discussion are committed to a uniform platform for ordering and operating optical fibers.

Contracts between house owners and fiber-optic network operators: The participants identified the need for guiding principles for contracts between house owners and fiber network operators. In order to make it easier for customers to switch providers, the group advocated for harmonized terms of service regarding notice and cancellation in consumer contracts. The working group seeks to adopt a joint recommendation in the near future and will further explore this set of issues in the months to come.

Moving forward, the FTTH Roundtable Initiative continues to operate in a slightly modified configuration with two different working groups aimed at clarifying open questions. ComCom also announced that it will be examining the need for new regulatory instruments in order to address any future shortcomings in the FTTH market; it is expected that the Swiss Federal Council will express its views on this matter to the parliament by mid-2010 at the latest.<sup>314</sup>

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<sup>314</sup> <http://www.comcom.admin.ch/aktuell/00429/00457/00560/index.html?lang=en&msg-id=29395>

## 4.14 Annex: Econometrics Literature Review

### 4.14.1 Follow-up Note on Estimating the Impact of Unbundling on Internet Penetration Rates

We include in this section a review and follow-up on several of the econometric attempts, including our own, to estimate quantitatively the impact of unbundling on penetration rates. As described earlier, after an extensive review of the literature, we are confident that the available evidence strongly supports our decision to rely on detailed qualitative analysis for conducting international comparisons. Nevertheless, cross-country quantitative analysis may indeed provide a heuristic aid to inform and guide qualitative analyses. We do not believe that cross-country empirical work, given the several data and model specification issues, can reliably inform questions of policy efficacy.

In the draft version of this report released in October 2009, we included a reanalysis of a paper commissioned by the OECD (De Ridder 2007) and critiqued by Boyle, Howell and Zhang (2008). We took those papers on their own methods, and explored the particular effects of influential points, in that case Switzerland, and the sensitivity to assumptions about the formal adoption of rules versus the actual effectiveness of implementation.<sup>315</sup> That analysis drew several responses, in particular in comments from one of the authors of Boyle, Howell, and Zhang, as well as in the response filed to the FCC by the consulting firm Empiris<sup>316</sup> on behalf of the National Cable & Telecommunications Association and United States Telecom Association.<sup>317</sup> The Empiris declaration in particular took the challenge head on, cleared up some of the quirks in the approaches of the two earlier papers, and added new data. We follow up on their analysis here, with all prior caveats about this approach in full force.

The Empiris declaration replicates the analysis with more observations by virtue of dropping the price variable. The Empiris declaration agrees with our sense that including price as an explanatory variable would be inappropriate and it is preferable to drop it as an explanatory variable. The authors remove Greece and The Slovak Republic, and add several other potential explanatory variables.<sup>318</sup> In addition to the standard issues with cross-country analyses, estimating the impact of particular policies on the broadband penetration rates is complicated by two particularly knotty issues. These issues carry through from De Ridder (2007), through Boyle, Howell, and Zhang (2008), the work included in our draft report, the Empiris declaration, and comments submitted to the FCC by Howell, along with many other related papers included in the literature review.

The first issue is that technology diffuses over time, and most observers agree that it diffuses in some form of an S curve—slowly at first, then at higher rates, and then slowly again as markets approach saturation. The second thing is that regulatory regimes are not binary. The existence of a policy masks

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315 Several comments to our draft report misunderstood the intention and logic of searching for influential points in the data.

We ‘dropped’ Switzerland, along with every other country in turn, to estimate the impact of individual countries on the analysis, not, as several comments suggested, because we were unhappy with the impact its inclusion had on the results.

316 Declaration of Robert W. Crandall, Everett M. Ehrlich, and Jefferey A. Eisenbach Regarding the Berkman Center Study (NBP Public Notice 13), November 16, 2009.

317 One other document, by the Phoenix Center, was more a vehement denunciation than a critique. We note only that both Empiris and Howell managed to analyze and criticize our analysis without mischaracterizing our technique or findings as downward sloping supply curves. We also note that the Empiris declaration, footnote 19, explains that the data do not provide sufficient price data to perform the two-stage least squares method that the Phoenix Center protested to be the only way to analyze these data, and which it then used to “find” the “errors” in our study.

318 We don’t understand the logic of including population as an explanatory variable. We found no explanation for including this variable.

tremendous variation across countries in the scope, depth and implementation of the policy.<sup>319</sup> Moreover, the date of formal passage of a rule is rarely the day on which it is effectively implemented and creates results. Regulators learn; entrants learn; incumbents learn. They all adjust their behavior over time, so that it is reasonable to assume that a regulatory system will function more effectively three or five years after initial implementation than immediately on the first year.<sup>320</sup> De Ridder sought to account for this effect with a variable GUyrs (Government-unbundling-years). Efforts to account for the second fact, however, encounter the problem that they might be simply capturing the natural S-curve diffusion. This was the nub of the Boyle, Howell, and Zhang critique, which is well taken. This is indeed a genuinely hard problem to solve. The authors of Empiris declaration tried to control for by using a variable describing the number of years since DSL was introduced into a country, and a separate dummy variable, for every year on which a country did, or did not, have unbundling in place, following Boyle, Howell and Zhang.

When they introduce DSL years, Empiris finds that the significant effect of unbundling over time, GUyrs, is rendered insignificant, supporting the work of Boyle, Howell, Zhang. However, when they replace GUyrs with their simple dummy variable for unbundling, they find that “Unbundling is negative and statistically significant,” suggesting that with more data over more time one can show that “unbundling has slowed the pace of broadband adoption in the sample countries.” (Empiris declaration, para. 27.) Empiris admirably provided their data in Table D.2. of the declaration allowing us to replicate the analysis using their data.

As a reality check, it is first important to recognize the value for the ‘unbundling’ variable is 1 for almost all countries in the dataset. Only Turkey, Mexico, the Czech Republic, Hungary, New Zealand, and Switzerland have a value of 0 for any appreciable amount of time in this dataset. The conclusions of the analysis, in other words, are that the rest of the countries have been doing something wrong, and this particular set of countries have done better by not adopting unbundling. The analysis suggests that the results of one country in the top quintile, plus four countries from the bottom quintile and one from the fourth quintile, should lead us to follow those countries' strategy of rejecting unbundling.

Two things are problematic with the Empiris analysis that we believe lead to this odd conclusion. The first is that, while GUyrs and DSLyears do have a simple correlation coefficient of 0.58, a multicollinearity test reveals that including both GUyrs and DSLyears in the model does not bias the results. This means that including only unbundling, and losing the data on how long an unbundling regime has been functioning, unnecessarily omits useful data. The second is that according to numerous sources, the correct method to employ with this type of data is not the Parks Method (FGLS) employed by Empiris. The Parks method is only efficient when the number of time periods is substantially greater than the number of units.<sup>321</sup> In this data set, the number of units is twice as large as the number of time

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319 In our draft report, we constructed an alternative measure of the unbundling policy variable in an attempt to capture more accurately the point at which each country implemented unbundling in a serious way, which is not captured by the existing unbundling variable. This new variable was constructed using our own best judgment after a review of the experiences of each country. We were fairly criticized in several of the comments for injecting too much subjectivity into the analysis and thereby leaving open the possibility that our own biases would influence the results.

320 In comments submitted to the FCC, Howell makes the case for using a dummy variable to measure unbundling, implying that the full impact of the policy change will be felt in the first year. We are not convinced.

321 The Parks method can underestimate standard errors. (Hurwicz, L. 1950. “Least-Squares Bias in Time Series.” In *Statistical Inference in Dynamic Economic Models*, ed. T. Koopmans. New York: Wiley.) Although the Parks method performs well in large samples (Cramer, J. 1986. *Econometric Applications of Maximum Likelihood Methods*. New York: Cambridge University Press.), the Parks method should not be used unless T is at least as big as N (Beck, Nathaniel, Jonathan N. Katz, R. Michael Alvarez, Geoffrey Garret, and Peter Lange. 1993. “Government Partisanship, Labor Organization, and Macroeconomic Performance: A Corrigendum.” *American Political Science Review* 87: 945-

points, and therefore leads to an underestimation of standard errors by at least 20%. One way to correct for this is apply a method of panel corrected standard errors (Beck and Katz, 1995). The following table was calculated using panel corrected standard errors for heteroskedastic error terms and autocorrelation. When employing this method, the dummy variable for unbundling is negative, but no longer statistically significant. Replacing unbundling with the GUyrs variable, we can see a positive and statistically significant relationship. In other words, on these new data that Empiris introduces, when we use the proper test and account for the increasing effectiveness of a regulatory regime over time, unbundling has a positive effect on penetration.

We do not argue here that by this analysis alone one can prove the efficacy of unbundling. The data are not capable of delivering that kind of certainty. Separating out the effects of diffusion over time, and the effects of improved regulatory effectiveness over time is genuinely hard. Deriving determinate causal claims from a simple cross-country regression is highly uncertain. This is true even when we ignore that many of the actions may be strategically driven, or the regional variation within countries, or any one of many complexities. Some have taken the argument in another direction to suggest that the inability of this approach to produce more reliable results suggests that unbundling has had no appreciable impact on broadband deployment. This is not correct. The inherent short-comings of this approach is why it is so important to use case studies and qualitative analysis, or narrow and well designed econometric studies using micro-data and exogenous instruments and natural experiments.

Panel Corrected Standard Error Model		
VARIABLES	(1) GUyrs	(2) Unbundled
guyrs	0.887** (0.300)	
dslyears	2.299*** (0.278)	3.014*** (0.172)
pop_density	0.011@ (0.006)	0.011@ (0.006)
pops_mils	-0.025*** (0.007)	-0.014* (0.007)
gdp	0.000* (0.000)	0.000*** (0.000)
unbundled		-1.328 (0.814)
Constant	-8.407*** (1.990)	-10.207*** (2.124)
Observations	168	168
R-squared	0.492	0.460
Number of countries	28	28

Standard errors in parentheses

\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

48). Even if T 4 times greater than N, the Parks method still underestimates standard errors by 20% (Beck, Nathaniel, Jonathan N. Katz, 1995. "Nuisance vs. Substance: Specifying and Estimating Time-Series-Cross-Section Models" Political Analysis, 6:1.

### 4.14.2 Complete Country Influence Testing Results for Wallsten Hausladen

Table 1: Without Austria

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.098@ (0.055)	-0.040 (0.044)		
GDP per Cap	-0.050 (0.172)	0.034 (0.066)	-0.106 (0.263)	0.020 (0.093)
Bitstream Lines per Cap			-0.219 (0.133)	-0.064 (0.055)
Constant	0.008 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 4: Without Cyprus

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.107@ (0.057)	-0.042 (0.046)		
GDP per Cap	-0.065 (0.163)	0.028 (0.063)	-0.125 (0.257)	0.014 (0.090)
Bitstream Lines per Cap			-0.231 (0.138)	-0.068 (0.058)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.008)	0.001 (0.003)
Observations	236	236	225	225
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.24	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 2: Without Belgium

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.119@ (0.059)	-0.045 (0.049)		
GDP per Cap	-0.064 (0.170)	0.029 (0.066)	-0.100 (0.256)	0.021 (0.090)
Bitstream Lines per Cap			-0.219 (0.139)	-0.065 (0.057)
Constant	0.008 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.21	0.05	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 5: Without Czech Republic

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.104@ (0.057)	-0.042 (0.045)		
GDP per Cap	-0.048 (0.168)	0.033 (0.065)	-0.101 (0.257)	0.021 (0.091)
Bitstream Lines per Cap			-0.222 (0.135)	-0.065 (0.056)
Constant	0.007 (0.005)	0.001 (0.002)	0.009 (0.008)	0.001 (0.003)
Observations	238	238	227	227
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 3: Without Bulgaria

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.103@ (0.056)	-0.041 (0.045)		
GDP per Cap	-0.048 (0.167)	0.034 (0.065)	-0.100 (0.255)	0.021 (0.090)
Bitstream Lines per Cap			-0.219 (0.133)	-0.064 (0.055)
Constant	0.007 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	242	242	231	231
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 6: Without Denmark

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.105@ (0.056)	-0.041 (0.044)		
GDP per Cap	-0.056 (0.161)	0.040 (0.074)	-0.121 (0.239)	0.025 (0.097)
Bitstream Lines per Cap			-0.226 (0.134)	-0.064 (0.055)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.007)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.17	0.04	0.22	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 7: Without Finland

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.097 (0.058)	-0.042 (0.047)		
GDP per Cap	-0.042 (0.176)	0.035 (0.067)	-0.093 (0.266)	0.024 (0.095)
Bitstream Lines per Cap			-0.218 (0.134)	-0.065 (0.056)
Constant	0.007 (0.005)	0.001 (0.002)	0.009 (0.008)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 8: Without France

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.101 (0.062)	-0.043 (0.049)		
GDP per Cap	-0.054 (0.165)	0.034 (0.065)	-0.102 (0.273)	0.021 (0.097)
Bitstream Lines per Cap			-0.268 (0.165)	-0.084 (0.070)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.008)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.24	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 9: Without Germany

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.108 (0.075)	-0.052 (0.059)		
GDP per Cap	-0.048 (0.164)	0.041 (0.070)	-0.183 (0.246)	0.021 (0.092)
Bitstream Lines per Cap			-0.261@ (0.147)	-0.065 (0.055)
Constant	0.007 (0.005)	0.001 (0.002)	0.012 (0.008)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.26	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 10: Without Greece

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.116@ (0.059)	-0.045 (0.048)		
GDP per Cap	-0.054 (0.176)	0.031 (0.067)	-0.103 (0.266)	0.021 (0.092)
Bitstream Lines per Cap			-0.226 (0.141)	-0.065 (0.055)
Constant	0.008 (0.005)	0.001 (0.002)	0.009 (0.008)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.20	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 11: Without Ireland

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.106@ (0.057)	-0.042 (0.045)		
GDP per Cap	-0.023 (0.195)	0.040 (0.075)	-0.091 (0.273)	0.023 (0.096)
Bitstream Lines per Cap			-0.221 (0.134)	-0.064 (0.055)
Constant	0.007 (0.006)	0.001 (0.002)	0.009 (0.008)	0.001 (0.003)
Observations	235	235	224	224
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 12: Without Italy

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.103@ (0.055)	-0.040 (0.044)		
GDP per Cap	-0.049 (0.171)	0.028 (0.063)	-0.094 (0.267)	0.017 (0.090)
Bitstream Lines per Cap			-0.220 (0.133)	-0.063 (0.054)
Constant	0.007 (0.005)	0.001 (0.002)	0.009 (0.008)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.18	0.04	0.22	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 13: Without Latvia

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.107@ (0.059)	-0.044 (0.048)		
GDP per Cap	-0.049 (0.169)	0.033 (0.067)	-0.102 (0.258)	0.021 (0.093)
Bitstream Lines per Cap			-0.222 (0.136)	-0.066 (0.057)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.008)	0.001 (0.003)
Observations	237	237	226	226
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 14: Without Luxembourg

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.091 (0.057)	-0.036 (0.041)		
GDP per Cap	0.723 (0.633)	0.345 (0.325)	1.063 (0.720)	0.476 (0.419)
Bitstream Lines per Cap			-0.259@ (0.144)	-0.079 (0.067)
Constant	-0.011 (0.015)	-0.007 (0.007)	-0.017 (0.016)	-0.009 (0.009)
Observations	234	234	223	223
Number of Countries	26	26	25	25
Adjusted R-squared	0.21	0.06	0.29	0.09

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 15: Without Malta

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.113@ (0.059)	-0.044 (0.048)		
GDP per Cap	-0.072 (0.160)	0.026 (0.061)	-0.124 (0.254)	0.014 (0.089)
Bitstream Lines per Cap			-0.227 (0.137)	-0.067 (0.057)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.008)	0.001 (0.003)
Observations	237	237	226	226
Number of Countries	26	26	25	25
Adjusted R-squared	0.20	0.04	0.24	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 16: Without Netherlands

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.108@ (0.055)	-0.040 (0.044)		
GDP per Cap	-0.051 (0.163)	0.033 (0.067)	-0.100 (0.255)	0.021 (0.090)
Bitstream Lines per Cap			-0.219 (0.133)	-0.064 (0.055)
Constant	0.008 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	233	233	233	233
Number of Countries	26	26	26	26
Adjusted R-squared	0.18	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 17: Without Poland

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.114@ (0.059)	-0.045 (0.048)		
GDP per Cap	-0.070 (0.162)	0.026 (0.062)	-0.122 (0.258)	0.014 (0.090)
Bitstream Lines per Cap			-0.229 (0.138)	-0.067 (0.058)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.008)	0.001 (0.003)
Observations	236	236	225	225
Number of Countries	26	26	25	25
Adjusted R-squared	0.20	0.04	0.24	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 18: Without Portugal

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.100@ (0.056)	-0.040 (0.044)		
GDP per Cap	-0.092 (0.146)	0.027 (0.063)	-0.193 (0.230)	0.000 (0.086)
Bitstream Lines per Cap			-0.246@ (0.143)	-0.070 (0.060)
Constant	0.009@ (0.005)	0.001 (0.002)	0.012 (0.007)	0.002 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.25	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 19: Without Romania

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.103@ (0.056)	-0.041 (0.045)		
GDP per Cap	-0.048 (0.167)	0.034 (0.065)	-0.100 (0.255)	0.021 (0.090)
Bitstream Lines per Cap			-0.219 (0.133)	-0.064 (0.055)
Constant	0.007 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	242	242	231	231
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 20: Without The Slovak Republic

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.096 (0.060)	-0.045 (0.048)		
GDP per Cap	-0.048 (0.164)	0.032 (0.067)	-0.103 (0.250)	0.019 (0.094)
Bitstream Lines per Cap			-0.216 (0.138)	-0.068 (0.058)
Constant	0.007 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	236	236	225	225
Number of Countries	26	26	25	25
Adjusted R-squared	0.17	0.05	0.21	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 21: Without Slovenia

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.104@ (0.056)	-0.041 (0.045)		
GDP per Cap	-0.053 (0.168)	0.032 (0.065)	-0.105 (0.257)	0.020 (0.091)
Bitstream Lines per Cap			-0.221 (0.134)	-0.064 (0.055)
Constant	0.008 (0.005)	0.001 (0.002)	0.009 (0.008)	0.001 (0.003)
Observations	236	236	225	225
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 22: Without Spain

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.108@ (0.057)	-0.042 (0.046)		
GDP per Cap	-0.053 (0.174)	0.032 (0.067)	-0.118 (0.276)	0.015 (0.096)
Bitstream Lines per Cap			-0.247@ (0.144)	-0.073 (0.063)
Constant	0.008 (0.005)	0.001 (0.002)	0.010 (0.008)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.20	0.04	0.25	0.06

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 23: Without Sweden

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.098@ (0.056)	-0.041 (0.045)		
GDP per Cap	-0.080 (0.101)	0.027 (0.053)	-0.090 (0.156)	0.018 (0.080)
Bitstream Lines per Cap			-0.115 (0.084)	-0.058 (0.062)
Constant	0.007 (0.004)	0.001 (0.002)	0.006 (0.005)	0.001 (0.002)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.19	0.02	0.16	0.02

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1

Table 24: Without United Kingdom

VARIABLES	(1)	(2)	(3)	(4)
	Entrant Fiber per Cap	Incumben t Fiber per Cap	Entrant Fiber per Cap	Incumben t Fiber per Cap
Unbundled Lines per Cap	-0.111@ (0.058)	-0.043 (0.047)		
GDP per Cap	-0.049 (0.178)	0.034 (0.070)	-0.100 (0.261)	0.023 (0.093)
Bitstream Lines per Cap			-0.216 (0.134)	-0.063 (0.054)
Constant	0.008 (0.005)	0.001 (0.002)	0.009 (0.007)	0.001 (0.003)
Observations	233	233	222	222
Number of Countries	26	26	25	25
Adjusted R-squared	0.20	0.04	0.23	0.05

Robust standard errors in parentheses  
\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, @ p<0.1