Europe's Next Generation Networks:

The Essential Role of Pro-Competitive Access Regulation

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Foreword

The modernisation and harmonisation of the European telecommunications market has been one of the remarkable achievements of the European Union over the past two decades. However, to maintain this level of progress and fulfil the promise of a Digital Economy, a renewed commitment to widely accessible and affordable high-speed broadband networks is necessary.

This study, for which the *Internet Economy Foundation (IE.F)* commissioned the respected London economic consultancy DotEcon, examines how best to foster the next wave of investment in and competition among the broadband networks of the future, as the relevant legal framework is currently being updated by the European Commission as part of its strategy for a Digital Single Market.

With our current study we build upon our first publication, in which we identified universal access to high-speed broadband infrastructure as one of the most important steps for the development of the Internet Economy in Europe. Next Generation Broadband is the basis for the economy of tomorrow!

The *Internet Economy Foundation* was established with the aim of being an inquisitive think-tank, an independent advisor and a competent dialogue partner in this dynamic environment. It aims to be an impartial organization and a pioneering voice for politics, the economy and society, providing information about the latest developments and defining the interests of the German and European Internet economy in a global context.

We trust that this study will provide a meaningful contribution to the debate about how to best move Europe's digital economy – and society as a whole – forward.

Friedbert Pflüger
Chairman
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Foundation

Clark Parsons
Managing Director
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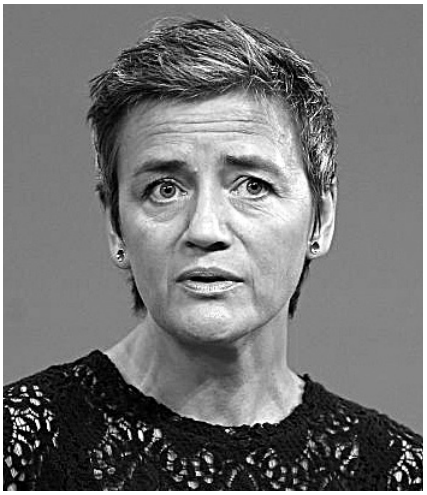
"We need to make sure that the level of competition achieved so far is not only maintained but enhanced, in order to enjoy all the benefits of a digital single market."



Margrethe Vestager
EU Commissioner for Competition

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Executive Summary

We look critically at claims that less access regulation would mean more investment

This paper provides a critical assessment of claims that regulatory obligations on incumbent telecommunications operators to provide access to their network infrastructure discourage investment, in particular in next generation access (NGA) networks, and that this is responsible for a widening gap between Europe and the US in terms of availability of fast broadband.

Access regulation has created substantial benefits in terms of enabling new entry, leading to greater competition, lower prices, better quality and more choice

Our starting point is the observation that access regulation has created substantial benefits in Europe. It has played a key role in opening up former monopoly markets to vibrant competition, which in turn has brought lower prices, innovation, more choice and better service quality. As a result, broadband penetration across Europe is high, contributing to Europe's economic position, its competiveness and overall welfare.

The overwhelming majority of access-based entry is making use of unbundled local loops. This involves substantial investment from new entrants, but gives them greater control over the services they offer and promotes differentiation, and makes the offers of new entrants more attractive: new entrants have gained more market share in countries where they rely to a greater extent on unbundled loops instead of other forms of access (such as bitstream access).

Access regulation can affect investment incentives – but there are many other drivers of NGA investment, and these are equally essential

We examine the drivers of investment in NGA infrastructure. Whilst access regulation can affect investment costs and expected return, there are many other factors that are often more important. Incumbents may often be reluctant to invest because this would cannibalise the rents they can earn from their legacy networks. Therefore, operators without existing copper assets or incumbents whose legacy networks are of poor quality are often found to lead investment in new network infrastructure. Infrastructure competition from other access networks provides a strong incentive for upgrading or replacing legacy copper networks and therefore drives investments. Customer willingness to pay for higher speeds and greater capacity is crucial, and thus the development of services that make use of the improved capability of NGA infrastructure matters for investment.

We show that many of the examples that have been put forward to support the claim that investment has followed from a relaxation of access obligations are misleading, as they ignore these other factors. Thus, whilst we acknowledge that access regulation can affect investment incentives, and that badly designed access regulation can have a chilling effect, we find no support for the claim that access obligations and competitive pressure in Europe have actually held back rather than fostered investment.

There is no evidence to suggest that access regulation has hindered investment

This suggests that any upside from pushing back or phasing out regulatory obligations is limited, whilst the downside is substantial: without explicit obligations, many of the benefits that have been created by access regulation could be lost. We consider the extent to which infrastructure competition or ex-post control within the standard competition law framework would provide effective protection, and conclude that neither of these two options would safeguard the benefits from a competitive market place that we experience right now.

Whilst any gains from pushing back access regulation are limited and speculative, the potential downside is substantial

Infrastructure competition will be limited, both geographically and in terms of the number of competing access networks that could be sustained. It is unlikely to provide strong incentives to the network operators to open up their networks to competitors. The fact that cable operators do not provide access to their networks even though this should be technically feasible is a strong indication that access will not be provided without explicit obligations to do so. In the extreme case, competition across the entire value chain could be limited by the extent to which competition is sustainable in the local access network, leading to a duopoly or narrow oligopoly. Consumers would suffer as a result. Competition law provides insufficient protection, as resolving disputes simply takes too long to be of any value for potential access seekers confronted with discriminatory or exclusionary behaviour from incumbent network operators. The New Zealand experience shows that competition law alone does not support a competitive telecommunications sector.

Neither infrastructure competition nor existing competition law provide an effective alternative to access regulation

The US example demonstrates that pushing back access regulation leads to higher prices and lower penetration, but not to more investment in NGA roll-out

To the extent that the US provides a relevant comparator, we show that there is little evidence to suggest that the regulatory reform of 2005 has spurred investment. Even if pushing back access obligations had resulted in more investment, customers have not gained. Availability of high-speed broadband is better in the US because of the greater prevalence of cable networks – but this is not the result of laxer access obligations on incumbent telecoms carriers. In any case, prices of high-speed broadband are substantially higher, and take up is lower in the US than in most European countries.

The challenge is to design access obligations that promote competition and investment

This means that there is a continuing need for access obligations – removing them would have no positive impact on investment incentives, and could jeopardise the level of competition we have experienced to date. If providing stronger investment incentives is becoming more important as we move forward, the answer is not to remove access regulation, but to design obligations that protect competition and promote investment.

Access regulation needs to set more explicit investment incentives, either through differentiated charging or through direct investment requirements

- First, it is not sufficient that access charges allow incumbents to recover the cost of investing in new network infrastructure without requiring them actually to make such investments in order to earn the corresponding revenues. The obvious answer to this problem is to differentiate access charges, with lower charges for access to legacy networks. However, the scope for such differentiation is limited by the difference in retail prices that can be sustained for services delivered over NGA networks and over legacy networks respectively. This difference may – at least at present – be small and may only become bigger with the development of more services that fully exploit the capabilities of NGA infrastructure. As the development of such services in turn depends on infrastructure, there is a co-ordination issue that may only be solved through being more explicit about investment requirements.

The regulatory framework should provide greater flexibility for access seekers and access providers to negotiate mutually beneficial agreements

- Second, the regulatory framework should provide greater flexibility to access seekers and access providers to negotiate access agreements, which can create substantial benefits. This could support, for example,

risk-sharing models in which access seekers receive discounts relative to regulated 'pay-as-you-go' access charges in exchange for commitments that move some of the risk from uncertain future demand conditions from the access provider to the access user.

- Third, there needs to be a strong regulatory back-stop to ensure that investment requirements are met and negotiations between access seekers and network operators can take place on a level playing field. This implies a clear requirement to provide some form of access at regulated terms that provides a reasonably attractive fall-back option for access seekers in case they cannot come to an agreement. The specification of such a default access service may vary across markets, but not the need for such a back-stop.

But commercial negotiations are no substitute for access regulation and the need for strong and clear obligations is paramount

Zusammenfassung

Wir setzen uns kritisch mit der Behauptung auseinander, dass die Zugangsregulierung investitionshemmend ist

Diese Studie setzt sich kritisch mit Behauptungen auseinander, nach denen die Zugangsregulierung für den Investitionsstau im Breitbandausbau verantwortlich ist, der wiederum dazu geführt hat, dass Europe in der Verfügbarkeit von Hochgeschwindigkeitsanschlüssen zunehmend hinter den Vereinigten Staaten zurück fällt.

Zugangsregulierung war entscheidend für die Entwicklung des Wettbewerbs im Telekommunikationssektor, der wiederum zu Innovation, mehr Qualität und niedrigeren Preisen geführt hat

Unser Ausgangspunkt ist, dass die Zugangsregulierung in Europa zu erheblichen Vorteilen für den Endverbraucher geführt hat. Regulatorische Auflagen, die Wettbewerbern den Zugang zu den Netzen der etablierten Betreiber ermöglichen, haben entscheidend dazu beigetragen, dass die alten Monopolmärkte für alternative Anbieter geöffnet wurden und so wettbewerblich geprägte Telekommunikationsmärkte entstanden sind. Dieser Wettbewerb brachte nicht nur niedrigere Preise, sondern auch eine Vielfalt von innovativen und qualitativ hochwertigen Diensten. Die daraus resultierende Versorgung mit Breitbanddiensten trägt zur Stärkung der Wirtschaftskraft Europas, seiner Wettbewerbsfähigkeit und dem gesellschaftlichen Gemeinwohl bei.

Markteinsteiger machen von der Möglichkeit, die entbündelten Teilnehmeranschlussleitungen (TAL) der etablierten Betreiber zu nutzen, regen Gebrauch – die überwiegende Mehrzahl der von den neuen Wettbewerbern bereitgestellten Anschlüssen nutzt die entbündelte TAL. Im Vergleich zu alternativen Vorleistungen (wie etwa dem Bitstromzugang) erfordert dies größere Investitionen der Neueinsteiger, gibt den Wettbewerbern aber mehr Kontrolle über Servicequalität und erlaubt mehr Differenzierung. Dies schlägt sich im Markterfolg nieder: in Ländern, in denen Neueinsteiger in größerem Umfang auf die entbündelte TAL zurückgreifen, erzielen sie einen höheren Marktanteil.

Zugangsregulierung kann im Prinzip Investitionsanreize beeinflussen – aber andere Faktoren sind genauso wichtig

Eine Analyse der Faktoren, die für Investitionen in den zukünftigen Breitbandausbau ausschlaggebend sind, zeigt, dass die Zugangsregulierung zwar sowohl Investitionskosten wie auch die erwarteten Erträge beeinflussen kann, es aber viele andere – und entscheidendere – Faktoren gibt.

Insbesondere für etablierte Betreiber spielt eine Rolle, dass sie mit ihren bestehenden Netzen Profite erwirtschaften können, ohne investieren zu müssen. Deshalb sind es oft Betreiber, die kein bestehendes Kupferanschlussnetz haben, oder deren Netz qualitativ minderwertig ist, die in den Glasfaserausbau investieren. Auch vom Infrastrukturwettbewerb geht ein starker Anreiz aus, die alten Kupfernetze zu modernisieren oder zu ersetzen und steigert so die Investitionen. Die Bereitschaft der Endkunden, für die höhere Qualität und den besseren Serviceumfang eines Breitbandnetzes einen Aufschlag zu bezahlen, ist ebenfalls wichtig. Deshalb kommt der Serviceinnovation in komplementäre Dienste, die die Fähigkeiten moderner Netze in vollem Umfang nutzen, eine entscheidende Rolle zu.

Wir zeigen, dass viele der Beispiele, die die These von der investitionshemmenden Wirkung der Zugangsregulierung stützen sollen, diese anderen Faktoren ignorieren und deshalb irreführend sind. Zwar kann die Zugangsregulierung Investitionsanreize beeinflussen (und schlechte Regulierung kann Investitionen verhindern), aber es gibt keine Indizien dafür, dass die Netzzugangsregulierung in Europa investitionshemmend war und der resultierende Wettbewerbsdruck nicht vielmehr zu höheren Investitionen geführt hat.

Es gibt keine Indizien dafür, dass Zugangsregulierung investitionshemmend war

Daraus folgt unmittelbar, dass etwaige Vorteile einer Beschränkung (oder gar der Abschaffung) von Zugangsverpflichtungen spekulativ und beschränkt sind. Dem gegenüber ist der potenzielle Schaden, den eine solche Politik verursachen kann, real und beachtlich. Ohne explizite Verpflichtung zur Bereitstellung des Netzzugangs für Wettbewerber stehen die Vorteile des Wettbewerbs, den die Zugangsregulierung ermöglicht hat, auf dem Spiel. Weder Infrastrukturwettbewerb noch wettbewerbsrechtlich fundierte Kontrollen sind allein in der Lage, den derzeit bestehenden Wettbewerb effektiv zu schützen.

Spekulativen und beschränkten Vorteilen einer Beschränkung von Zugangsverpflichtungen stehen reale und potenziell beachtliche Risiken gegenüber

Der Infrastrukturwettbewerb ist zwangsläufig beschränkt – sowohl geographisch, als auch in der Zahl der miteinander konkurrierenden Zugangsnetze. Es ist nicht zu erwarten, dass Infrastrukturwettbewerb alleine dafür

Weder Infrastrukturwettbewerb noch wettbewerbsrechtliche Vorschriften stellen einen sind ein effektiver Ersatz für Regulierungsauflagen

sorgt, dass die Netzbetreiber ihren Wettbewerbern auf freiwilliger Basis Netzzugang gewähren. Dass die bestehenden Kabelnetzbetreiber keinerlei Zugangsleistungen anbieten, obwohl dies technisch möglich sein sollte, ist ein deutliches Indiz dafür. Im Extremfall kann deshalb der Wettbewerb über die gesamte Wertschöpfungskette zu einem Duopol (oder einem engen Oligopol) verkümmern. Den Endkunden würde ein derart reduzierter Wettbewerb deutlich schaden. Wettbewerbsrechtliche Schutzvorschriften würden den Wegfall von Regulierungsauflagen nicht auffangen. Wettbewerbsverfahren brauchen einfach zu viel Zeit, um einen effektiven Schutz für Wettbewerber zu bieten, denen ein etablierter Betreiber den Netzzugang verweigert, oder die sich diskriminierenden Zugangsbedingungen ausgesetzt sehen.

Das Beispiel der USA zeigt deutlich, dass eine Rückführung von Entbündelungsauflagen zu höheren Preisen und weniger Nutzung führt – nicht aber zu mehr Investitionen

Es gibt keine Anzeichen dafür, dass die De-Regulierung in den USA in 2005 tatsächlich zu mehr Investitionen im Breitbandausbau geführt hat – aber selbst wenn dies der Fall sein sollte, dann haben die Verbraucher nicht davon profitiert. Die bessere Versorgung mit Breitbanddiensten in den Vereinigten Staaten resultiert aus den weit verbreiteten Kabelnetzen, für deren Ausbau die Rückführung von Entbündelungsauflagen ohne jegliche Bedeutung ist. Preise für vergleichbare Dienste in den Vereinigten Staaten sind höher als in Europa, und trotz größerer Verfügbarkeit werden die Angebote nicht in größerem Umfang genutzt.

Die Aufgabe ist die Entwicklung von Regulierungsauflagen, die sowohl Wettbewerb als auch Investitionen fördern

Verpflichtungen zur Bereitstellung von Zugangsleistungen sind weiterhin notwendig. Eine Beschränkung (oder gar eine Abschaffung) der Zugangsregulierung würde nichts zu Investitionen beitragen, hätte aber potenziell weitreichende Nachteile. Wenn es darum geht, mehr Investitionsanreize zu schaffen, ist die Antwort nicht die Abschaffung von Zugangsregulierung, sondern eine Gestaltung der Auflagen, die Wettbewerb schützt und Investitionen stimuliert.

Die Zugangsregulierung sollte explizit Investitionsanreize setzen – sei es durch eine Differenzierung von Zugangsentgelten oder explizite Investitionsvorgaben

- Dass Zugangsentgelte es den Netzbetreibern ermöglichen, Investitionskosten in moderne Netze zu decken, reicht als Investitionsanreiz nicht aus, wenn die Investition nicht wirklich gemacht werden müssen, um die

entsprechenden Einnahmen zu erwirtschaften. Die unmittelbare Antwort auf dieses Problem ist eine Differenzierung der Zugangsentgelte, mit einem Abschlag für den Zugang zu etablierten Kupfernetzen. Allerdings ist die maximale Differenz in den Zugangsentgelten durch die Preisdifferenz beschränkt, die sich im Endkundenmarkt für Dienste, die über NGA-Netze und alte Kupfernetze angeboten werden aufrecht erhalten lässt. Diese Preisdifferenz ist – zumindest derzeit – möglicherweise gering, und wächst nur dann, wenn hinreichend attraktive Dienste angeboten werden, die die Fähigkeiten moderner Zugangsnetze voll ausschöpfen. Die Entwicklung solcher Dienste wiederum hängt von der Verfügbarkeit der Netzinfrastruktur ab: es besteht ein Koordinationsproblem, das sich möglicherweise nur durch explizitere Investitionsvorgaben lösen lässt.

- Zugangsregulierung sollte flexible Vereinbarungen zwischen den Netzbetreibern, die Zugangsleistungen bereitstellen, und den Wettbewerber, die diese Vorleistungen nutzen, ermöglichen. Solche Vereinbarungen können zu erheblichen Effizienzgewinnen führen und zum Beispiel eine bessere Verteilung der Investitionsrisiken ermöglichen. Ermäßigte Zugangsentgelte (relativ zu den vom Regulierer spezifizierten ‚pay-as-you-go' Entgelten) im Gegenzug für eine Verpflichtung zur Abnahme von Zugangsleistungen seitens des Wettbewerbers können z. B. die Investitionsanreize verbessern.

Die Zugangsregulierung sollte flexible Arrangements zwischen Netzbetreibern und den Nutzern von Zugangsleistungen ermöglichen

- Solche flexibleren Vereinbarungen funktionieren allerdings nur dann, wenn potenzielle Wettbewerber sich in letzter Instanz auf explizite Auflagen zur Erbringung von Zugangsleistungen berufen können. Das bedeutet, dass klare regulatorische Verpflichtungen zur Bereitstellung des Netzzugangs erforderlich sind, die den Wettberbern eine effektive und kommerziell attraktive Option bieten, falls Verhandlungen scheitern. Welche detaillierten Zugangsleistungen dafür spezifisch erforderlich sind, kann durchaus von den Marktbedingungen abhängen – nicht aber, dass solche Auflagen weiterhin notwendig sind.

Allerdings sind freiwillige Vereinbarungen kein Ersatz für Zugangsregulierung, sondern funktionieren nur auf der Grundlage von effektiven Auflagen zur Bereitstellung des Netzzugangs

1 INTRO-DUCTION

Telecoms liberalisation in Europe has been a success story: most of us nowadays enjoy the benefits of ubiquitous internet connectivity that gives us access to an ever-growing range of services and allows us to communicate with others regardless of where they are at reasonable prices. This makes it is easy to forget that there was a time, not too long ago, when phone calls were kept short because they were expensive, making international calls was positively a luxury, internet connectivity was paid for by the minute, and video-conferencing was out of reach of almost all.

Full liberalisation of telecoms markets in Europe happened less than two decades ago.[1] Within this relatively short time, a sector that was once dominated by state-owned monopolies was transformed beyond recognition. Vibrant competition now provides consumers with greater choice, lower prices and more innovation.

Much of this change has of course been driven by rapid technological progress. However, regulatory policy has also played a major role in this process. It has opened up former monopoly markets and enabled new entry, which in turn allowed customers to benefit from greater competition and innovation.

Access regulation has been a key factor in the process of telecoms liberalisation

At the heart of these developments were obligations on incumbent operators to provide access to their network infrastructure and to interconnect with the networks of new entrants on terms and conditions that were subject to regulatory control.

The general idea of access regulation is that even where certain assets, such as network infrastructure, are not (or not easily) replicable, this need not limit competition. Being able to access such assets enables the provision of services over these networks, and allows competitors to build their own networks where replication is feasible. Requiring former monopolistic telecoms companies to allow competitors to use parts of their infrastruc-

1 For a brief overview of the liberalisation of the EU telecoms sector, see Cave (2009).

ture enabled new entrants to come into the market. Supported by growing demand for capacity, combined with changes in technology, it became clear that many segments of the market that were traditionally thought to be natural monopolies could sustain multiple competitors. New entrants invested in their own networks, and competing infrastructures now cover many parts of the value chain. Many new services have been developed, and new jobs have been created.

Without access obligations, competition across the entire value chain would have been (and would be) limited to the level of infrastructure competition that is sustainable in the part of the network with the strongest scale economies. Without access obligations, a natural monopoly over a tiny part of the network could spread across the entire sector.

Getting access regulation right is a challenging task

Access regulation pursues multiple objectives. Access obligations should support competition in the provision of services over the existing infrastructure and promote the development of complementary and competing infrastructures where feasible. This means that access charges (and more generally access conditions[2]) need to be set to provide the right incentives for both new entrants to invest in their own networks and for the incumbent access provider to maintain and improve its network assets. At the same time, access charges are an important part of the cost faced by competitors who use regulated access and therefore affect retail prices and thus consumers.

This makes access regulation a challenging task. When setting access prices, the regulator must find a "sweet spot": setting prices both "too high" or

2 In practice, there are more dimensions to access regulation. The regulator needs to define the conditions under which access obligation should be triggered, and the types of access services that the regulated firms will be required to provide. Access regulation not only determines the prices that have to be paid by users of regulated access products, but may specify – explicitly or implicitly – a host of other terms and conditions such as lead times for provision, what information has to be provided between the parties, the ability of the access provider to change product specifications, notice periods, service levels, response times etc.)

"too low" could have undesirable consequences. For example, excessively high access prices will limit the scope for competition, expose access seekers to a margin squeeze and/or reward access providers with economic profits and make end users pay more. Setting them excessively low could jeopardise the ability of access providers to maintain and improve their networks, and might distort build-or-buy decisions. All of this makes setting access charges a difficult business, and there are many ways in which access regulation can go wrong.

Nevertheless, the regulatory framework in the EU has performed well. Infrastructure and service competition has developed across substantial parts of the network, and consumers and businesses generally have a good choice of provider, even though much of the 'local access' part of the network (figuratively, the 'last mile') is still exclusively controlled by the incumbent operator.[3]

Looking from past achievements to future challenges, there is arguably a greater need to consider investment incentives. Existing (legacy) networks are unlikely to be capable of meeting the growing demand for higher bandwidth or the speed and coverage targets set as part of the European Digital Agenda. Substantial investments are needed to upgrade or potentially replace existing infrastructure, in particular at the access level. It is therefore important to consider the implications of access regulation on the incentives of both incumbents and new entrants to invest in next generation access (NGA) networks.

3 In some areas, cable networks originally built for the provision of television services provide an alternative to customers living in areas covered by these networks. However, cable networks have not been required to, and do not generally provide, access to third parties. In some countries, there is also limited deployment of competing access networks, in particular in densely populated metropolitan areas, partly driven by investment of alternative providers into development of fibre-to-the-home (FTTH) networks.

Given the investments needed to meet demand for higher speeds, some have called for access obligations to be reduced or perhaps phased out, alleging that access regulation discourages investment

In this context, arguments have been made[4] to suggest that access regulation has been holding back the required investment, and that in order to achieve the desired NGA build, access obligations should become more limited or perhaps be completely phased out. Access regulation is accused of not having had the desired 'ladder of investment' effect which would see new entrants progressively building out their own networks and eventually invest in their own (NGA-ready) access infrastructure while at the same time having discouraged investment from incumbents in upgrading their networks.

Supporters of such arguments have pointed towards the US, claiming that the FCC has helped to promote NGA investments through a de-regulatory agenda, ending the extensive obligations to provide unbundled network elements in 2005.[5] With revenues and investment allegedly being much higher in the US than in Europe, customers in the US are said to benefit from greater availability of next generation networks. Similarly, differences in the progress made towards the roll-out of fibre networks across Europe have been linked back to differences in regulatory approaches.

At the same time, proponents of the idea that access regulation should be phased out argue that such obligations are not necessary where retail competition is effective, and in particular where infrastructure-based competition from alternative access networks (predominantly cable) exists.

This report shows that such claims are misleading and that much of what has been achieved would be put at risk if they were answered

However, as we will argue in the remainder of this report, these arguments are problematic, and following them could put at risk much of what has been achieved over the past two decades.

4 Examples of studies that develop these arguments are Boston Consulting Group (2013) or Plum Consulting (2016).

5 As a general point, broad-brush references to the US pursuing a strong de-regulatory agenda are somewhat misleading. The 2005 reforms brought an end to a policy that required the provision of a wide variety of unbundled network elements at prices, which made it attractive for new entrants to buy re-bundled network elements rather than investing in complementary infrastructure. Unbundled local loops continue to be available to access seekers (see Bauer, 2006).

Specifically, we will argue that:

- access regulation has produced substantial benefits in terms of enabling new entry, leading to greater competition, lower prices, more choice and better quality (Section 2);

- there is a complex relationship between access regulation and investment incentives, and that simply phasing out access obligations would not promote investment (Section 3); and that

- whilst any upside of removing access regulation is uncertain, the benefits of access regulation would be at risk if access obligations were to be pushed back or phased out (Section 4)

This leads us to conclude that there is a continued case for imposing access obligations, though indeed more attention may need to be paid to making sure that such obligations promote competition and investment. This does not call for abandoning access regulation, but for making it smarter. As we set out in Section 5, we consider that this entails:

- creating more explicit investment incentives through differentiated access charges and potentially explicit investment requirements;

- providing greater flexibility for access seekers and access providers to negotiate arrangements that allow them to share risks; and

- providing an effective regulatory back-stop that is the basis of such negotiations and ensures that investment requirements are being met.

2 THE BENE-FITS FROM ACCESS REGULATION

Access regulation has been a key element of telecoms liberalisation in Europe. The original Open Network Provision framework (which laid the foundation of full liberalisation of the telecoms sector across Europe) included obligations on operators with significant market power[6] to provide interconnection and access with charges being set on the basis of transparency and cost-orientation.[7] Following the review of the ONP framework and its replacement with the regulatory framework for electronic communications, these obligations are enshrined in the Access Directive.[8]

2.1 New entry and competition in the provision of broadband

Access regulation has supported entry, with new entrants using a range of access products

Access obligations have promoted new entry into various telecommunications markets and competition across an ever-increasing portion of the value chain. Now entrants use a variety of access products to serve a substantive portion of the broadband markets across Europe.

The market share of new entrants has been increasing steadily, and by the middle of last year, almost 60% of broadband lines were provided by new entrants (including cable operators, who are almost without exemp-

6 Note that the concept of 'significant market power' under the ONP framework was different from the present one. Under the ONP framework, significant market power was simply defined as holding a market share of more than 25% in a one of a series of markets that were pre-defined without regard to the competition law concepts that guide market definition under the revised framework that came into place in 2002.

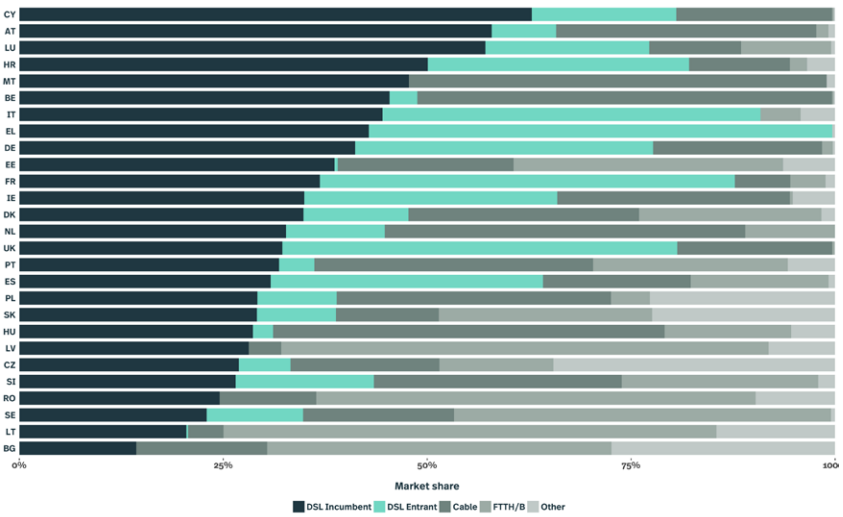
7 See in particular Directive 97/33/EC of the European Parliament and of the Council of 30 June 1997 on interconnection in Telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network Provision (ONP)

8 Directive 2002/19/EC of The European Parliament and of The Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (amended by Directive 2009/140/EC)

tion classified as 'new entrants').[9] Looking at DSL subscriptions (including VDSL) only, the share of lines provided by new entrants has grown from less than 40% to almost half over the past 10 years.[10] As Figure 1 shows, there are substantial differences across member states. In some countries, such as Malta, Romania or Bulgaria, there are hardly any entrants offering DSL lines. Competition there comes from cable networks and – to some extent – FTTH/B networks deployed by new entrants. In other countries, such as France, the UK or Spain, new entrants account for more than half of DSL lines.

Figure 1

Market shares of new entrants vary considerably across member states. There are also substantial differences in the relative importance of cable, DSL and FTTH/B

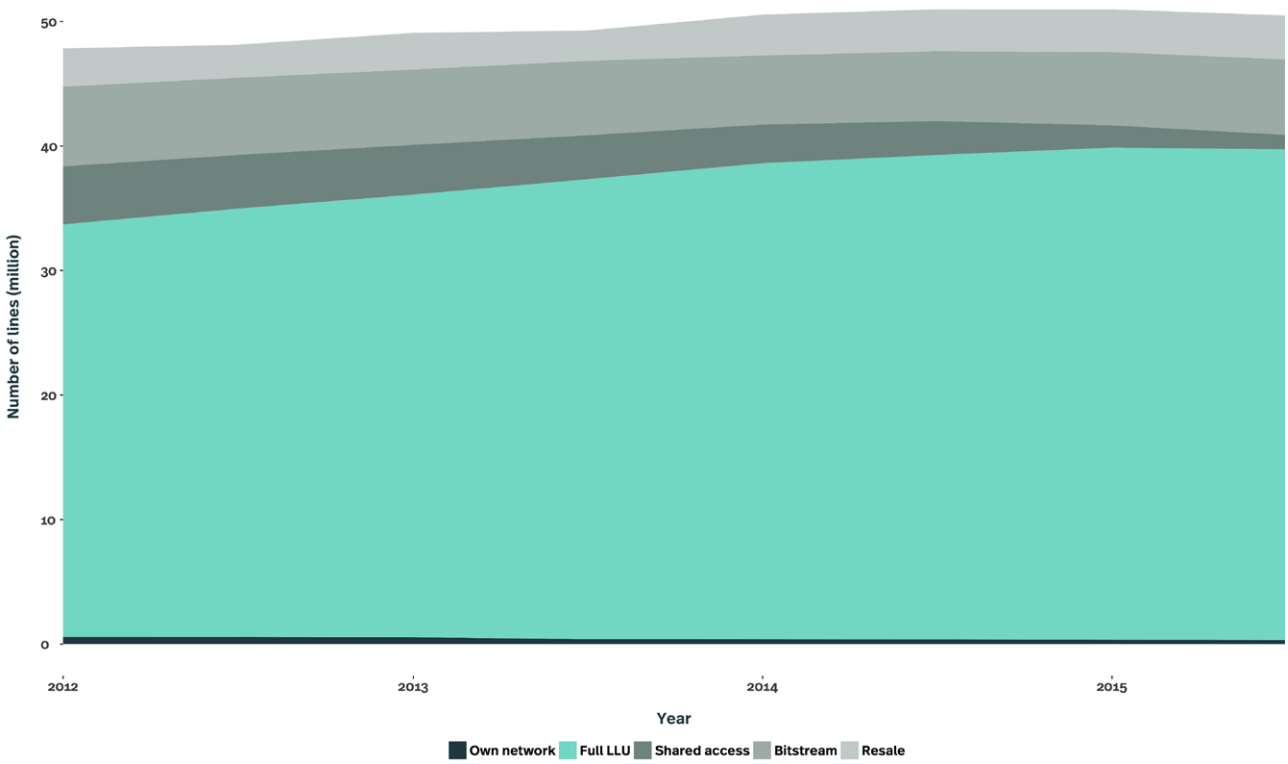


2015 market shares of broadband subscriptions; note that no breakdown into incumbent/new entrant shares is available for FTTH/B connections.
Source: European Commission, Broadband Access in the EU, July 2015, DotEcon calculations

9 Only around 4% of cable broadband subscriptions in the EU are classified as 'incumbent' subscriptions (see European Commission, Broadband Access in the EU, July 2015). This reflects the classification used for the EU data which identifies as incumbents "[o]rganisations having enjoyed special and exclusive rights or de facto monopoly for the provision of voice telephony services before liberalisation, regardless of the role played in the provision of access by means of technologies alternative to the PSTN." By contrast, new entrants are "[a]lternative telecommunications operators, as well as internet service providers (ISPs)." (see European Commission, Digital Agenda Scoreboard 2015, Electronic communications market indicators: Definitions, methodology and footnotes on Member State data, European Commission).

10 European Commission, Broadband Access in the EU, July 2015

These differences may to some extent arise from differences in the implementation of access regulation, but also reflect the very different role played by cable networks and the different levels of FTTH/B investment in the different member states. Overall, the new entrants' DSL offerings are mainly based on using the incumbent's fully unbundled local loops (full LLU). The number of fully unbundled lines has been growing steadily over the last few years (see Figure 2).



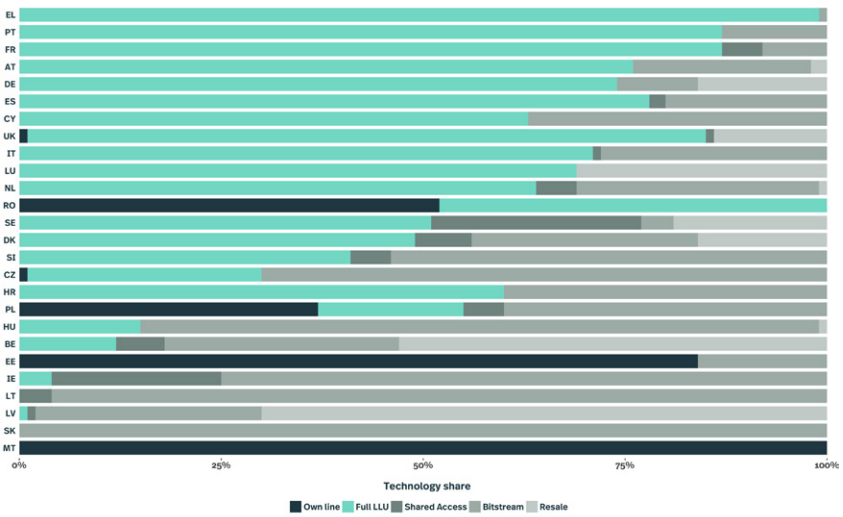
New entrant's DSL subscriptions by type of access at EU level (excl. VDSL); shared access lines supplied by the incumbent to other operators are lines where the incumbent continues to provide telephony service, while the new entrant delivers high-speed data services over that same local loop, and as such also rely on unbundling. Source: Broadband Access in the EU, July 2015

Figure 2
New entrants providing broadband services over DSL use mainly unbundled local loops

Again, these aggregate developments mask a substantial degree of heterogeneity across the EU. Slovakia, for example, relies almost exclusively on bitstream access, whilst full LLU is the predominant form of access in countries such as Austria, Germany or the UK. In Malta and Estonia, new entrants use mostly their own lines, whilst in Latvia and Italy many of the new entrant's offerings are based on resale.

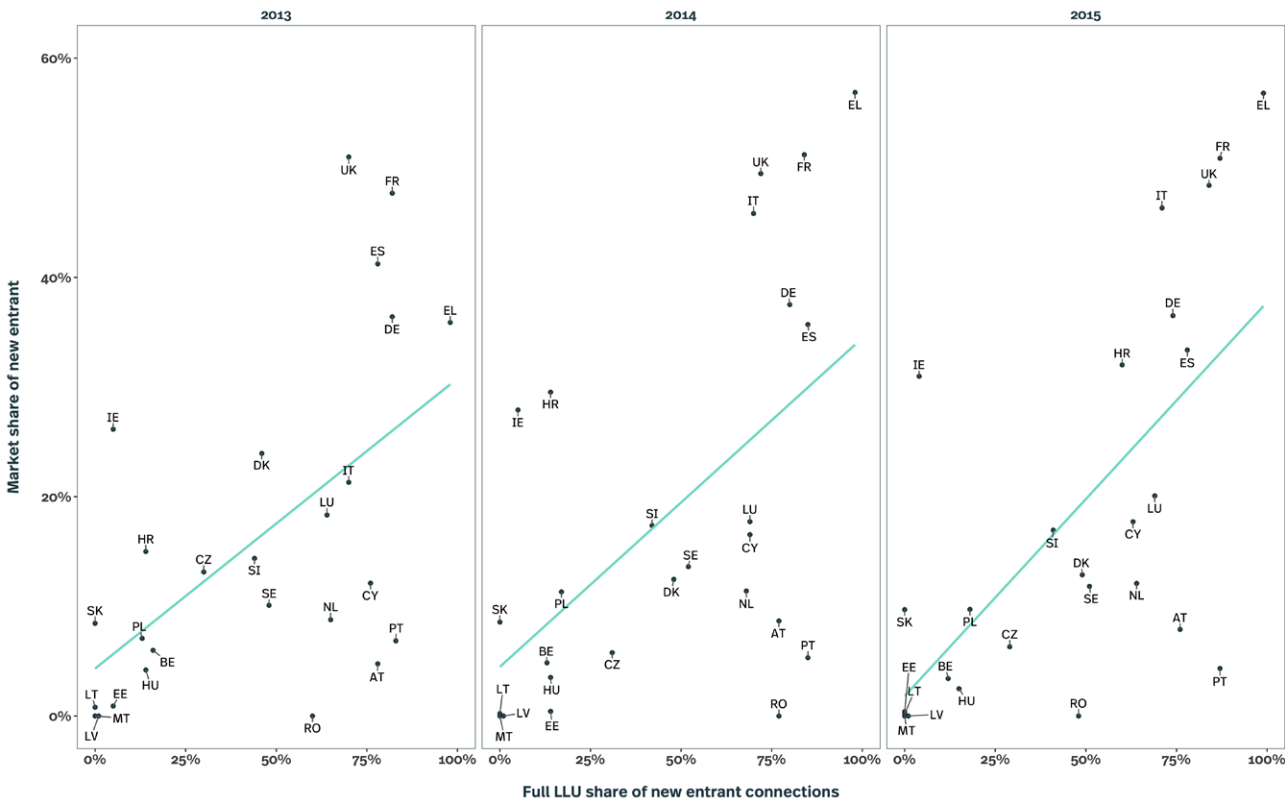
Figure 3

Use of unbundled loops varies considerably across Europe, but there are only very few countries where they are not the predominant form of access



2015 breakdown of new entrant DSL connections by type of access (incl. own network; VDSL excluded). Source: European Commission – Source: European Commission, Broadband Access in the EU, July 2015, DotEcon calculations

Looking at the differences in the market share of DSL entrants and the type of access across member states suggests a link between the two factors. Indeed, it seems to be the case that relying on full LLU allows new entrants to gain a larger market share. This might well be explained by the fact that using unbundled loops gives new entrants greater control over their offerings and allows them to offer services that are more differentiated from those available from the incumbent.



Full LLU share of new entrant connections and entrant market shares Source: European Commission, Broadband Access in the EU, July 2015, DotEcon calculations

Figure 4
New entrants gain higher market shares where they rely to a greater extent on unbundled local loops (which give entrants greater control over service quality and support more differentiation)

Overall, this evidence indicates that regulated access – and in particular LLU – has been a key driver in encouraging entry and enabling competition. So consumers in Europe frequently can choose between several broadband providers offering a range of speeds and different value-added services (such as hosting of mail services or web content, static IP addresses enabling customer to host their own services, etc.), generally at fairly attractive prices.

For example:

- in the UK, by 2013 more than 93% of premises were connected to an exchange that has been unbundled by at least one alternative operator[11] and customers can choose from more than 60 broadband providers;[12]

- in France, following the introduction of regulated access to France Telecoms network in 2003, Iliad and Neuf Telecom entered the market with unbundled services; now Iliad holds 24% of the broadband market;[13]

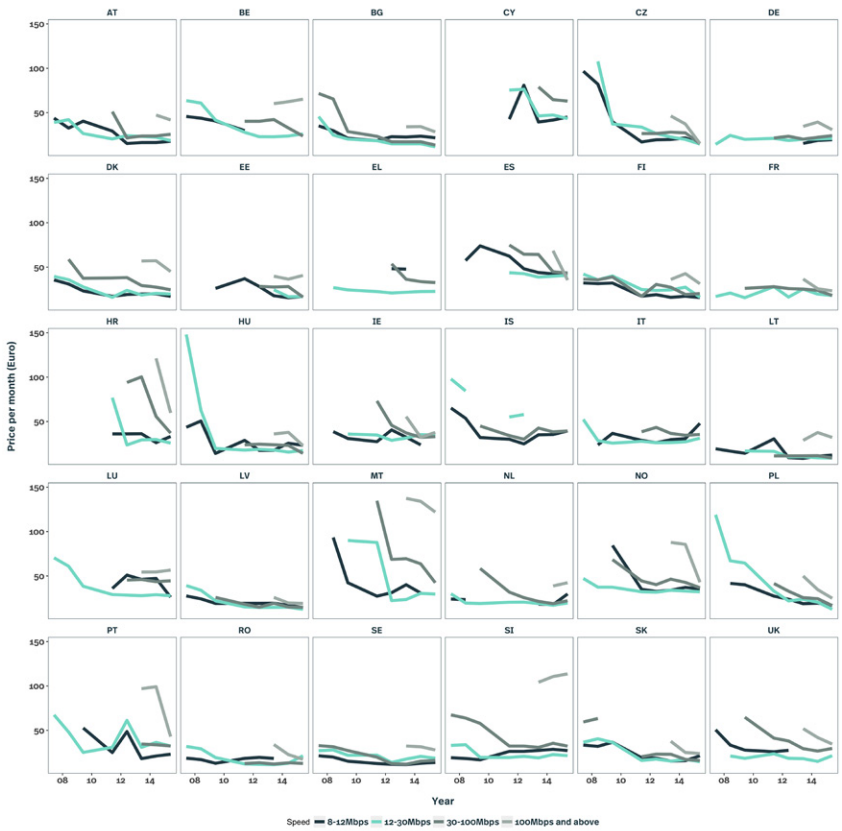
- As the Berkman Center (2010) points out, *"Germany was an early leader in liberalizing telecommunications markets, and was the first European country to implement local loop unbundling"* (in the face of strong resistance from Deutsche Telekom). Now the broadband market has a large number of players. Some of them also offer triple play services with the broadband component provided over DSL.[14]

2.2 Competition has brought lower prices

New entry has encouraged competition on price

Increased competition from new entrants has put pressure on prices that consumers pay for broadband. Prices across almost all European countries have dropped across all speed brackets, including in high-speed categories in recent years. Prices in countries that started out with very expensive services have converged towards the levels in those countries where competition has been effective for a number of years.

11 Ofcom (2013), paragraph 3.20
12 According to ISPreview (www.ispreview.co.uk/list.shtml); accessed on 2 June 2016
13 'Iliad's Billionaire Hero Needs a Deal', www.bloomberg.com/gadfly/articles/2016-03-10/billionaire-xavier-niel-s-iliad-needs-french-mobile-deal
14 DSL Germany, 'Price and Cost Analysis of Germany's Popular Internet (DSL) Providers' (dsl-germany.com/en/biglist.php)



Monthly price of standalone Internet access, by maximum advertised download speed
Source: European Commission, Digital Agenda Scoreboard Key Indicators

Figure 5
Prices of standalone Internet access have been falling in almost all member states and across all speed brackets. In the most expensive countries, price reductions have been substantial and prices are converging across Europe

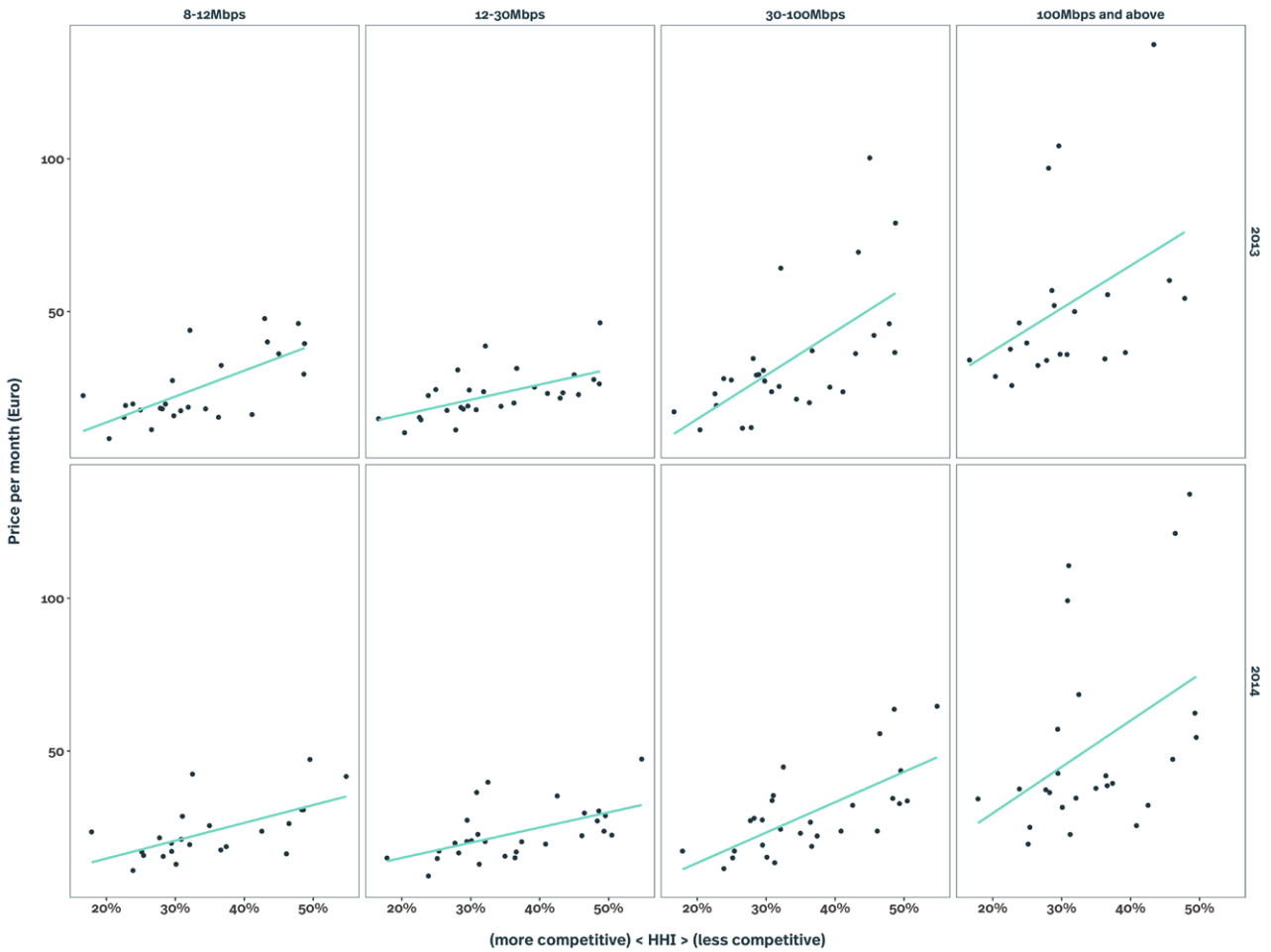
Competition has a clear impact on prices: prices tend to be higher in more concentrated markets, i.e. markets with fewer competitors or markets where the strongest competitors account for a higher proportion of the total.

Measuring market concentration

A common way of measuring market concentration is the so-called Herfindahl-Hirschman Index (HHI), which is defined as the sum of squared market shares. Because it uses squared market shares, the HHI captures both the number of competitors and any asymmetry between them. So for a monopoly market, the HHI is equal to 1 (100% × 100%). A symmetric duopoly produces 50% × 50% + 50% × 50% = 0.25 + 0.25 = 0.5. A very asymmetric duopoly gives a higher HHI – so with the market split 30/70, for example, we would get 30% × 30% + 70% × 70% = 0.09 + 0.49 = 0.55, and an even more asymmetric 10/90 split would give 0.82. Thus, a higher HHI indicates fewer competitors and/or a greater share of the market being taken by fewer suppliers.

Prices increase with market concentration (the level of the HHI), and this relationship holds across all speed brackets. For broadband with speeds over 100Mbps (for which the Digital Agenda goal is to have 50% of EU citizens using such connections by 2020), an increase in market concentration has the greatest impact on price (see Figure 6). Annex A presents a simple regression model linking prices to concentration, which indicates that changes in competitiveness could potentially result in substantial price increases.

Overall, prices for broadband services in the EU compare favourably to those in other OECD countries (including the US). Figure 7 shows that the majority of EU countries in the OECD can be found towards the lower end of the pricing spectrum (though there are substantial ranges in some countries).



Relationship between market concentration and price for internet-only packages in different speed brackets. Source: European Commission Digital Agenda Scoreboard Key Indicators; DotEcon calculations

Figure 6

Broadband services are more expensive in more concentrated markets, and the price impact is greatest for high-speed services

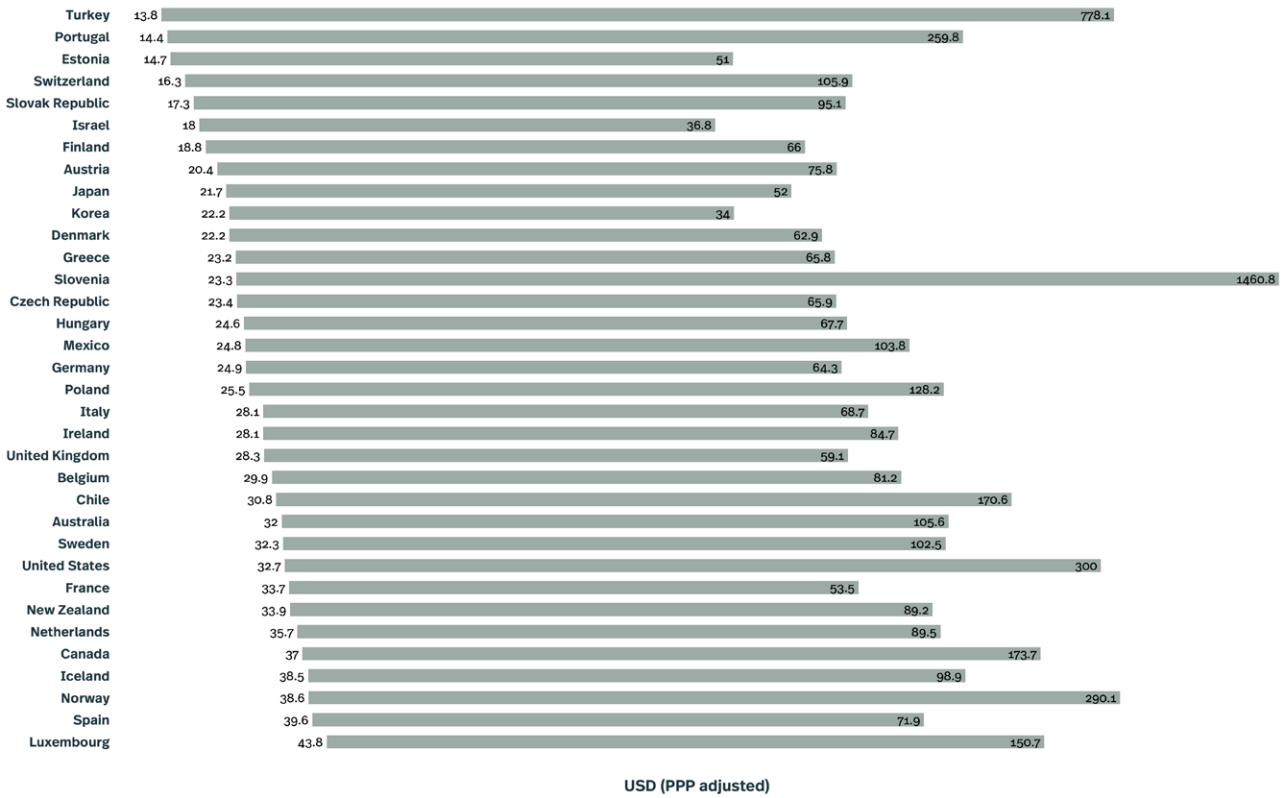


Figure 7

Fixed broadband subscription prices in many European countries are low by international comparison

Fixed broadband subscription price ranges across OECD countries Source: OECD, "Fixed broadband subscription price ranges, September 2014, all platforms, logarithmic scale, USD PPP"

2.3 Competition has a positive impact on penetration, coverage and speed

Competition has also improved availability and take-up

Competition has not only brought down prices. Coverage and take-up of fixed broadband coverage have increased steadily as broadband services available at attractive prices have attracted more and more customers.

With an average coverage of (standard) fixed broadband at 97.4% of households in 2015, almost all customers in the EU are able to connect to the internet. 80% of households have a fixed broadband connection, making use of this option.[15]

NGA networks have been rolled out since the beginning of the decade, and now reach on average 70% of households.[16]

In terms of fibre deployment, the best-performing countries (such as Sweden, Lithuania and Latvia) are only just behind Asia Pacific leaders on FTTH/B rollout, though other countries (such as Germany) are more at the bottom of the league table.[17]

Competition again appears to have a positive impact on both coverage and penetration, at least in relation to higher speed connections.

Plotting the level of market concentration against coverage suggests that NGA coverage is higher in less concentrated markets (and that standard broadband coverage is higher in more concentrated ones).

15 Standard fixed broadband coverage/availability (as a % of households) and proportion of households with a broadband connection in 2015, from the European Commission Digital Agenda Scoreboard Key Indicators.

16 European Commission, "Trends in European Broadband Markets 2014," Digital Agenda Scoreboard, 2014, available at https://ec.europa.eu/digital-single-market/en/news/scoreboard-2014-trends-european-broadband-markets-2014

17 IDATE for FTTH Council Europe, February 2016 (ftthcouncil.eu/documents/PressReleases/2016/PR20160217_FTTHranking_panorama_award.pd)f

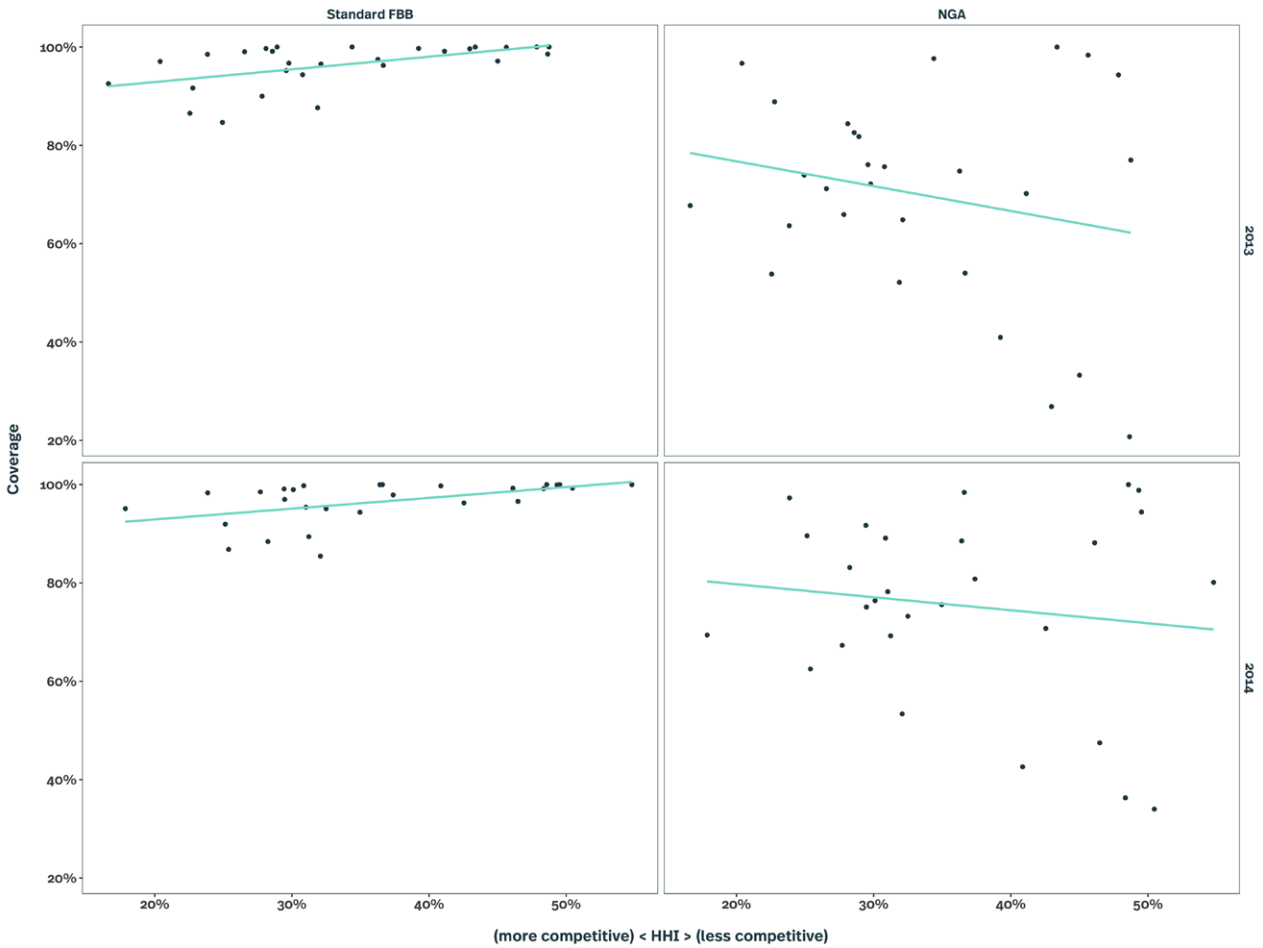
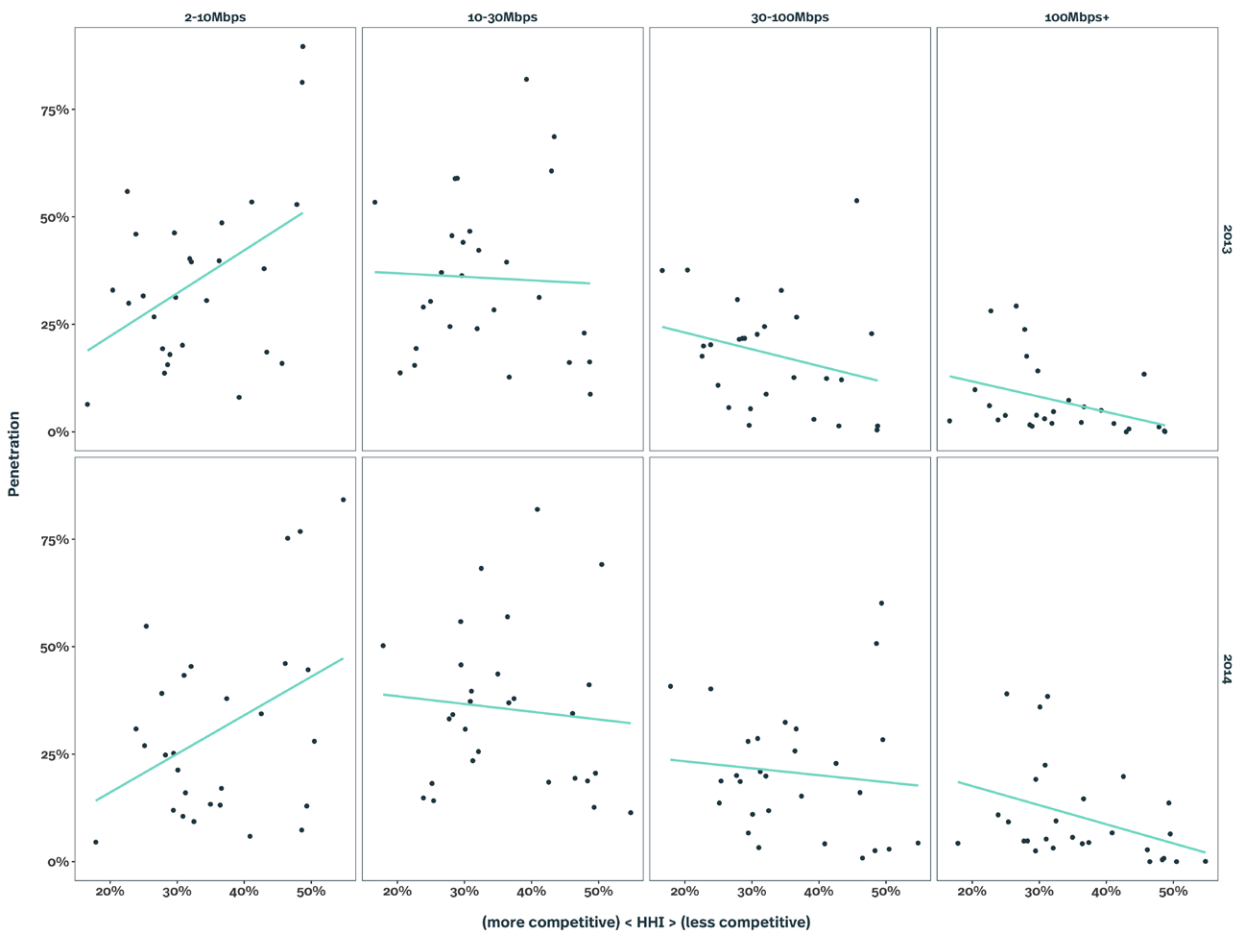


Figure 8

NGA coverage is lower in more concentrated markets, which show higher levels of coverage with standard broadband services

Relationship between market concentration and broadband coverage. Source: European Commission Digital Agenda Scoreboard Key Indicators; DotEcon calculations

A similar effect can be observed when looking at penetration levels. Whilst penetration levels are generally lower for higher speed brackets, they increase with the level of market concentration for lower speeds but decrease as the speed of connections increases. This implies that more competitive markets have a higher share of connections at higher speeds.



Relationship between market concentration and broadband penetration. Source: European Commission Digital Agenda Scoreboard Key Indicators; DotEcon calculations

Figure 9
Penetration increases with concentration for lower speed brackets, but in the higher speed brackets less concentrated (more competitive) markets achieve higher penetration levels

More intense competition also appears to have a positive impact on the ratio of actual to advertised download speeds.

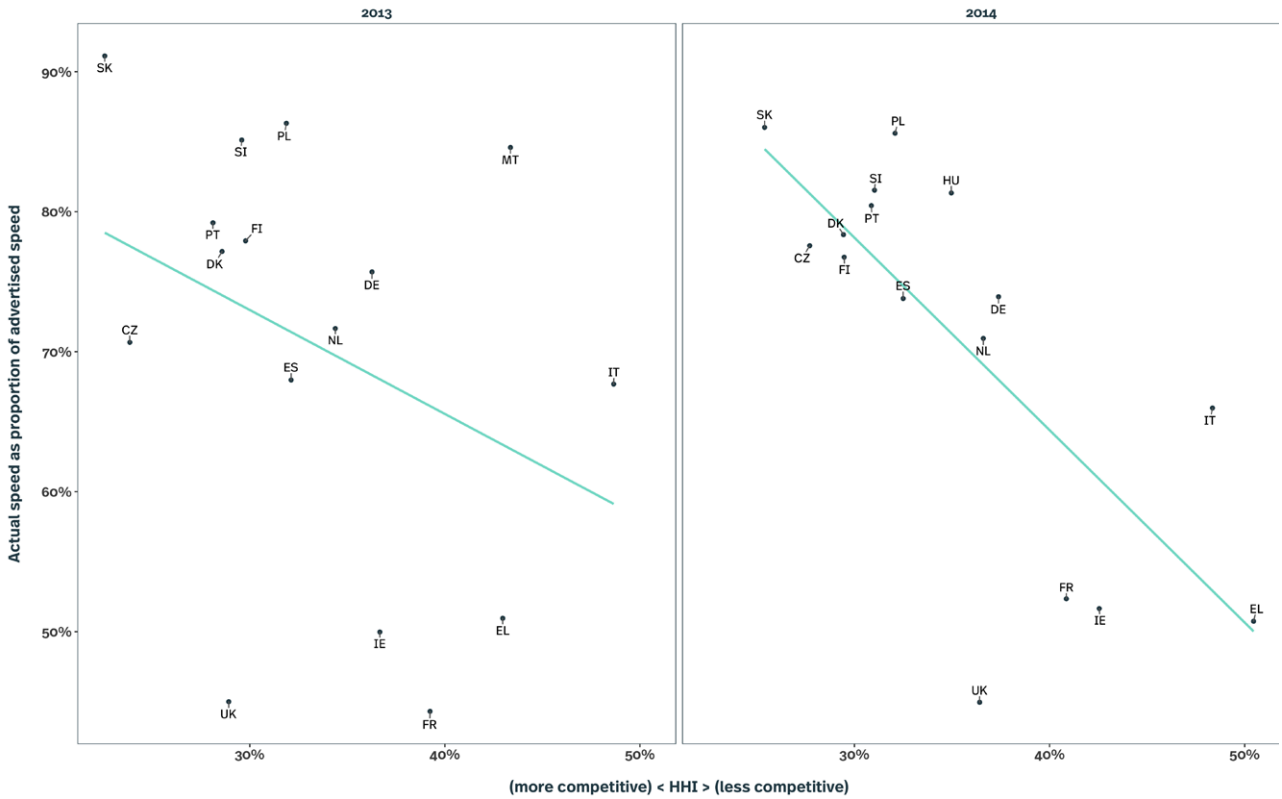


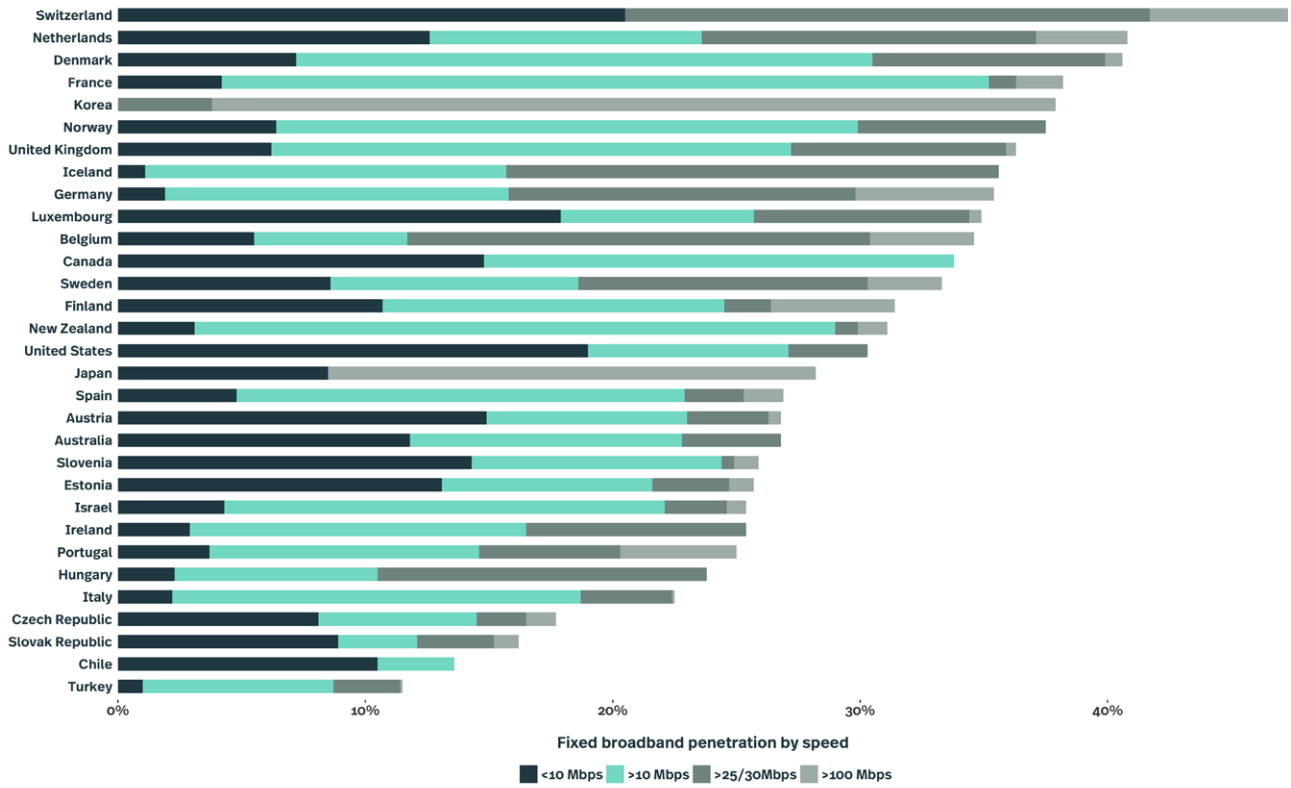
Figure 10

Where the least concentrated markets deliver actual download speeds that are around 80% of those advertised, customers in more concentrated ones get as little as 50% of advertised speeds

Relationship between market concentration actual xDSL download speeds. Source: European Commission Digital Agenda Scoreboard Key Indicators; DotEcon calculations

Overall, EU member states perform well on coverage, adoption and speed compared with other OECD countries.

Across OECD countries, European countries take the top spots with highest fixed broadband subscriptions per 100 habitants in Switzerland, the Scandinavian countries and large European states, well ahead of the United States. Moreover, a greater share of subscriptions is for services with higher speeds compared with the US, where only a relatively small proportion (3.2%) of subscriptions are for services with a speed of more than 25/30Mbps.



Fixed (wired) broadband penetration by speed tiers, June 2014. Source: OECD, Digital Economy Outlook 2015

Figure 11
European countries lead in relation to fixed broadband penetration and have a relatively high share of high speed connections

Again, EU countries perform well on speed in comparison to other OECD countries (and in particular in relation to the US). For example, comparing average actual connection speeds across EU countries and the US using Akamai speed test data from Q4 2015 shows that Sweden had the highest average connection speed, with an average of 19.1 Mbps, closely followed by the other Scandinavian countries, the Netherlands and (non-EU member) Switzerland. US connection speed is comparable with Belgium and the UK.

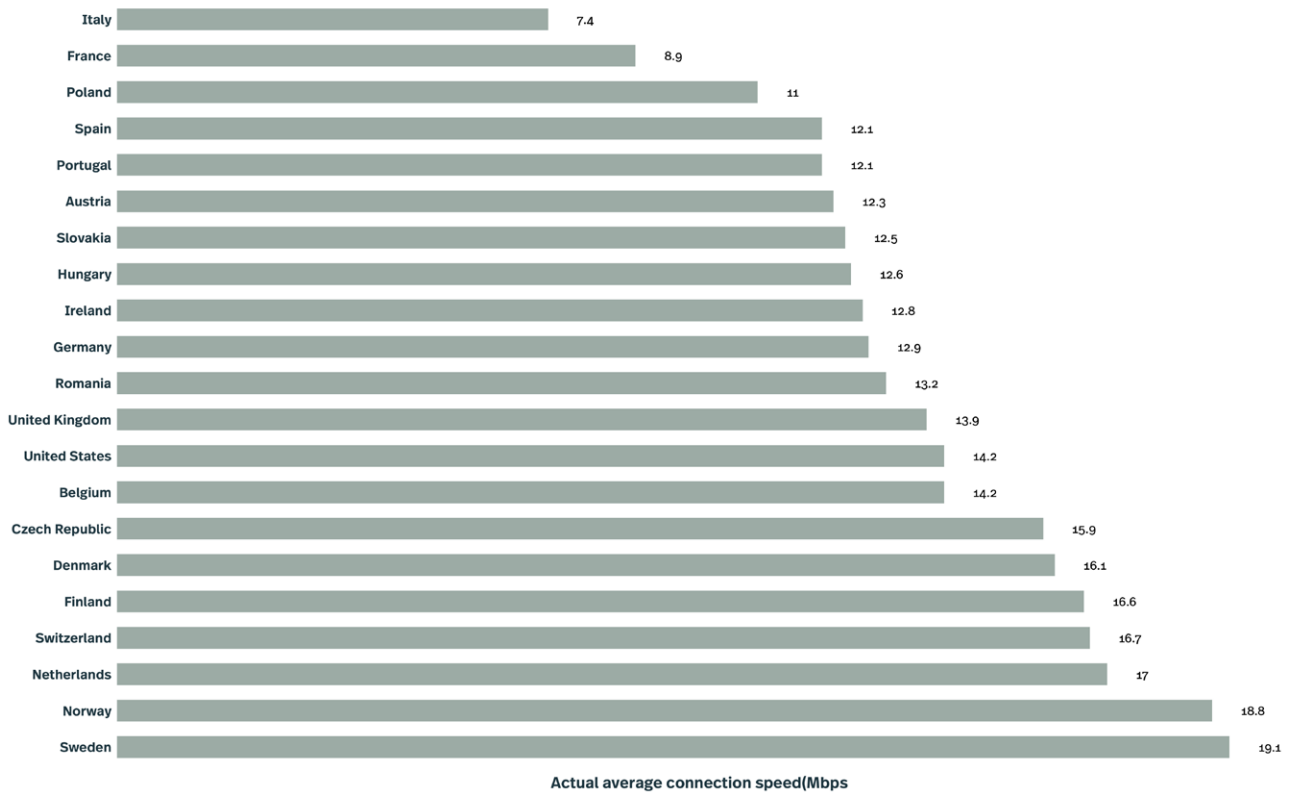


Figure 12
In particular the Scandinavian countries perform well on average connection speed by international comparison

Actual average connection speed Source: Akamai State of the Internet Report 2015 Q4 Connectivity Report

2.4 Summary

In this section, we have shown that competition – supported by access regulation – has resulted in lower prices, greater availability, greater penetration and better services (in terms of speed). We have relied mainly on data collected by the European Commission, using market concentration (as measured by the HHI) as a proxy for competition.

The benefits from access regulation in terms of developing a competitive market place with lower prices, greater choice and higher quality are generally also acknowledged in the literature. For example:

Access regulation promotes broadband penetration

- Grosso (2006) uses OECD data to establish the determinants of broadband penetration and finds a positive effect for the unbundled local loop dummy variable. Similarly, de Ridder (2007) finds a positive impact of access regulation (proxied through a number of variables such as the number of years since the introduction of access obligations or the share or entrants' ADSL lines) on penetration.

Intra-platform competition is a key driver of lower prices

- Fageda et al (2013) use data from the Spanish market over the period from 2005 to 2011 to look at the impact of competition on broadband prices. The authors compare the impact of inter-platform competition (i.e. competition between different technical platforms such as cable and DSL) and intra-platform competition supported by access regulation and find that the latter is a key driver of lower prices in the Spanish market.

Competition promoted by LLU improves quality and speeds

- Nardotto et al (2015) use data from the UK broadband market to show that local loop unbundling has brought clear benefits in terms of increased broadband penetration in the early years, and improvements in service quality and speeds available to end users. They find that *"the LLU regulation designed to grant full control of the connection to entrants has been successful. This success is not the result of an increase in total broadband penetration, but of a substantial increase in the quality of the service provided: LLU entrants invested in order to make their broadband connections faster than those of the incumbent, and on average 42.8% faster than when they operated using Bit-stream technology".* Furthermore they argue that this *"has led to a shift in the locus of competition, from the price to the quality dimension, with a resulting increase in product differentiation."* Local exchange areas where LLU entry has occurred provide *"considerably higher"* average broadband speeds than areas with no LLU entry. From this, the authors conclude that *"[r]emarkably, this higher speed is entirely due to LLU entrants; there is no significantly higher average speed for BT customers' lines."*

The benefits from a competitive telecommunications market, supported by access regulation, extend beyond lower prices, better services, greater take-up and innovation because the ICT sector generates important spill-over benefits for the wider economy.[18] This suggests that competition based on access regulation has contributed to the competitiveness of the European economy and has helped to generate and safeguard jobs.

18 For an overview, see Atkinson and Stewart (2013). Katz (2012) examines the contribution of broadband deployment to economic growth and finds that "[t]he evidence generated for this study as well as the results of prior research validate the positive contribution of broadband to GDP growth both for developed and developing countries and regions."

3 NGA INVESTMENT AND THE ROLE OF ACCESS REGULATION

Whilst the benefits from access regulation in terms of enabling new entry and supporting competition are generally recognised, there have in recent years been calls to roll back regulatory obligations. These calls are based on the claim that regulation has been holding back investments in NGA infrastructure which would be needed to support the growing demand for bandwidth and to meet the speed and coverage targets set by the European Digital Agenda.

There have been calls for a roll-back of access regulation as access obligations are claimed to discourage investment

Comparisons are often drawn with the US, where the reduction in the scope of unbundling requirements in 2005[19] are said to have driven greater investment, leading to better availability of high speed connectivity. However, much of the evidence offered in support of these claims needs to be taken with a pinch of salt (see box below).

Comparing investments

Comparisons of investment levels between the US and Europe are misleading unless they are like-for-like. This is not necessarily the case for a number of reasons.

For example, as Crawford and Scott (2015) point out, 93% of US households have both cable and telephone connections[20] whereas in Europe only 43% of residents have access to both cable modems and DSL or fibre (see Turner, 2015). The greater prevalence of duplicate infrastructure will inevitably result in higher investments for maintenance reasons.

Moreover, US capex figures often include spending on Customer Premises Equipment (CPE) such as modems and set-top boxes. Given that up to 90% of US cable operators' capital expenditure has been accounted for by spending on modems and set-top boxes, these investment figures do not provide a reliable indicator of infrastructure investments (see Ammori, 2015, and Turner and Wood, 2014). As expenditure on CPE is generally not included as capital expenditure in Europe, this also makes comparisons of aggregate investment figures meaningless.

As Turner (2015) also points out, with US per capita GDP being 50% higher than the EU average, higher labour costs of investment may also result in higher investment figures.

19 As noted above, the US reforms of 2005 have not completely abolished access regulation, and in particular incumbents are still required to provide fully unbundled loops.
20 National Cable & Telecommunications Association, 'America's Internet Leadership' (www.ncta.com/positions/americas-internet-leadership)

Indeed, although levels of investment per line may be higher in the US, capital intensity (ratio of investment divided by revenues) is similar in Europe and the US (around 15%).

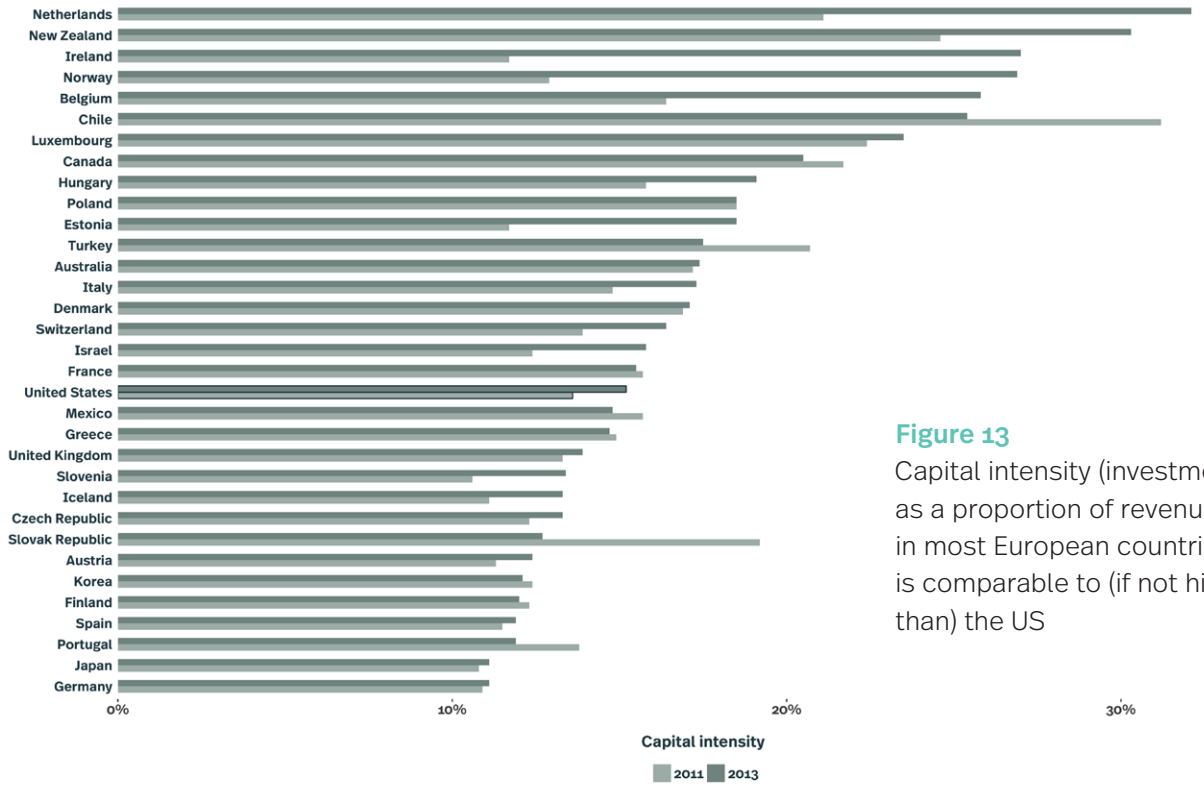


Figure 13
Capital intensity (investment as a proportion of revenues) in most European countries is comparable to (if not higher than) the US

Investment in telecommunications as a proportion of revenue (excl. spectrum fees)Source: OECD, Digital Economy Outlook 2015

Moreover, the relationship between access regulation and investment is complex, and any blanket statement to the effect that access regulation discourages investments is overly simplistic. In particular, there is no obvious conflict between access regulation and competition on the one hand, and investment on the other. On the contrary, well-designed access regulation

The relationship between access regulation and investment is complex, and promoting efficient investment has always been a regulatory objective

can have a positive impact on investment. Retail competition results in greater differentiation and can stimulate demand for the underlying network services. Access providers benefit from such greater demand through higher access revenues. At the same time, access seekers often invest in complementary infrastructure, as demonstrated by the widespread use of unbundled loops (and often sub-loops). Access seekers and incumbents create an ecosystem where wholesale revenues provide an important revenue stream for incumbents whilst competition helps to grow the market and stimulates innovation and the development of new services.

The fact that investment in competing infrastructures is beneficial for sustainable competition is reflected in the explicit obligation on regulatory authorities to wield their powers (including in relation to setting access obligations) in a manner that encourages efficient investment, which has been in force for more than a decade (see box below).

Investment and regulatory objectives

Annex III of the 1990 Directive on the establishment of the ONP framework[21] sets out the principles with which open network provision conditions should comply. Amongst the requirements for harmonised tariff principles is that "[a]ny charge for access to network resources or services must ... take into account the principle of fair sharing in the global cost of the resources used and the need for a reasonable level of return on investment."

Article 6(2) of the Interconnection Directive[22] then stipulates that "[c]harges for interconnection shall follow the principles of transparency and cost orientation. The burden of proof that charges are derived from actual costs including a reasonable rate of return on investment shall lie with the organization providing interconnection to its facilities."

Article 8(2) of the 2002 Framework Directive[23] then specifies an explicit objective for national regulatory authorities to "promote competition in the provision of electronic communications networks, electronic communications services and associated facilities and services by inter alia ... encouraging efficient investment in infrastructure, and promoting innovation."

Even though access regulation in Europe has not necessarily always been focused on promoting investment in (competing) infrastructure to the extent that one might have wished, there is no evidence to suggest that it has held back investment. The fact that competitors now predominantly

21 Council Directive 90/387/EEC of 28 June 1990 on the establishment of the internal market for telecommunications services through the implementation of open network provision

22 Directive 97/33/EC of the European Parliament and of the Council of 30 June 1997 on interconnection in telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network Provision (ONP)

23 Directive 2002/19/EC of The European Parliament and of The Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities

rely on fully unbundled loops shows that substantial investments in infrastructure have been made by access seekers (even though they may not have climbed the last rung of the 'ladder of investment').[24] The evidence available continues to support the propositions with which Cave (2007, p 13) summarises the results from the extant economic literature at that point, namely that *"the 'best' form of competition for diffusion (and end-user welfare) is platform competition across the whole value chain/ladder of investment; [that] incompetent access regulation can harm diffusion; [and that] targeted and well-designed access regulation can enhance it."*

We begin with a brief review of the drivers of NGA investment and then look at how access regulation might affect investment incentives.

3.1 Drivers of investment in NGA infrastructure

What drives investment and innovation has always been a key question for economic policy.

There are many factors that impact the balance of costs and returns that are at the heart of investment decisions

At the most basic level, what matters is the balance of costs and returns, adjusted for the risk that investments may be unsuccessful. When looking further at the drivers of investment, and in particular the role played by competition, the following effects are normally discussed:

- Making investments and innovating allows the investor to **'escape competition'** and enjoy a stronger market position – at least for a period of

24 Plum Consulting (2006) assess the evidence on the extent to which the 'ladder of investment' has worked, noting that "[t]here is virtually no evidence which supports use of the full ladder of investment concept. But there is some which suggests that the short ladder [up to the use of LLU] may have had beneficial effects." It is worth noting that this more nuanced assessment is not reflected in the main body of the report, which claims that "there is now wide [sic] range of studies which point firmly to the conclusion that the ladder of investment concept does not work and should be abandoned."

time. The profits that successful investors can make during this period provide a strong investment incentive. The greater the expected profits, the greater the investment incentives. This incentive is weakened if profits are competed away completely and almost instantaneously.[25]

- At the same time, making such investments may entail replacing perfectly good and serviceable assets that the investor could have used to serve the market. This **'replacement effect'** discourages investments, particularly by incumbent firms not under threat from competition. The more competitive an environment, the weaker this replacement effect, as a firm would not remain competitive for long without upgrading and investing.[26]

This means that there is no simple linear relationship between competition and investment incentives. Too much competition curtails the expected upside from successful investment, too little competition curtails the downside from skimping on investment and removes the pressure to innovate. There is now broad agreement that both too much and too little competition can be detrimental to investment, and that the relationship between competition and investment is best described by an inverted U-shape (Aghion et al, 2005).

Against this background, one should expect that – in addition to access obligations imposed by regulation – the following factors have an impact on NGA investment:

- infrastructure competition from other networks that are capable of providing high-speed access (predominantly cable, and – where it exists – fibre), which weakens replacement effects as an incumbent network op-

25 The need for innovators to earn profits is at the heart of the Schumpeterian argument that in markets where competition is too intense and firms are unable to earn profits they are lacking both the funds for making investments and innovating, and the incentive to do so.

26 For a more detailed discussion of this effect first identified by Arrow, see for example Tirole (1988).

erator will have to match – and may want to exceed – the capability of the competing network;

- the state of the legacy infrastructure, which affects both the replacement effect and the cost of upgrades; in the case of a poor legacy infrastructure, investments in upgrades are necessary in any case and the replacement effect is weak; by contrast, good existing network infrastructure creates strong replacement effects but can also reduce the cost of incremental upgrades;

- the extent to which government-sponsored initiatives (which are generally seen to be behind the high levels of fibre deployment in Singapore, Korea and Japan) reduce the risk for investors and guarantee returns; and

- the extent to which downstream competition and the growth of complementary services results in additional demand and willingness to pay from end users for high bandwidth, as this will increase the return on successful investment in network upgrades.

Infrastructure competition is an important driver of investment

Competition from alternative infrastructures affects the incentives to invest in upgrading or replacing legacy networks because without such investments there is a risk of losing customers to the competing networks. If competition only took place between incumbents and new entrants using regulated access, the speed and quality of the 'last mile' connection would be the same for access provider and access users. In this case, an incumbent may have little incentive to invest in existing infrastructure, as it can still earn a return on its legacy network that compares favourably against the uncertain payback on network improvements. Only infrastructure competition places incumbent operators under competitive pressure across the entire value chain.

There is indeed good evidence to suggest that competition from cable (or other new infrastructure deployed by new entrants) spurs investment by incumbents in upgrading or replacing their legacy networks.

Infrastructure competition and investment

For example, a study by Bouckaert et al (2010) finds that inter-platform competition (i.e. competition that "is not dependent on access regulation, but instead results from rivalry between multiple infrastructures in a country (often DSL and cable networks)") has a significant positive effect on broadband penetration. The study measures inter platform competition using the HHI, and finds a significant relationship between the HHI and the total number of broadband connections as a share of total households.[27]

Briglauer et al. (2013) find a highly significant correlation between cable lines run by entrants (as a percentage of total cable and DSL lines), and the number of fibre lines deployed.[28] The data show the inverted U-shaped relationship between the level of platform competition and investment in NGA infrastructure. As the authors explain, this is because where competition is minimal, incentives to invest in NGA are weak as market players earn economic rents on existing services and very high levels of competition curtail the ability of investors to earn temporary market rents. The strongest investment incentives exist where there is sufficient competitive pressure to limit the rents that can be earned from existing assets but not so much that future profit opportunities would be eroded too quickly: "[r]ecent, and future investment in NGA is driven by competitive pressure, most notably from cable and mobile networks, which 'threaten' first-generation networks as regards new broadband services and substantially reduce the replacement effect in many EU countries."

Similarly, Briglauer et al (2015b) use data from 57 telecoms operators from 23 European countries to test the impact of infrastructure competition on firm-level investment. The data covers the period from 2003 to 2012, representing almost a full decade of broadband competition and regulation. The authors measure infrastructure competition by using the share of fixed broadband lines provided by entrants other than DSL (e.g. cable, fibre, WLL) and the incumbents. They find that infrastructure competition has a positive, significant impact on incumbent and entrant firm-level investment.[29] (See footnotes on the following page.)

The economic literature finds that infrastructure competition has a positive impact on investment, both from incumbents and new entrants, including investment in NGA networks, and also confirms the U-shaped relationship between competition and investment

WIK (2015, p 21) notes that *"[w]here cable exists and has a significant presence, it has usually played a strong role in stimulating NGA deployment. The response from incumbents has in most cases been to deploy FTTC/VDSL as has occurred in Belgium, the UK, Germany and elsewhere – with progressive further technological investments and deployment of fibre towards the end-user (for example through VDSL vectoring, and G.fast). The stimulus to move straight to FTTH on the other hand, has in several cases been stimulated by the initiation of FTTH deployments by alternative fibre investors and/or municipalities."*

BEREC (2016) points out that cable infrastructure encourages incumbents to invest more in in FTTC/VDSL, which provides a path towards upgrading quickly to "keep pace" with cable operators, and that independent FTTP network providers (e.g. in Germany and Sweden) have triggered investments by the incumbent in NGA roll-out.

Another example demonstrating the impact of infrastructure competition is that investments into the deployment of FTTH networks by AT&T and CenturyLink in the US were limited prior to the announcement of Google Fiber's deployment plans[30] – and this is despite the existing competition with cable networks.

Legacy infrastructure matters for a number of reasons:

Legacy infrastructure affects both the strength of replacement effects and the cost of network upgrades

First, continuing to use the legacy infrastructure without investing in upgrades, or replacing it with alternative infrastructure, is the obvious alternative to making such investments. Any benefits from investing will be measured relative to the rents that can be earned from simply continuing

27 Similar effects had been found in earlier studies by Distaso et al. (2006), Aron and Burnstein (2003) and Höffler (2007).

28 The authors also find a significant relationship between the percentage of the population using 3G and more advanced mobile networks, and the number of fibre lines deployed.

29 The study also examines the impact of competition from mobile networks, using the ratio of mobile lines to fixed lines, on investment activities of fixed broadband operators but finds no effect.

30 'Google Fiber brings AT&T, CenturyLink to the FTTH table' (www.fiercetelecom.com/special-reports/google-fiber-brings-att-centurylink-ftth-table-year-review-2013)

to use legacy copper assets without any investment. Put differently, the return that can be earned from the continued use of legacy assets creates an opportunity cost of investment.

This means that investment *incentives* are greater for operators who do not have existing access networks (though of course such operators may face higher costs unless they can get access to the incumbent's passive network infrastructure such as ducts and poles). Indeed, operators who did not have extensive copper assets made many of the early investments in NGA infrastructure, and in particular fibre networks.

For example, BEREC (2016) notes that in Denmark, fibre has been deployed primarily by utility companies rather than the incumbent telecoms operator. Incumbent TDC owns the local fibre network in the Copenhagen area – but this is only because it acquired the utility company that had initially deployed it. In Portugal, Optimus (the third mobile operator at the time) was the first operator to roll out FTTH within the major urban areas of Lisbon and Porto. In Latvia, alternative operators were the first movers rolling out of fibre networks, deploying mainly FTTB and in some cases FTTH, and by January 2016 these operators held a 91.7% share of all active NGA broadband connections.

It also means that investment incentives for incumbents are greater where the legacy copper network is poor or where the network topology is not conducive to upgrading towards higher speeds. In these cases, continued use of legacy assets without making investments is not an attractive alternative. Upgrades are required in any case, and it is often more sensible to deploy new network infrastructure than trying to upgrade the existing one. This explains the extensive deployment of fibre in some countries where the old PSTN infrastructure was in poor condition or where network topology made upgrading networks to higher speeds difficult.

The quality and topology of copper networks may make simple upgrades more difficult

Depending on the quality of existing copper cables and the topology of the legacy network, it may be difficult to upgrade the existing infrastructure to support higher speeds, and investments in new infrastructure investments such as FTTH/B become more attractive.

For example, in Hungary where there are no street cabinets and in Sweden where local loops are relatively long, deploying fibre to the cabinet or attempting to upgrade to VDSL is infeasible, making FTTH/B investments relatively more attractive. In countries such as Romania and Bulgaria where the copper network has historically been very underdeveloped, infrastructure investment is required in any case. Obviously, such investment will be made in modern assets (see BEREC, 2016).

In the US, Verizon is the only operator that has invested in extensive FTTH deployment after 2005, and this has been linked back to the poor condition of Verizon's copper assets and copper plant[31] together with the advantageous density and spending power of Verizon's territories (see Ammori, 2015).[32]

Conversely, good legacy networks are relatively easy to upgrade, allowing the network operator to provide high-speed access at relatively low cost. For example, where the quality of the copper plant between street cabinets and customer premises is good and where sub-loops are relatively short, upgrades such as FTTC or VDSL are an attractive and relatively low-cost way of increasing network speeds. In these cases, one would expect to see incremental improvements, with upgrades to the copper loop (such as VDSL) and deployment of fibre infrastructure to higher network levels (such as FTTC). BEREC (2016, Annex 2) highlights that this is what we observe in countries such as:

- Belgium, where the incumbent prefers DSL upgrades to FTTH, only deploying FTTH in greenfield areas or where street cabinets have been removed due to urban re-planning;

- Italy, where loops and sub-loops in the legacy network are relatively short and ducts are typically only installed between the local exchange and the street cabinet and where FTTC has emerged as the favoured solution, as fibre cables can easily be installed in existing ducts and the short loops limit transmission loss over the 'last mile';

31 Verizon's copper wires were in such poor condition such that the Communications Workers of America (CWA) filed a request with the Pennsylvania Public Utility Commission to open an investigation into the safety, adequacy and reasonableness of the service provided by the firm ('Pa. to look into complaints about Verizon copper lines', http://articles.philly.com/2016-02-24/business/70877742_1_copper-fios-puc).

32 Verizon reportedly also received subsidies for the planned roll-out, but has wound down its fibre deployment without having completed its planned build-out (see 'Verizon winds down expensive FiOS expansion' (usatoday30.usatoday.com/money/industries/telecom/2010-03-26-verizon-fios_N.htm); 'Verizon nears "the end" of FiOS builds' (arstechnica.com/business/2015/01/verizon-nears-the-end-of-fios-builds/); 'What Billions in Subsidies Bought: The Final Map of Verizon's FiOS Fiber' (www.techdirt.com/blog/netneutrality/articles/20150126/04502529814/what-billions-subsidies-bought-final-map-verizons-fios-fiber.shtml). Though being the largest provider of residential fibre connections, the service is available to only about 30–40 million people, mainly in large metropolitan areas like New York City, Washington D.C. and Tampa, Florida. Costs for a 500Mbps connection are in the range of $270–$300 per month, excluding a set-up fee ($150) and modem costs ($10/month or $199 one off); see the coverage map on fiberforall.org/fios-map/; see also broadbandnow.com/Verizon-Fios

- Denmark, where the SMP operator has deployed high capacity networks through upgrades to the copper network by moving street cabinets closer to customers and deploying vectoring at these street cabinets (aided by the absence of a requirement to offer sub-loop unbundling); or

- Germany, where to date Deutsche Telekom has focussed on upgrading local loops and connecting fibre to the local exchange with investment in FTTH/B being limited. A preference for incremental upgrade to FTTC could also be explained by the need to "catch up" with speeds being offered over widespread cable networks.

Public funding drives NGA projects where there are social benefits but business cases are not sufficiently strong

Private investments in high-speed networks such as FTTH may be limited where the business case for rolling out fibre all the way to the customer's premises is not sufficiently strong. Therefore, there can be a case for **government intervention to promote NGA investment** (in particular fibre), on the basis that positive spill-over effects may create a strong public policy case for fibre roll-out even if the business case is weak. Indeed, the Commission's Digital Agenda has favoured increased public intervention to drive the deployment of ultra-fast broadband networks (subject to state-aid rules).[33]

33 The latest guidelines on broadband state aid entered into force in January 2013. See Regulation (651/2014/EU) of 17 June 2014, Article 52 (3)

The public policy case for fibre roll-out

The EC considered a strong public policy case for governments to intervene to drive rollout of FTTH networks. As the Digital Agenda notes, "[w]ithout strong public intervention there is a risk of a sub-optimal outcome, with fast broadband networks concentrated in a few high-density zones with significant entry costs and high prices. The spill-over benefits created by such networks for the economy and society justify public policies guaranteeing universal broadband coverage with increasing speeds." Achieving the objectives set out was seen to require action that was "focused on providing the right incentives to stimulate private investment, complemented by carefully targeted public investments, without re-monopolising our networks."

A Digital Agenda for Europe, Communication from the European Commission COM(2010) 245, 19 May 2010

Many member states are operating programmes to support the roll-out of NGA infrastructure, particularly to rural areas where infrastructure is unlikely to be developed on commercial terms. Projects in Spain, France, Lithuania, Poland and the UK have all been approved under State Aid rules in recent years.

Finland introduced a national broadband scheme in 2008 led by the Government with the purpose of improving fast broadband accessibility in rural areas. As part of this scheme, regional councils planned around 800 projects for the building of new broadband infrastructure, with many of these rural fibre projects supported by state aid and implemented by new local/regional operators (see BEREC, 2016). There are also many examples of projects led by municipalities and local governments, such as Stokab in Sweden, which used publicly backed loans to deploy fibre in Stockholm.[34]

34 'Stockholm's Stokab: A Blueprint for Ubiquitous Fiber Connectivity?' (www.stokab.se/Documents/Stockholms%20Stokab%20-%20A%20Blueprint%20for%20Ubiquitous%20Fiber%20Connectivity%20FINAL%20VERSION.pdf)

In fact, according to BEREC (2016) there are approximately 180 municipal fibre networks in Sweden, which together own 58% of all fibre lines.

The almost complete fibre coverage in South Korea and Japan has been achieved through subsidised deployments, tax incentives or interest rate subsidies on loans (see Atkinson et al., 2008). In Japan the government introduced policies for service competition and open-access wholesale networks, and was the first country to introduce access regulation for fibre.[35] Using government subsidies to encourage fibre deployment spread to Hong Kong and Malaysia has resulted in rapid deployment of fibre there too.[36]

Australia and New Zealand have opted for public funding of fibre networks in whole or in part, creating wholesale-only operating models for fibre networks with strong access obligations.

Demand-side factors matter, and service innovation can drive demand for NGA capabilities and willingness to pay

There are many reasons why business cases for NGA deployment (in particular investment-heavy roll-out of fibre infrastructure) may be weak. One factor that plays a role is that there is substantial **uncertainty over whether users will be prepare to pay a premium for higher speeds**, in particular where there may be limited availability of services at present that would exploit the potential of higher speeds. Indeed, availability of content and applications that require high bandwidth increases the value customers place on having access to higher bandwidth connections and thus their willingness to pay a premium, providing investors with greater certainty that they will earn a return on investment.

35 'Unlike U.S., Japanese Push Fibre Over Profit' (www.nytimes.com/2007/10/03/business/worldbusiness/03broadband.html?_r=0); Atkinson et al. (2008)

36 'The many paths of Asian fibre', http://www.fibre-systems.com/feature/many-paths-asian-fibre; see also McKinsey (2010)

Innovation has played an important role as a demand driver for broadband. Service and content innovation aided by new business models and tariff plans (including flat rate offers and offers without data caps) have led to new applications that require higher bandwidth.[37] Rich content (and in particular video streaming services) are a main driver of demand, which then translates into investments in network upgrades and NGA deployment.

37 As noted by OECD (2015), operators may also include additional features and applications within their offers to customers. For example, offering discounted subscriptions to music streaming services (such as Spotify or even proprietary music stores such as TDC Play in Denmark) or video services (such as Netflix). Furthermore, including an interface to access over-the-top (OTT) applications via set-top boxes provided in the triple-play package can further encourage customers to use online applications over their internet connection.

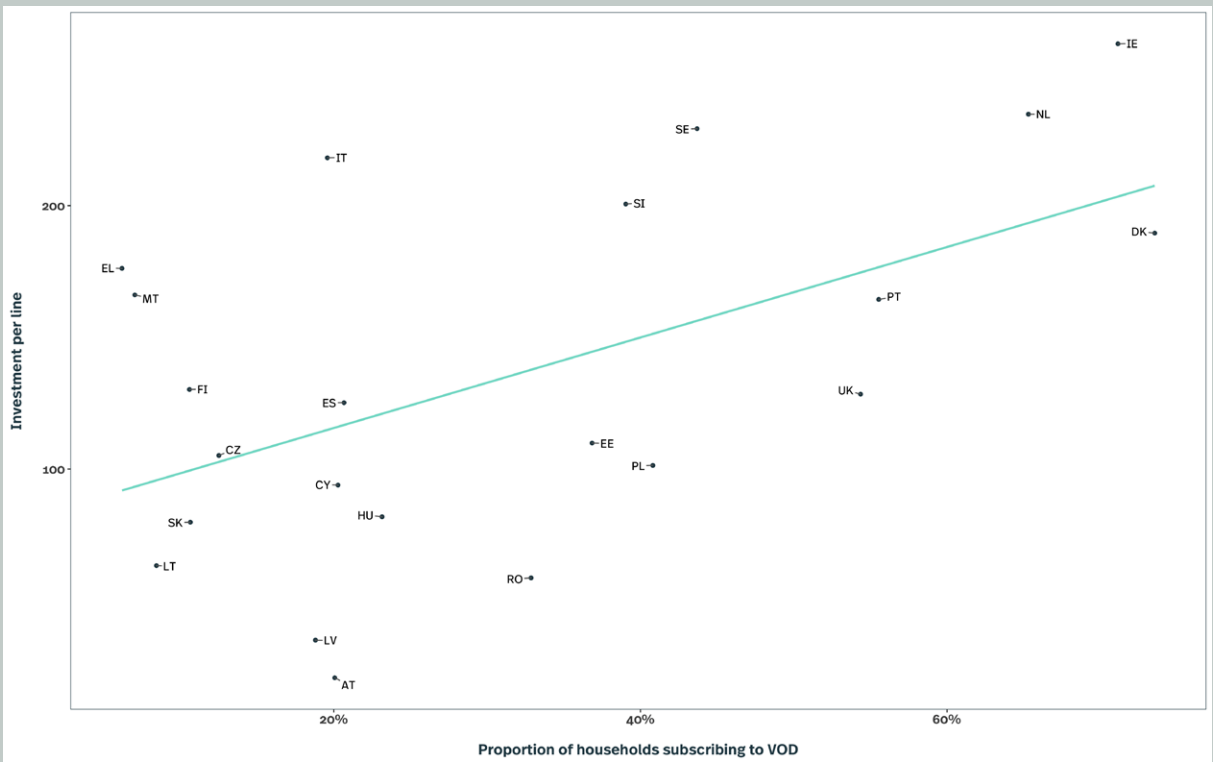
The importance of demand drivers

At present, it appears to be mainly video services and gaming that make use of the capacity and speed offered by NGA infrastructure. For example, announcing further investments into fibre in Spain, Orange Deputy CEO Gervais Pellissier pointed towards the role played by video content in the success of previous investments, stating that "[t]he biggest trend we've seen is in Spain, where there's been an APRU increase of €3–5 per month. … This is down to the new technology but also because of new content. When you deliver FTTH, the main use is video and in Spain we've had a rapid increase in the number of TV customers on our network. At the end of 2014 we had 120,000 TV subscribers which is less than 10% of our broadband base; but at the end of 2015 we multiplied that by more than three, more than 400,000 customers. By the end of 2018 we see more than 50% TV penetration on our broadband customer base in Spain."[38]

Similarly, Ammori (2015) suggests that it was increasing pressure for video streaming that pushed incumbent phone providers in the US, to invest in FTTH several years after deregulation.

Using data from the European Commission's Digital Agenda scoreboard, we can see that demand for for video services (proxied by the proportion of households that subscribe to Video-on-Demand services) has a positive impact on fixed telecoms investment: the more household subscribe to VOD services, the more providers invest per line.

38 'Orange pledges €15bn FTTH and LTE investment by 2018' (telecoms.com/470232/orange-pledges-e15bn-ftth-and-lte-investment-by-2018/)



Data for 2013; investment in the electronic communications sector includes all telecommunications network investment (both tangible and intangible) excluding license fees and is broken down into 'fixed', 'mobile' and 'other'. Source: European Commission Digital Agenda Scoreboard Key Indicators and Financial indicators, fixed and mobile telephony, broadcasting and bundled services indicators

3.2 The impact of access regulation on NGA investment

In addition to the factors discussed above, the incentives (and potentially the ability[39]) to invest in NGA infrastructure will be affected by access regulation.

Access obligations can affect the return on investment both directly and indirectly where the access provider is vertically integrated

Access obligations affect the return on investment that a regulated firm can be expected to earn directly through their impact on access revenues. All other things being equal, permitting higher access charges will lead to greater returns and improve investment incentives.

If the access provider is vertically integrated and also supplies downstream markets, there will be an indirect effect through the impact that access regulation has on competition. Although there is no clear one-to-one relationship between access charges and prices that can be obtained in downstream markets, higher access charges will ultimately translate into access users having to set higher retail prices, which in turn will allow the regulated firm to earn more from its (unregulated) downstream activities through charging higher prices or gaining a larger market share (being able to undercut access seekers and engage in a so-called 'margin squeeze').[40]

From the perspective of new entrants, the terms and conditions on which regulated access is available affect the 'build-or-buy' decision. All other things being equal, facing higher access charges, new entrants are more likely to consider investing in their own infrastructure. Lower access charges will make it more attractive to use regulated access to the incum-

39 Access regulation may affect the ability to invest if there are strong capital market imperfections and thus free cash flows and retained earnings are an important source of funding of investments. In this case, higher access charges provide a source of funding for incumbents, but potentially reduce the amount of funding available for investment by access seekers.

40 Access obligations may have a further effect on vertically integrated firms through their impact on the regulated firm's ability to engage in price discrimination. Laffont and Tirole (2000) provide a complete overview of the impact of access regulation on competition and investment.

bent's network, but may also enable competing operators to fund complementary investments.

In addition, it is worth bearing in mind that any form of regulatory control can create additional risks. To the extent that regulators can exercise discretion and change their approach to the setting of charges or other access terms, for example, there is additional uncertainty that needs to be taken into account by both access providers and users of regulated access services.

These effects, and the basic trade-offs they create with regard to promoting competition and curtailing the exercise of market power by incumbent firms, are well understood and have figured prominently in the debate about the appropriate scope and design of access regulation.[41] There is general agreement that access charges should be 'cost-based', and there are recommendations and guidelines that regulatory authorities should apply when setting cost-based access charges.

Cost-based access charges should ensure that investments in infrastructure pay off, but establishing such charges is not straightforward

41 See, for example, van Damme (1999) or Dobbs and Richards (2004).

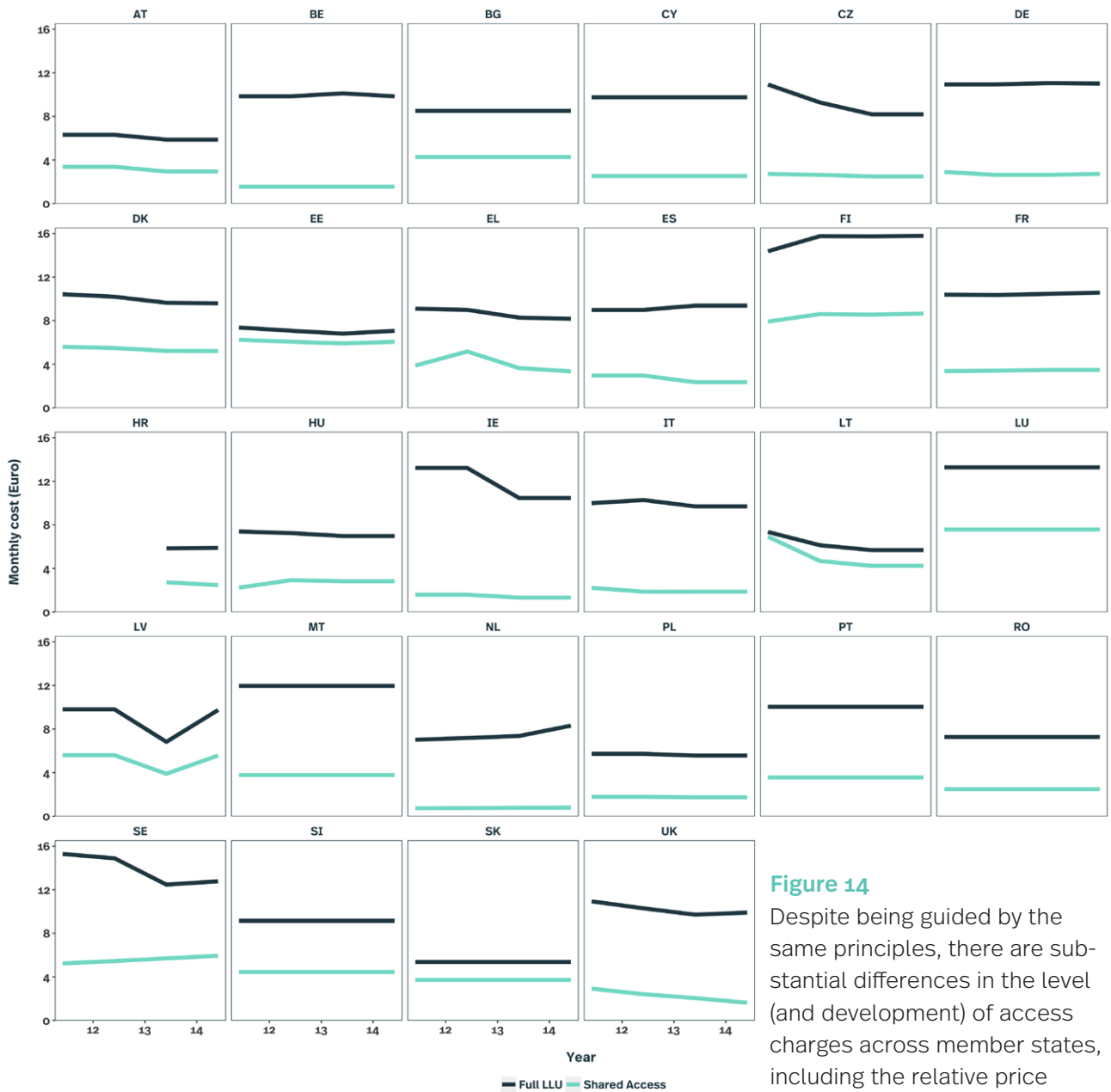
The Commission's recommendation on costing methodologies

The Commission considers that an appropriate costing methodology should lead "to access prices replicating as much as possible those expected in an effectively competitive market." This means that costs "should be based on a modern efficient network, reflect the need for stable and predictable wholesale copper access prices over time ... in order to provide a clear framework for investment and be capable of generating cost- oriented wholesale copper access prices serving as an anchor for NGA services, and deal appropriately and consistently with the impact of declining volumes caused by the transition from copper to NGA networks." The objective must be to have a "costing methodology that provides the appropriate 'build-or-buy' signal strikes an appropriate balance between ensuring efficient entry and sufficient incentives to invest and, in particular, to deploy NGA networks and hence deliver new, faster and better- quality broadband services."

In the Commission's view, a "bottom-up long-run incremental costs plus (BU LRIC+) costing methodology best meets these objectives for setting prices of the regulated wholesale access services. This methodology models the incremental capital (including sunk) and operating costs borne by a hypothetically efficient operator in providing all access services and adds a mark-up for strict recovery of common costs. Therefore, the BU LRIC+ methodology allows for recovery of the total efficiently incurred costs. The BU LRIC+ methodology calculates the current costs on a forward-looking basis (i.e. based on up-to-date technologies, expected demand, etc.) that an efficient network operator would incur to build a modern network today, one able to provide all required services. Therefore, BU LRIC+ provides correct and efficient signals for entry. ...

Therefore, since no operator would today build a pure copper network, the BU LRIC+ methodology calculates the current costs of deploying a modern efficient NGA network."

Commission Recommendation of 11.9.2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment



Monthly cost of unbundled loops and shared accessSource: European Commission, Financial indicators, fixed and mobile telephony, broadcasting and bundled services indicators

Figure 14

Despite being guided by the same principles, there are substantial differences in the level (and development) of access charges across member states, including the relative price of fully unbundled loops and shared access

However, the devil is – as always – in the details. Establishing the costs associated with the provision of a particular access service is less than straightforward. Such services are normally provided using assets that have been constructed at some point in the past, have a long life span and support a range of services that can be provided concurrently. Indeed, there is considerable variation across EU member states, both in terms of the level of access charges and the extent to which they differentiate across different types of access. In some countries, there is a marked difference between the cost of fully unbundled loops and shared access (such as bitstream), whilst in others levels are much closer.[42]

Cost-based access charges do not necessarily provide investment incentives for incumbents, who can earn rents on their legacy infrastructure

Though setting access charges on the basis of replacement costs[43] is considered to be appropriate because it would allow any investor – incumbent or new entrant – to recover the costs incurred in investing in the regulated infrastructure, this ignores the replacement effects that are relevant for incumbents. Very often, incumbents will be permitted to charge at a level that would allow them to recover investment costs, but can provide the services using legacy network infrastructure that has potentially been paid for over and over again. Offering access to their legacy copper network with little or no upgrade will generally be much more profitable for the incumbent than making investments that would replace substantial parts of the network.

42 It is worth pointing out that with the exception of the Czech Republic, none of the price paths are consistent with what one would expect from regulatory authorities trying to provide strong incentives for access seekers to invest in complementary infrastructure. As Cave (2007) points out, following the 'ladder of investment' idea suggests that "access regulation should be varied over time to encourage competitors to invest progressively more deeply in the network and to encourage the incumbent to look to its laurels and invest too." This would mean that shared access should become relatively more expensive over time – which is not evidently a policy approach adopted by most European NRAs.

43 Replacement costs at a particular point in time can be established using 'modern equivalent assets' at current cost. Alternatively, one could use the historic cost incurred for an asset written down to take into account depreciation of the assets. Whilst the historic cost approach may ensure that costs actually incurred are recovered, this may not necessarily give appropriate build or buy signals to access seekers, especially where this includes inefficiently incurred costs which should not be recovered from the access seeker.

As Neumann and Vogelsang (2016) show, an incumbent being *compensated* for providing access at a level of charges that would permit the firm to recoup investments in modern equivalent assets does nothing to ensure that such investments are actually undertaken. Instead, the incumbent firm is better off investing elsewhere the economic rents earned. It is important to acknowledge that investment incentives are lacking in this case not because access charges are set at a level that would not allow the investor to recoup costs, but rather because the incumbent does not have to invest in order to receive the revenues. Higher access prices in this case (or the complete removal of access obligations) would not increase investment incentives.[44]

Access prices begin to matter when replacement effects become less and less important. As we have discussed above, this is the case where the incumbent would need to upgrade or replace its infrastructure in order to exploit the willingness of customers to pay a sufficient premium for higher speed services, or where it would otherwise lose business to competing infrastructures (such as cable networks). At this point, the prospect of being confronted with access charges that do not allow the firm to recover its investment would undermine investment incentives. Considering the impact of access obligations on future revenues (taking proper account of risk and uncertainty) then becomes important.

Where access charges are crucial for investment decisions, avoiding regulatory hindsight bias and accounting for the value of real options is important

44 Note that this does not mean that access prices should be reduced, or could be brought down without any detrimental impact, as this could undermine the reputation of the regulator not to exploit the fact that most of the investments that have been made in network infrastructure are sunk, which exposes the investor to a hold-up problem.

Regulatory hindsight bias and real options

Regulatory hindsight bias and real options are two main challenges for the appropriate treatment of risk in a regulatory context.

Regulatory hindsight bias arises from the fact that regulatory controls will only affect successful investments. This matters, for example, when considering what would constitute a 'reasonable return' on capital. Using a firm-specific Weighted Average Cost of Capital (WACC) in the calculation of cost-based access charges involves such a bias. Imagine, for example, the case where a regulator sets access charges in a manner that limits the return of the regulated firm from the provision of access to its WACC. This ignores that at the point at which an investment is made future returns are uncertain, and may include cases in which the investment has to be written off completely as well as cases in which the return in an unregulated world might well be above the WACC. In the absence of the regulatory control, an investor would take account of both the downside and the upside. However, expecting to be regulated on the basis of earning no more than WACC in the case that the investment is successful curtails the upside, without limiting the downside. This could discourage investment.

In addition, the assumption that allowing an investor returns equal to the (properly measured) WACC is sufficient to provide appropriate incentives to invest fails to consider that investors typically have the 'real' option to delay their investment. Such an option is potentially very attractive if the investment is sunk and cannot be recovered if market developments turn out to be unfavourable. This means that in order to have an incentive to invest now rather than to wait and see, an investor needs to be compensated for the value of the real option to invest later, which means that the required returns must be above the WACC. As Pindyck (2003) puts it, the "WACC does not incorporate any adjustment for option value. To understand why, note that the WACC is simply the firm's opportunity cost of capital. However, it is not the threshold expected return (or hurdle rate) needed to justify an investment. It would be the threshold expected return (or hurdle rate) if the investment in question was reversible, or if the firm had no option to delay investing and thereby wait for more information about market conditions. If, on the other hand, the investment in question is irreversible (as is usually the case in the telecom industry), the hurdle rate must exceed this opportunity cost of capital."

Whilst an investor in network infrastructure gives up the option to invest at a later stage, contingent on developments of demand, for example, its competitors purchasing wholesale access at regulated terms continue to benefit from substantial option values, as they essentially receive access on a 'pay as you go' basis without sinking any costs. This asymmetry in risk faced by an access seeker and the access provider also needs to be considered in looking at access prices in order to ensure that expected returns are sufficient to compensate the investor for undertaking the investment.

All of this makes access regulation a difficult business, and there are many ways in which access regulation can go wrong. Given the different terms of access, and a number of other influencers of investment incentives (discussed above), it is perhaps not surprising that, as WIK (2015) note, the evidence of a clear relationship between the impact of access regulation on investment incentives is mixed (and generally not as strong as the evidence on the positive investment impact of infrastructure competition).

Results from the economic literature

The Berkman Center (2010) reviews twenty-two quantitative papers studying the effects of access regulation on investment[45] using a range of variables as a proxy for access regulation (including: number of unbundled loops per capita; interconnection rates; regulatory efficacy indices; market share of entrants; and market share of access-based entrants). Results are mixed.

Several papers found positive effects of access regulation on investment. Some of these were econometric, including a paper by Jung et al (2008). The authors find that higher entrant market shares result in more investment and that the effect is stronger for access-based entrants. Using company surveys and reports, London Economics and PwC (2006), for the European Commission, find a positive effect of well performing regulatory regimes on incumbent and entrant investment. Cadman (2007) uses a regulatory efficacy index as a proxy for access regulation, and finds a positive effect on incumbent and entrant investment. Some theoretical papers also find positive effects including Christodoulou and Vlahos (2001) which finds positive effects on both incumbent and entrant investment and Foros et al (2009) which finds positive effects on incumbent investment only.

Ten of the papers reviewed found a negative effect of access regulation on investment with half of these empirical and half of these theoretical. Wallsten and Hausladen (2009) find a negative relationship between the number of unbundled lines per capita and fibre subscriptions in Europe. However, the reviewers note that the coefficient on incumbent fibre subscriptions drops to zero when Estonia is removed, and the effect on total (incumbent plus entrant) connections is reduced by 70% when Estonia and Lithuania are removed, suggesting that these two countries are driving results. Alter (2006) uses highly localised data to find that access regulation delays investment. Of the theoretical papers Hausman (1999), Crandall, Ingraham and Singer (2004) and Pyndick (2007) find a negative effect on incumbent investment. Friederiszick et al (2008) find no effect of access regulation on incumbent investment in fixed-lines or incumbent or entrant investment in mobile, but find that access regulation is negatively correlated with fixed-line entrant investment.

Chang, Koski and Majumdar (2003) and Willig (2006) find that the impact of access regulation on investment is dependent on the pricing methodology used for regulated access, and Guthrie (2006) finds mixed effects in his theoretical study, concluding from his review of the literature that "[a]lmost 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."

More recent studies have, as of yet, not produced much more clarity and highlight the practical issues of assessing the relationship between regulation and investment empirically. Grajek and Röller (2012) discover a trade off between access regulation and investment and find evidence of an endogeneity problem where higher investment by incumbents results encourages regulated access. Briglauer et al (2015b) find that service based competition has no significant impact on incumbent or entrant investment.

45 The selection is based on listed empirical papers reviewed by Cambini and Jiang (2009).

Competition can have a positive impact on investment

Regarding the indirect impact from increased competition, European Commission data shows that there is nothing to suggest that a more competitive market would results in less investment – if there is any pattern to be observed, it is consistent with the inverted U-shape i.e. as competition increases there will be increased incentives to invest in NGA, as the returns on existing infrastructure are under threat, the opportunity cost of investing in upgrades declines, and the expected returns on NGA investment higher. However, where competition is very intense, the expected returns on new investments may be small given that any excess economic rents will be competed away.

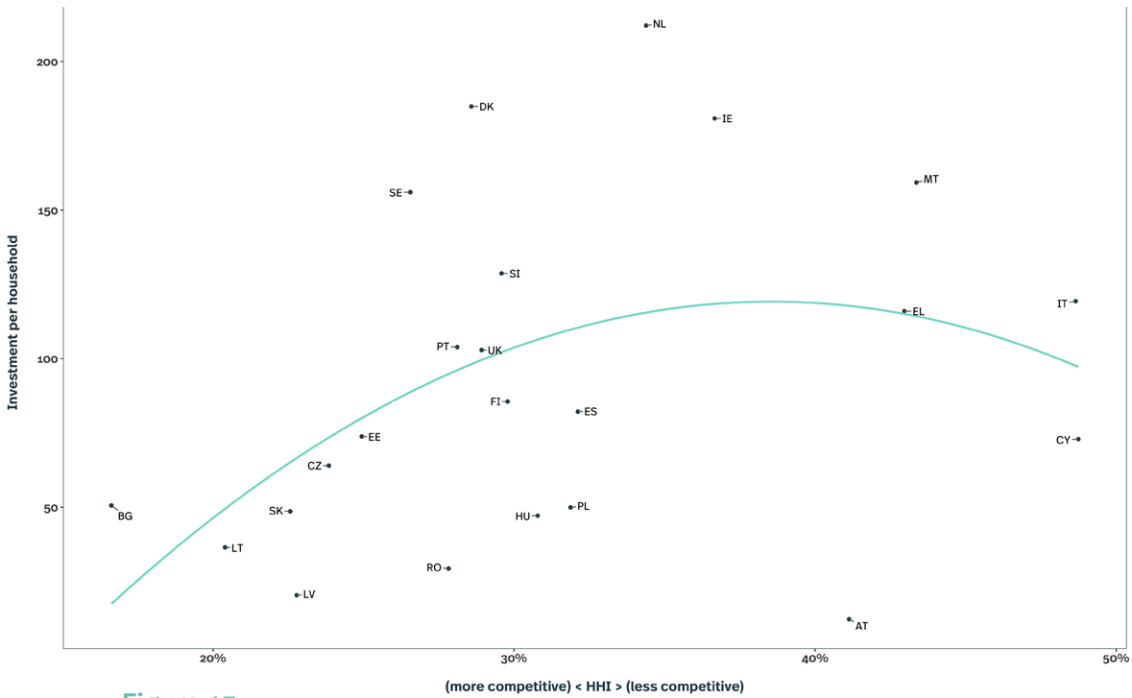


Figure 15
The relationship between market concentration and investment shows the inverted U-shape

Data for 2013; investment in the electronic communications sector includes all telecommunications network investment (both tangible and intangible) excluding license fees and is broken down into 'fixed', 'mobile' and 'other'
Source: European Commission Digital Agenda Scoreboard Key Indicator; Financial indicators, fixed and mobile telephony, broadcasting and bundled services indicators

3.3 Assessing the evidence

As there are many factors that could have an impact on NGA investments, claims that pushing back access regulation would promote investments are overly simplistic. Indeed, many of the examples that have been put forward to show how relaxing access obligations has driven investment in NGA infrastructure are more effective in demonstrating the complex relationship between the various drivers.

There are many factors that influence investment incentives, and arguments for the removal of access regulation may be misleading

For example, Plum Consulting (2016) argues that *"[i]n Spain and Portugal the move to relatively light regulation of WBA products in return for open duct access has led to substantial deployment of FTTH. In Spain differentiation of regulation by bandwidth allowed relaxation of regulation while in Portugal differentiation by geography supported relaxation of regulation."* The reference to 'open duct access' is of course important.

Portugal has been described as one of the frontrunners in Europe in terms of rolling out high-speed broadband infrastructure, and duct access has been considered by the Portuguese regulator as the main enabler of next generation access networks in the country. As Prof. João Confraria, a Board Member of Portuguese regulator ANACOM, stated in an ITU interview, *"[t]he main regulatory driver for that success has been to impose asymmetric access to the ducts and poles of Portugal Telecom. This measure was taken by ANACOM almost nine years ago and was an important factor in reducing the cost of investing in broadband networks"*[46]

Portugal is amongst the leaders on FTTH not because of lax access regulation, but because of wide-ranging access obligations covering passive infrastructure

It is important to highlight that a duct access obligation was imposed in Portugal in 1991 on PT – Portugal Telecom, the incumbent operator and owner of the only duct network in Portugal, when the operator obtained a license to deploy and operate a Cable TV network (see ANACOM, 2012). Since then, the legal framework has been evolving with the inclusion of a

46 'Meeting the demand for broadband capacity in Portugal' (https://itunews.itu.int/En/5222-Meeting-the-demand-for-broadband-capacity-in-Portugal.note.aspx)

reference offer obligation on PT in 2004 and access to network obligation to all electronic communications network operators and public entities in 2008 (see ANACOM, 2008).[47] As ANACOM (2011) stated, *"Portugal was a pioneer in making the incumbent operator subject to an obligation to develop an access offer to its duct network; this access offer has made it possible for interested operators (OSP) to develop their own networks at a much lower cost than if they had sought to build their own ducts. In addition to the specific structural separation of PT Multimédia (now ZON) and Portugal Telecom, these measures have been decisive for the use of own infrastructure by the OSP in Portugal."*

As a result of this measure, fibre investment flourished, which has since led to a decline in the use regulated access such as LLU. The number of unbundled lines in use has been falling since the third quarter of 2008.[48] In 2010 Optimus[49] discontinued the use of LLU and all retail connections are now based on their own infrastructure, namely fibre[50].

Thus, whilst it is correct to point out that NGA investment in Portugal has been substantial, it is not the removal of access regulation that has stimulated investment. Rather, strong obligations on the incumbent to provide access to its passive infrastructure have resulted in new entrant investment in competing NGA infrastructure. Portugal Telecom has at the same time upgraded its own networks to the extent that it has announced the complete withdrawal of copper.[51]

47 This was followed in 2009 by the publication of Decree Law 123/2009, that defined the 'legal regime governing the construction, access to and set up of electronic communications networks and infrastructures' (www.anacom.pt/render.jsp?contentId=975261)

48 The maximum of 319,908 was achieved in 2008 with a constant decline since then achieving 129,303 in the 4Q2014.

49 In 2010 Optimus was the third mobile operator and is currently known as ZON after the merger with the main cable operator, NOS in 2014.

50 ANACOM (2016)

51 'Portugal Telecom selling off its copper' (www.totaltele.com/view.aspx?ID=493077)

In March 2015 the incumbent announced that they would begin offering wholesale access to their fibre network (on a voluntary basis).[52] As part of its assessment of market 3a and 3b, ANACOM (2016) has published a draft decision within which it sets out terms for a possible dark fibre remedy.

Spain has benefited from greater fibre roll-out, also explained in part by the availability of access to passive infrastructure. For example there is an extensive, high quality duct network, which reaches most buildings, is in good condition and has good access through manholes (See BEREC 2016, Annex 2). Since 2009, as a result of regulation imposed by the Comisión Del Mercado De Las Telecomunicaciones (CMT)[53] requiring Telefónica to provide access to its civil infrastructure, alternative operators could gain access to this duct network as cost-oriented prices.

Similarly, Spain has had access obligations to passive infrastructure in addition to strong cable competition and there has been co-investment and co-deployment

However, there are other factors that may also have contributed to the increased roll-out of fibre, including several co-investment and co-deployment agreements between parties including between Telefónica and Jazztel in 2012[54] and Vodafone and Orange in 2013.[55] As noted by BEREC (2016) competitive pressure exerted by cable and LLU operators also appears to have been a key driver in densely populated areas with multi-dwelling buildings that favour NGA roll-out by reducing deployment costs.

Even with the shift to fibre, there remain access obligations on infrastructure owners. For example, regulation imposed by the CNMC (the National

52 'PT moves forward with wholesale offer for fibre network' (www.telecom.pt/en-us/media/noticias/pages/2016/marco/pt_avanca_com_oferta_grossista_para_a_rede_fibra.aspx)

53 'Decision regarding the analysis of the offer for access to ducts and junction boxes of Telefónica de España, S.A. and their adequacy to the requisites of the Comisión del Mercado de las Telecomunicaciones (MTZ 2009/1223)' (telecos.cnmc.es/c/document_library/get_file?uuid=-628f3a56-11e1-4fa3-85ce-7c7c982f707d&groupId=10138)

54 'Jazztel inks FTTH deal with Telefonica for shared deployment' (www.telegeography.com/products/commsupdate/articles/2012/10/10/jazztel-inks-ftth-deal-with-telefonica-for-shared-deployment/)

55 'Spanish units of Vodafone and Orange to roll out joint fibre network' (www.telegeography.com/products/commsupdate/articles/2013/03/14/spanish-units-of-vodafone-and-orange-to-roll-out-joint-fibre-network/)

Markets and Competition Commission) in 2012 requires that the first operator to reach a building with its fibre, must provide access to third parties at reasonable prices and under transparent conditions.[56] Following the latest market review of the wholesale broadband access market, Telefónica is also obliged to provide access to both the civil infrastructure level of its FTTH network and the terminating segments in some competitive municipalities[57] and must provide indirect access to both its copper and fibre network[58] in less competitive areas.[59]

Despite higher degree of competition in FTTH (particularly in urban centres), WIK (2015) highlights that consumer outcomes in Spain are below average compared with some other major European Member States[60] with take up of NGA and usage of bandwidth relatively low and prices higher than, for example, in the UK.

Roll-out of FTTH in the Baltic states is mainly driven by poor legacy infrastructure, public investment programmes and a strong focus on digital leadership

Similarly, the claim that the difference in NGA deployment between the Baltic states and other Eastern European countries is due to differences in regulatory policy is overly simplistic. For example, Briglauer et al. (2015a) argue that *"Estonia, Latvia and Lithuania in particular have proved very successful in deploying NGA networks. What the three Baltic States have in common is relatively low first-generation broadband penetration and the lack of strict cost-oriented fibre access obligations. The former factor is shared with other eastern European EU members. The latter is not. Hungary, Poland, Slovenia and Slovakia all introduced stricter fibre access regulations than the Baltic States and have achieved less spectacular investments in fibre. The exception is*

56 European Commission (2015)

57 This includes those areas where there is a sufficient level off retail broadband competition and the presence of at least three NGA networks with a sufficient level of coverage.

58 Fibre access is in the form of virtual unbundled local access (VULA) type product over its FTTH network (BEREC 2016).

59 BEREC (2016); 'CNMC finalises wholesale broadband regulations' (www.telegeography.com/products/commsupdate/articles/2016/02/26/cnmc-finalises-wholesale-broadband-regulations/)

60 The other Member States considered in WIK (2015) include: France, Germany, Italy, Netherlands, Sweden and UK.

the Czech Republic, where NGA network expansion has been rather weak despite the lack of strict regulation. The examples of Bulgaria and Romania seem to corroborate this picture. Both lacked a well-developed legacy infrastructure, have abstained from strict NGA regulation and have been very successful in deploying fibre, albeit only the ultra-fast architecture in Bulgaria."

It is not entirely clear how the authors identify 'lax' or 'strict' fibre access regulation, and a review of the 2015 Implementation Report does not suggest any notably lax or strict approaches to fibre access regulation (though an asymmetric obligation to provide unbundled access to metallic and fibre access lines on the incumbent operator since 1 September 2014 is explicitly mentioned for Latvia).[61] Moreover, the narrative ignores, for example, that:

- both Poland and Hungary are well-served by cable networks, with Hungary showing the third highest market share of cable operators in the EU (see Figure 1);
- there have been large publicly-funded fibre deployment programmes in both Latvia and Lithuania;[62] and
- Estonia, in particular, is known for its strong focus on attracting technology businesses by being innovation-friendly and promoting investment in the infrastructure to support those businesses.

61 European Commission Staff Working Document, Implementation of the EU regulatory framework for electronic communication – 2015, p 188 f.
62 European Commission Staff Working Document, Implementation of the EU regulatory framework for electronic communication – 2015, p 185 and p 196.

Promoting the digital economy in Estonia

The Digital Agenda for Estonia 2020 sets out that "The focus for the future will [...] be on creating an environment that facilitates the use of ICT and the development of smart solutions in Estonia in general. The ultimate goal is to increase the economic competitiveness, the well-being of people and the efficiency of public administration" with several policies aimed at making sure the latest technology is in place including a "no legacy principle" whereby the public sector should not be using any ICT solutions older than 13 years old.[63]

The Ministry of Economic Affairs and Communications has set out ambitious targets within a 'Estonian Entrepreneurship Growth Strategy 2014–2020'. This strategy also outlines the details of 'technology development centres' to promote the development of technology and innovation.[64] Efforts have been made to ensure it is very simple for tech entrepreneurs to register and start up within Estonia.[65]

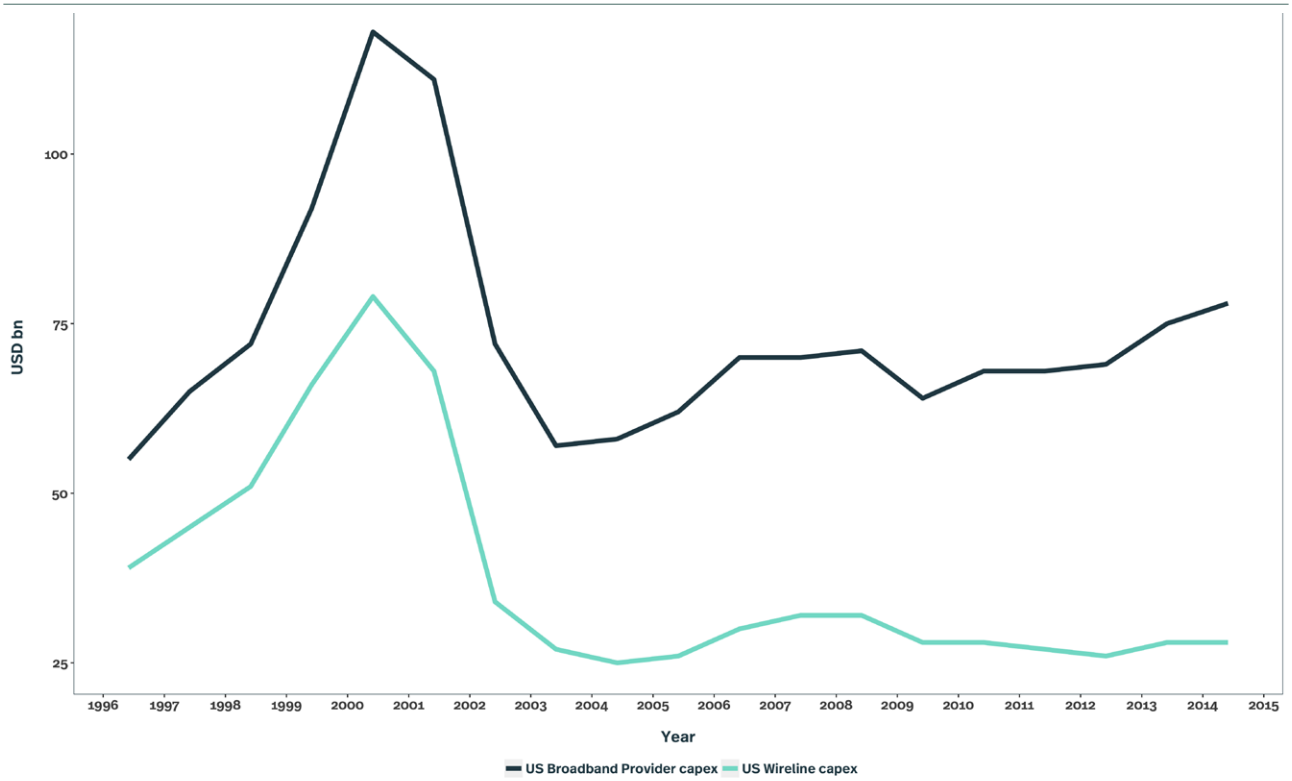
US investment figures do not suggest that regulation discourages investment

Last but not least a look at the timing of US broadband investment does not provide any support for the claim that access obligations have held back investment, and that the 2005 reform has provided a strong boost: there has been a slight increase in investment in 2006–2008, but overall investment figures had been much higher in the period after 1996 when the extensive unbundling requirements were in place.

63 Digital Agenda for Estonia 2020 (e-estonia.com/wp-content/uploads/2014/04/Digital-Agenda-2020_Estonia_ENG.pdf)

64 See www.mkm.ee/en/objectives-activities/economic-development-and-entrepreneurship/innovation#technological-development-centres1

65 For example see 'Not only Skype' (www.economist.com/blogs/schumpeter/2013/07/estonias-technology-cluster)



Source: US Telecom (www.ustelecom.org/broadband-industry/broadband-industry-stats/investment)

Figure 16
Investment in the US into both broadband provision and wireline networks was higher in the period in which extensive access obligations applied than in the period after 2005. There has been a reduction in investment in 2003 and 2004 and slight increase in the years after 2005, but investment levels remain below their pre-2002 level

3.4 Summary

As we have discussed, there are many factors that could have an impact on NGA investments, and claims that pushing back access regulation would promote investments are overly simplistic. While badly designed access regulation can potentially discourage investment, well-designed regulation can promote it.

The examples that have been put forward to show how relaxing access obligations has driven investment in NGA infrastructure are more effective in demonstrating the complex relationship between the various drivers. They show that investment in NGA infrastructure is driven by a number of factors, and that the simple recipe that less regulation leads to more investment is rather misleading.

4 IS THERE A CASE FOR REMOVING ACCESS REGULATION?

Even if there were any clear indication that access regulation discourages investment in new infrastructure, this would not be sufficient to support the case for reducing or removing such obligations. In light of the clear benefits that flow from access regulation promoting competition, which leads to lower prices, greater choice, more innovation and better quality, there would ultimately be a trade-off between potential gains from greater investment, and losses from higher prices, less choice and lower quality.

Even if reduced access obligations were to spur investment, one would ultimately have to look at the trade-off between more investment and reduced competition

Any case for pushing back access obligations on the basis of such a trade-off becomes very much weaker when considering that there is no clear evidence in support of the claim that access regulation has a chilling effect on investment and innovation (though badly designed access regulation – by definition – would have such an impact).

Proponents of a policy of reducing the scope of access regulation, and ultimately removing such obligations completely, would have to demonstrate

that the benefits from competition supported by access regulation will not be put at risk. There appear to be two main strands to the arguments made to date that access obligations could safely be rolled back or phased out, namely that:

- infrastructure competition would be sufficient to protect customers, not least because it would provide incentives for access networks to open up their infrastructure to third parties; and that

- ex-post controls would provide protection against potential abuses of market power resulting from the control of bottleneck infrastructure.

We look at both of these arguments in turn.

4.1 Is infrastructure competition sufficient?

Without access obligations, there is a risk that competition across all stages of the value chain and all parts of the network could be limited by the extent to which competition is sustainable at the level of the 'last mile': there is no reason to assume that the level of retail market competition we observe at present would continue to exist if access obligations were rolled back or removed completely (and it is therefore misleading to claim that access obligations could be removed where retail competition is effective).

Unless competition between alternative access networks provides incentives for the network operators to allow downstream competitors to make use of their networks, there would be 'platform competition' across the entire value chain, with the number of competitors being limited by the number of competing local access infrastructures that can be sustained.

Infrastructure competition is beneficial, but is geographically limited and unlikely to lead to widespread access offers

Plum Consulting (2016), for example, argues that *"as consumer demand for higher speed access grows, the interests of access providers and access seekers will become better aligned, particularly in areas where there is infrastruc-*

ture-based competition. In such areas, both access seekers and the regulated access provider have an interest in competing more effectively with rival platforms. In some markets, recognising the constraints of uniform regulated access terms on their ability, they have reached long-term voluntary commercial arrangements."

It is not clear whether this should be taken as a suggestion that infrastructure-based competition, which in relation to access networks will inevitably be limited to two – and at most a handful – competing access infrastructures, is sufficient to provide incentives for those controlling the infrastructure to offer access on voluntary terms. Clearly, any agreement we have seen to date has been concluded in an environment where there is a regulatory backstop that protects access seekers. Without some obligation that potential access seekers could reasonably invoke if no voluntary agreements are forthcoming, negotiated access arrangements might not come about.

In any case, infrastructure competition is likely to be limited in Europe. In many areas, cable networks – initially built for the delivery of television services, but since upgraded for the provision of data services – offer an alternative for the end user, but in many countries, their coverage is regionally limited and usually limited to private households. Cable share of fixed broadband subscriptions ranges from 0% in Italy to a maximum of 51% in Belgium. On average, in the EU, cable represents 19% of fixed broadband subscriptions.[66] There is no indication that these networks will achieve comparable coverage to the existing telecoms infrastructure (and even less of an indication that removing access obligations on new fibre networks would contribute to improved cable coverage).

Even in the US, infrastructure competition is limited geographically. Crawford and Scott (2015) note that providers of high speed broadband access face direct competition in less than one fifth of their territories. Companies

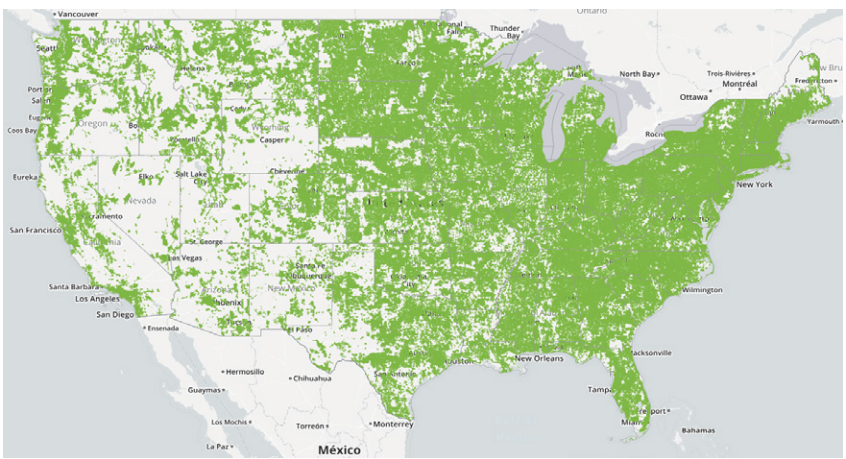
66 European Commission, Broadband Access in the EU, July 2015.

have "carved up" regions and do not compete outside their territories[67], resulting in price increases for consumers. This occurs extensively in rural areas where DSL services have no price competition in theory.

The least competition is in the fastest speeds. As Wheeler (2014) notes, of the 80% of households who have access to services with 25Mbps, almost 70% have no choice of provider. Only 3% of these customers can choose from three or more ISPs: *"At 25mbps, there is simply no competitive choice for most Americans."* As Figure 17 shows, with the exception of the most densely populated areas, US customers are faced with a duopoly at best.

Figure 17

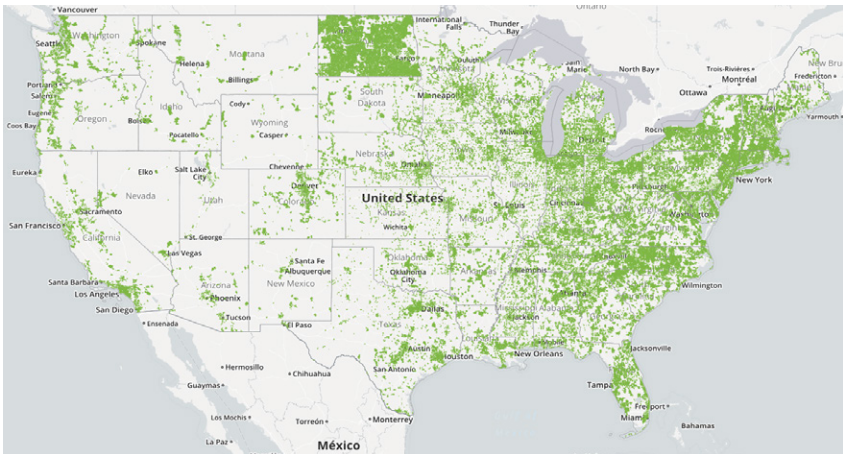
Whilst broadband availability in the US is good, competition is limited – only in some of the most densely populated areas do customers have a choice of three or more providers, and much of the US is served by only a single supplier



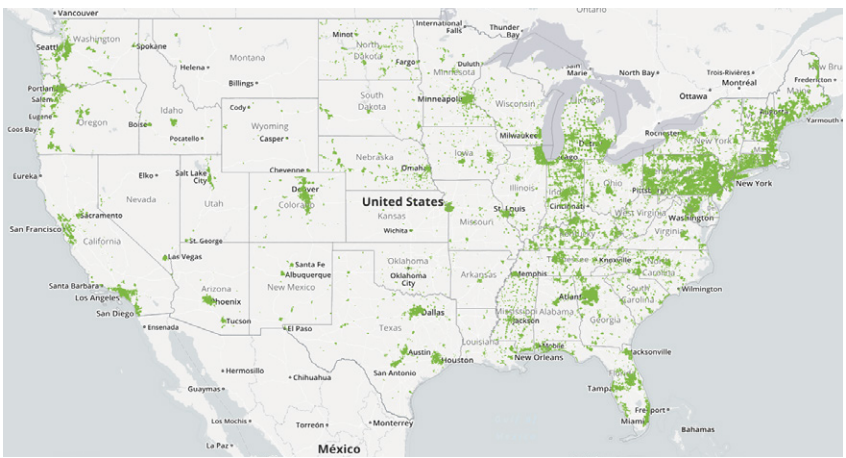
Coverage (at least one provider)

Source: National Broadband Map (www.broadbandmap.gov/)

67 See 'These maps show why internet is way more expensive in the US than Europe: Telecom companies appear to split up territory to avoid competition' (www.theverge.com/2015/4/1/8321437/maps-show-why-internet-is-more-expensive-us-europe-competition)



Duopoly (exactly two providers)



Three or more providers

There is no evidence that operators of alternative networks who are not subject to regulatory obligations (such as incumbent cable operators, or new fibre networks) would be prepared to let downstream firms use their

networks.[68] Cable networks currently do not provide access to competitors, even though DOCSIS should allow them to do so.[69]

And regardless of whether one considers the type of competition supported by the extensive unbundling requirements of the 1996 Telecommunications Act desirable, the US experience certainly suggests that the removal of access obligations can wipe out competition from access seekers who have relied on such access.

68 To the best of our knowledge, the only potential exception is Portugal Telecom, which has been reported to offer access to its fibre network on a voluntary basis (see www.telecom.pt/en-us/media/noticias/pages/2016/marco/pt_avanca_com_oferta_grossista_para_a_rede_fibra.aspx)

69 For example in 2012 Opticom "launched one of Australia's first wholesale cable networks in the Western Australian development of Brighton, allowing retail internet service providers to provide services at similar speeds to the National Broadband Network under a similar pricing construct." ('Opticomm: No technical barrier to open access cable', www.itnews.com.au/news/opticomm-no-technical-barrier-to-open-access-cable-290926)

Access after the removal of obligations in the US

In the US access regulation was introduced by the 1996 Act, with wide-ranging obligations to provide unbundled network elements (UNEs) at cost-based prices. Arguably, these prices had been set at levels that made it attractive for new entrants to come into the market by leasing "re-bundled" UNEs from incumbents. According to Bauer (2006), "[i]n the mass market, an unbundled network platform, consisting of local loop, switching and transportation (short 'UNE-P') emerged as an attractive entry model", which allowed competing carriers "to enter the market with only minimal complementary facilities investment." Incumbents "claimed that UNE-P was a resale service in disguise at a price much lower than would have resulted from applying the retail price minus avoided cost formula. Conversely, new competitors and state PUCs argued that UNE-P was an important step in opening the local market to competitors." These extensive unbundling requirements were scrapped between 2003 and 2005.

From 2004 to 2010 the number of lines using unbundled elements fell from 21 million to 3 million. Spiwak and Ford (2016) note that following the phasing out unbundled local loops the entrants have mostly disappeared as a result, explaining that "most of the competitive carriers who relied on the unbundling regime – including the long-distance telecommunications behemoths AT&T and MCI – are now gone, some dying quickly, some slowly, and some eventually acquired by [incumbent local exchange carriers] ILECs".

Removing obligations based on the belief that incumbents would have an incentive to provide access and enable downstream competition where otherwise such competition would be restricted to only one other (or at least not more than a handful of competitors, some of which may not even be able to provide access) seems to be a high-risk gamble with very limited upside but a potentially large downside of losing competition across much of the value chain.

Without access obligations, competition could be limited across the value chain by the level that is sustainable in the access network – i.e. a duopoly or narrow oligopoly

Without such obligations, there is a clear risk that rivalry across the whole value chain might be limited by whatever competition is feasible in the most naturally monopolistic (or narrowly oligopolistic) part of the value chain – last mile access. Even in the best case, such competition involving alternative fixed access network infrastructure (cable) and mobile/wireless, which is an imperfect substitute, will be geographically limited.

One might of course argue that infrastructure competition is sufficient to protect consumers and create the benefits that we have observed in the liberalised telecommunications markets to date. However, the comparisons between the US and Europe in terms of prices, coverage and penetration suggest that a small number of competitors may not be sufficient.

The limits of infrastructure competition also become apparent when looking at mobile markets, where concerns about a reduction in the level of competition and the consequent harm for customers have led the European Commission to block the proposed acquisition of O2 in the UK by rival mobile operator Three.[70] This transaction would have reduced the number of mobile network operators in the UK from four to three. A cable/PSTN duopoly would be even worse than that, with only two suppliers with less than complete geographical overlap.

That these concerns are well-founded has been demonstrated in recent studies by the Austrian regulator (RTR) and the Austrian Competition Authority (BWB) looking at the price effects of the merger between Orange and Three in Austria that was completed in January 2013. The merger resulted in higher prices, and prices only began to come down with the entry of new MVNOs (which in turn might not have taken place without the explicit commitments required from the merging firms as part of the merger clearance).

70 'Commission prohibits Hutchison's proposed acquisition of Telefónica UK' (europa.eu/rapid/press-release_IP-16-1704_en.htm)

The Austrian mobile merger led to substantially higher prices

RTR (2016) compared prices in Austria from 2011 to 2014[71] against a reference group of ten European countries where the number of MNOs did not change.

RTR used detailed tariff data from Tarifica in order to calculate monthly costs for different user profiles:

- a 'smartphone user' based on average usage of minutes, text and data in each country (BEREC data); and
- a 'traditional user' assumes 50% lower minutes and texts, no data;

Usage was country-specific and assumed to be constant over time.

For each point in time RTR took the average of the cheapest four tariffs per operator subject to taking at most two pre-paid tariffs per operator in order to not exclude post-pay (which was often more expensive, but had a large market share). The weighted average of operator price averages was then taken as the basket price for each country.

Using this data, a counterfactual was established against which the evolution of prices in Austria could be compared. The regulator used two different econometric models to establish the counterfactual: (i) a difference-in-differences approach (DiD); and (ii) a synthetic control group approach (synth).

For the smartphone user, RTR identified a statistically significant merger effect on prices of between 50% (synth) and 90% (DiD) by 2014. For the traditional user the impact was smaller, but still of the order of 22–31%.

The Austrian competition authority (BWB, 2016) conducted its own analysis into the price effect of the merger. Using a merger simulation model BWB found that the merger had led to an increase in price of the order of up to 20% across all segments (pre-paid and post-paid tariffs), with the greatest impact on the pre-paid tariffs. Pre-paid tariffs showed price increases of up to 30% between December 2012 and December 2014.

4.2 Reliance on ex-post controls

Ex-post controls (such as competition law provisions) are not sufficiently effective because of the time required to resolve disputes

The claim that ex-post competition law enforcement would be sufficient to protect competitors and ultimately customers from any exploitation of market power arising from control of bottlenecks is highly questionable. The time it takes to resolve such disputes renders ex-post enforcement in all likelihood ineffective – justice delayed is justice denied. Webb Henderson & SPC Network[74] argue that ex-ante regulation is more suitable than ex-post, given that *"[t]he timescale can be so long that entrants would be forced to exit the market before a case was resolved."*

Whilst there are clear timelines for resolving disputes arising from regulatory obligations[72], resorting to general competition law requires disputes to go through national courts, making the whole process much slower. Figure 18 presents the average length of ex-post processes in Belgium, France, Germany, the Netherlands and the UK, ranging from around 7 months in France to almost two years in the Netherlands and Belgium. Such timescales are clearly inappropriate for the resolution of any access dispute where the potential access seeker might effectively be prevented from operating while the resolution is pending.

71 Note that this period does not include the date at which the MVNO access commitments imposed on the merged entity became effective.

72 For example, within the European Union, Articles 7 and 7a of the Framework Directive establish a timeline of 3 and 4 months respectively, for the process of notification of remedies by regulators to the Commission, assessment, and eventual resolution of incompatibilities with the EU legislation. In the UK, Ofcom has established a four-month period, unless exceptional circumstances, for dispute resolution (see Ofcom, 2011),

Country	Court	Average length (months)[73]
Belgium	Cour d'appel de Bruxelles	23.5
France	Cour d'appel de Paris	7.5
Germany	Verwaltungsgericht Köln	9.4
The Netherlands	College van Beroep	23.6
United Kingdom	Competition Appeal Tribunal	16.8

Figure 18
Ex-post resolution of disputes can take up to two years

Examples of average length for ex-post resolutions – electronic communications sector
Source: CERRE (2011)

These proceedings are lengthy not only because they involve economic, technical and legal complexity, but also because some jurisdictions have backlogs in their courts. The study presented by CERRE (2011) indicates *"there is no realistic hope to see the length of the appeal proceedings be substantially reduced in all jurisdictions in the future"* – and one might expect that any increase in the load will lead to the resolution of disputes taking more time.

The experience with the light-handed regulatory approach in New Zealand provides another indication of the difficulty associated with relying on competition law to support a competitive telecommunications sector.

73 The average time length is the one indicated as 'on the merits', except for Germany where the length reflects the average of all the proceedings.

The failure of the light-handed regulatory approach in New Zealand

New Zealand opened its telecommunications sector to competition towards the end of the 1980s and privatised the incumbent, Telecom New Zealand, in 1990. Rather than adopting sector-specific regulation, New Zealand relied on general competition law to prevent anti-competitive behaviour by the incumbent, with enforcement left to the Commerce Commission or private litigation in the courts. In addition, information disclosure requirements were placed on Telecom New Zealand, and there was a threat that regulation would be introduced if the incumbent abused its market power.

Although some competition emerged under this regime, it was encumbered by sometimes lengthy disputes and uncertainty over interconnection prices. Clear Communications initiated proceedings against Telecom New Zealand in 1991 after failing to negotiate acceptable terms for local loop access (in particular the interconnection price). Resolution of the dispute took five years and involved going all the way to the Privy Council, New Zealand's final appellate court. Terms and conditions for local loop interconnection were finally agreed in 1996.[74]

By the end of the decade, the shortcomings of the approach were obvious. The market was characterised by high prices and poor quality of service. Disputes would take years to be solved, at courts that would impose remedies that proved to be inadequate. Following a Ministerial Inquiry into Telecommunications announced by the new government, sector specific regulation was introduced in 2001 with the establishment of a Telecommunications Commissioner to regulate the telecommunications sector. As a condition of allowing Telecom to participate in the government's UltraFast Broadband Initiative, under which the government contracted with network operators to build FTTP networks covering 75% of New Zealand, the network business (Chorus) and the retail business (Spark) were structurally separated in 2011.

Source: "New Zealand: Using Competition Law to Regulate Interconnection", ICT Regulation Toolkit (www.ictregulationtoolkit.org/en/toolkit/notes/PracticeNote/2597); Patterson (2011)

4.3 The impact on consumers

Implicit in the claim that investment is held back by access regulation is the acceptance that a removal of regulatory obligations would lead to higher prices.[75] If – as Plum Consulting (2016) claims – investment in Europe is low because revenues are low (with the ratio between investment and revenue being 'remarkably stable'), then higher investment can only be

Even if laxer access obligations spurred investment there is no evidence to suggest that customers would be better off

74 Webb Henderson, SPC Network, 'The Future of European Telecoms Regulation', pg. 49, February 2014

75 We assume that the positive impact of removing regulation would not purely be the result of reduced investment risk with unchanged revenue streams. If this were the case, there would indeed be a good case for removing the regulatory obligation. However at the same time, these obligations would have to be extremely badly designed und have the sole effect of creating avoidable risks for investors.

achieved if revenues go up, i.e. customers pay more for the services than they currently do and would be worse off.

Unless one were prepared to argue that investment is an objective in its own right, it is therefore important to consider the overall impact on consumers and welfare.

Theoretical models (such Nitsche and Wiethaus, 2011 or Bender, 2011) that look at investment incentives and consumer welfare find indeed that consumer welfare is higher with access regulation even if removing obligations may in some cases promote investment.

Regulation, investment incentives and welfare

Nitsche and Wiethaus (2011) develop a simple model for analysing the incentives to invest in Next Generation Networks (NGN) under different regulatory regimes. Specifically, they consider a standard Long Run Incremental Cost (LRIC) framework, which they model as an entitlement to recover investment costs from access seekers if the investment is efficient (i.e. if the NGN investment turns out to be justified by the willingness to pay of end-users); a Fully Distributed Cost (FDC) framework in which investment costs are recoverable from access charges regardless of whether the investment turns out to be successful; risk sharing arrangements where the incumbent and the new entrant jointly invest in the network (aiming to maximise industry profits), and then use it to compete downstream without making any payments; and a 'regulatory holiday', which means that there is no regulatory obligation to provide access, at least for a predefined period of time.[76]

Investment incentives are measured by the extent of NGN deployment. Expected consumer welfare takes account of both NGN roll-out and end-user prices.

Comparing the different models, the authors find that both a regulatory holiday and FDC-based access charges provide greater investment incentives than risk sharing, and that the latter provides greater incentives than LRIC-based charging unless the probability that consumers have a higher willingness to pay for NGN access is sufficiently large (i.e. the success of the investment is virtually guaranteed). However, when looking at prices and the overall welfare impact, the results "suggest that regulators may dismiss regulatory holidays for good reason whilst they might consider risk- sharing arrangements a priori positively or even encourage them.[77]"

The authors acknowledge that the model is highly stylised, based on restrictive assumptions and very specific implementation of a limited range of regulatory policies. However, it effectively demonstrates the complex effects that regulatory policies have on investment and the role of risk (and its asymmetric distribution on investors and access seekers). It also demonstrates the importance of considering investment incentives and the intensity of competition when looking at the consumer welfare effects of different regulatory options.

To the extent that the US is held up as a shining example of what telecommunications in Europe could be, the obvious question is whether policymakers should move in this direction. As we have shown above, Europe performs well in comparison with other OECD countries, and in particular the US.

The US market demonstrates that higher availability does not necessarily translate into higher penetration

76 Nitsche and Wiethaus also consider the application of a 'risk premium' to mitigate the asymmetric curtailment of the upside under the LRIC approach, where an incumbent would be allowed to charge above cost in the case that demand is high in order to compensate for the fact that access charges would not make any contribution if demand were low. However, the authors believe that the leverage of such an instrument would be limited because it would come into effect only when willingness to pay turns out to be very high, and would in this case have a potentially large impact on competition.

77 The authors highlight that a critical question in this case is on what conditions (late) entrants who have not participated in the investment would obtain access. Treating such entrants too favourably could jeopardise the very idea of risk sharing.

Looking at prices per Mbps advertised download speed, for example, the US can be found towards the bottom of the league, with only Chile, Spain, Turkey and Greece having a higher price at the bottom end of the price bracket (and only Turkey having a higher price at the top end).[78]

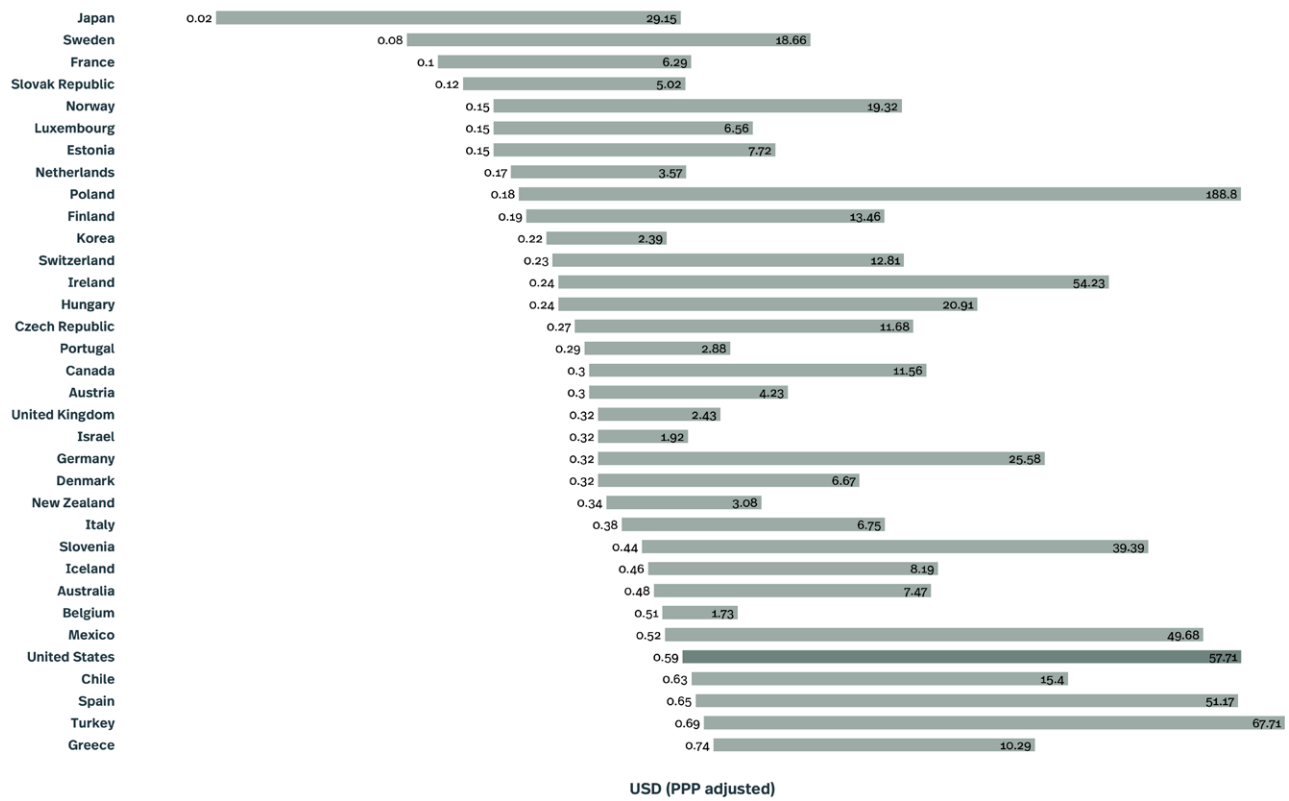


Figure 19
Broadband services in the US are the fourth most expensive amongst OECD on a per Mbps-of-advertised-download-speed basis

Fixed broadband prices per megabit per second of advertised speed; data for September 2014, USD PPP. Source: OECD Digital Economy Outlook 2015

78 See OECD (2015), figure 2.37

Price comparisons undertaken by the OECD suggest that the US is the most expensive country for a high-use basket (requiring speeds of 25/30Mbps and above), with prices (in PPP-adjusted USD) being more than 20% higher than in the most expensive EU country (Luxembourg), and more than three times the price of a comparable basket in the cheapest EU country (Slovakia).

The Cost of Connectivity dataset from the Open Technology Institute (2014) contains information about prices and advertised download speeds for broadband-only options from the main broadband providers in a number of cities around the globe.[79] From this data, we have calculated the average price per month and the average activation fee (in PPP-adjusted USD) shown below. This demonstrates that broadband services in comparable speed brackets are substantially more expensive in the US (with the exception of a lower average activation fee in the 10–30Mbps bracket), and that the price gap becomes larger as speeds increase.

Speed bracket (Mbps)	Average Price per month		Average Activation Fee		Number of cities (n)	
	Europe	US	Europe	US	Europe	US
<10	35.50	42.83	42.99	67.97	7 (31)	8 (30)
10–30	35.64	59.62	36.12	28.02	10 (77)	11 (57)
30–100	45.35	93.92	33.50	136.25	10 (119)	11 (46)
>100	66.05	148.28	25.40	178.93	10 (43)	11 (31)

Source: Open Technology Institute (2014), DotEcon calculations

Figure 20
Broadband services in the US are more expensive than in Europe – and cost more than double in the higher speed brackets

79 Prices were collected from information about the plans offered by the main broadband providers that were publicly available.

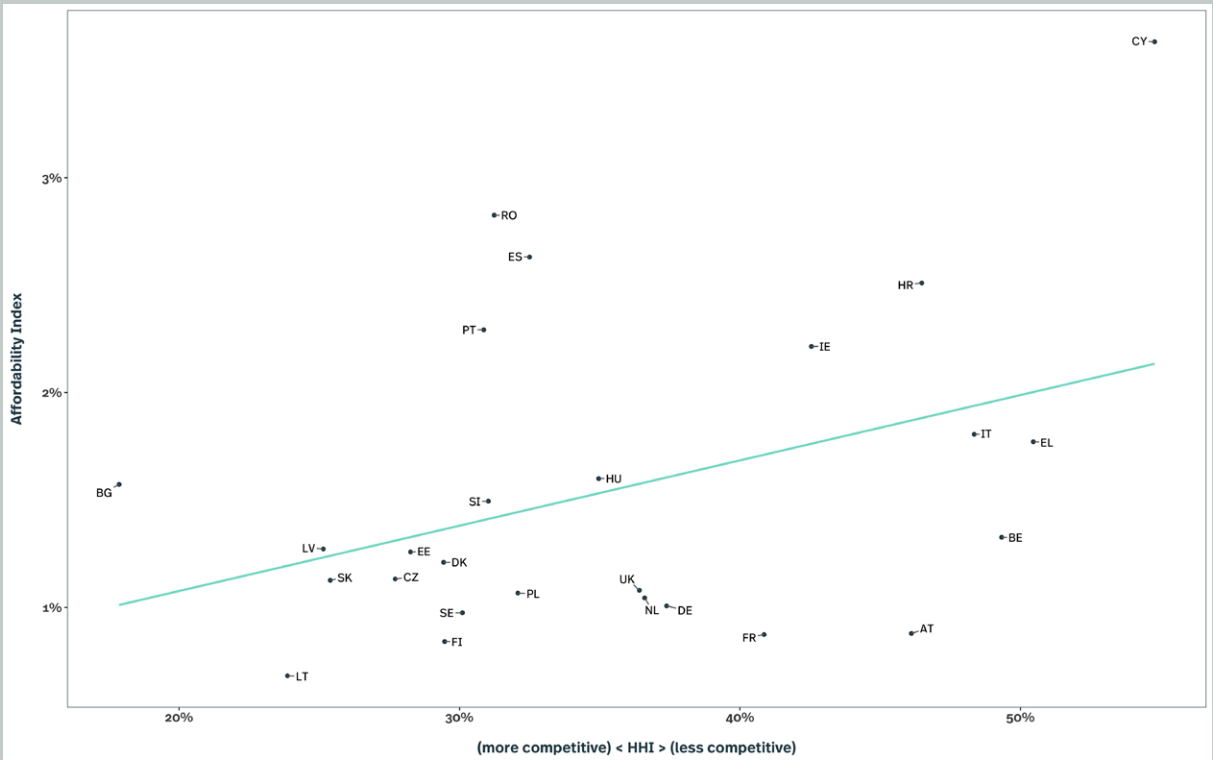
Prices and affordability

The high prices in the US have led to concerns about a widening digital divide, pricing lower income families out of fixed broadband services. Crawford and Scott (2015) note that in the US "affordability is becoming a concern and has resulted in pricing certain groups out of broadband," whilst noting that in the EU "competitive pressures on price that make even the most advanced Internet access products affordable". A report published by the White House concerning broadband adoption in the US notes that "[o]ne of the main challenges facing increased broadband adoption is price".[80] The report observes that in 2012, 32% of families with an income below $25,000 that were not online highlighted price as the limiting factor.

Looking at the affordability measure used by the European Commission, we find that in less competitive markets, stand-alone internet access takes up a larger proportion of disposable income, as shown below.

Comparing the performance of OECD countries on coverage, speeds, latency and prices across different speed tiers, the Berkman Center (2010) finds that the US is *"middling at best."* This average or below average performance needs to be seen in the context of the US being one of the most advanced economies with one of the best tech industries. By contrast, EU countries (and in particular the Nordic countries) perform well in these comparisons.

80 'Community-Based Broadband Solutions' (www.whitehouse.gov/sites/default/files/docs/community-based_broadband_report_by_executive_office_of_the_president.pdf)



The affordability of stand-alone internet access is measured as 12 times the monthly price divided by the „real adjusted gross disposable income of households per capita“ of the previous year; data for 2014. Source: European Commission Digital Scoreboard Key Indicators

The role of cable and FTTH/B

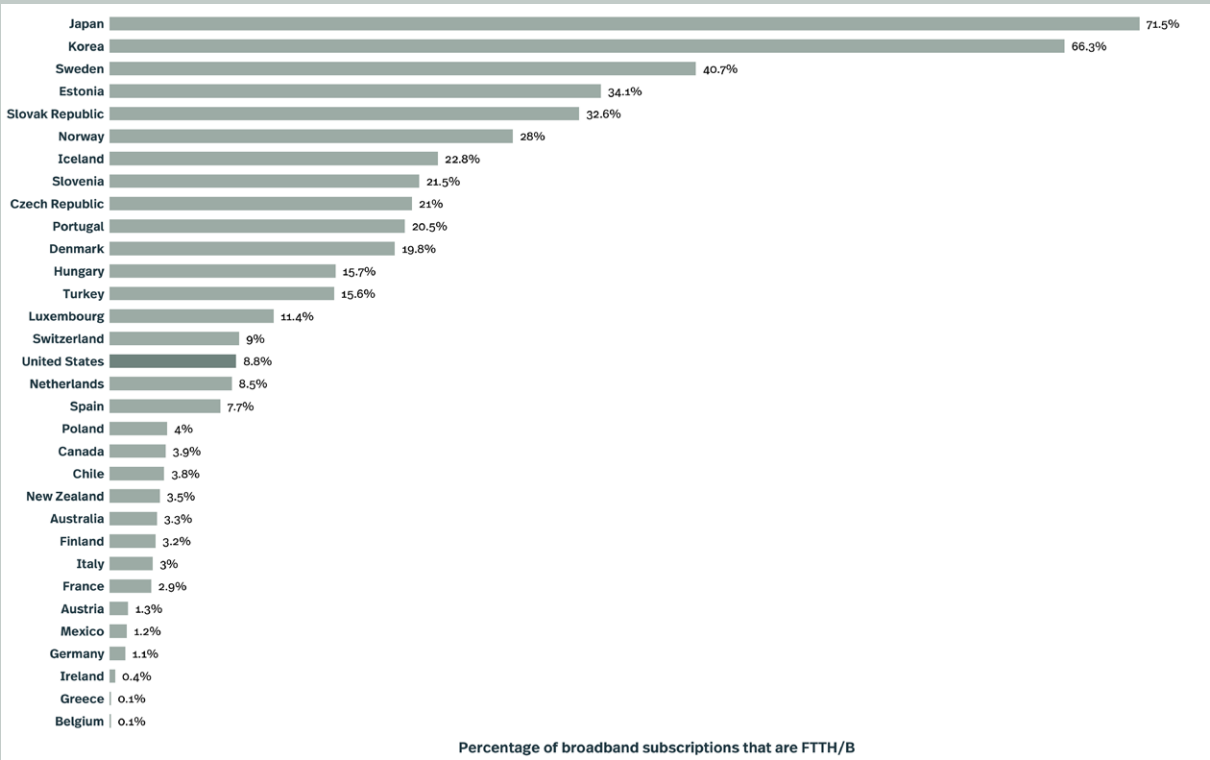
To the extent that the US can be said to be leading in the availability of higher-speed connections (generally defined as connections with speeds above 25Mbps), Crawford and Scott (2015) have suggested that this is due to the wider deployment of cable networks in the US. Indeed, cable networks account for a large proportion of NGA coverage also in Europe. Whilst NGA coverage is around 70% on average, it is 88% in the quarter of countries with the highest levels of cable deployments.

Quartile	Share of cable of broadband connections	NGA coverage
1	Below 12%	68%
2	12%–19%	72%
3	19%–30%	83%
4	30%–5%	88%

Data for 2015
Source: EU Commission Digital Agenda Scoreboard Key Indicators... for 2015

As far as FTTH/B deployment is concerned, much of Europe appears to be performing better than the US, as OECD analysis suggests.

Proportion of fibre connection in total fixed broadband subscriptions



Data for 2014
Source: OECD Digital Economy Outlook 2015

Entwistle (2014) also shows that Europe has now overtaken in terms of FTTH deployment, but that the US leads by a large margin in terms of DOCSIS 3 deployment. His conclusion is that the US is not ahead of Europe in terms of fixed (and mobile) broadband, but that the two regions are simply different in relation to the technology mix.

4.4 Summary

We have argued that infrastructure competition will be limited and is unlikely to provide effective protection against the exploitation of market power. Similarly, ex-post control through competition law is likely to be ineffective in protecting competition.

With no evidence to suggest that access to bottleneck infrastructure would be offered in the absence of regulatory obligations, there is a risk that the lack of infrastructure competition could eventually spread across the entire value chain. The result would be a reduction in competition, higher prices and more restricted choice. Thus, even if a roll-back of access obligations were to result in more investment, this would not be beneficial for consumers.

5 PRO-COMPETITIVE ACCESS REGULATION

We have shown the benefits from access regulation: access obligations enable competition across the value chain even if some parts of the network remain natural monopolies, and end users benefit from increased choice, higher speeds and lower prices. These benefits are all at risk of being lost if access regulation were to be removed. There is no support for the simplistic claim that less access regulation means more investment, and even if this were the case, more investment does not necessarily benefit end users. Thus, whilst the potential benefits from pushing back access obligations and potentially phasing out access regulation altogether are elusive and limited, the potential downside is real and substantial.

There is no contradiction between access regulation and investment, and the challenge going forward is to design access obligations that promote investment

Over the past decade, access regulation in Europe has been the foundation for the development of vibrant competition with substantial investment in networks, though to a large extent on legacy copper networks for the last mile. Moving forward, the focus turns to opportunities associated with NGA networks. NGA networks will create benefits that go beyond higher speeds and greater capacity for end users, from improvements in productivity to the increased take up of e-commerce, e-education, e-government,

or e-health. Policy makers aim to encourage the investment needed to deploy NGA networks, whilst maintaining the benefits of strong competition.

Providing incentives for investment and enabling downstream competition are not opposites, and getting access regulation right can promote both objectives. Therefore it is reasonable to ask whether there are ways in which access regulation could be improved to provide stronger investment incentives, in particular in NGA infrastructure, without reducing the scope for competition.

5.1 Implications for access charges

Higher access charges alone are unlikely to solve the problem of insufficient investment incentives

Our first observation is that concerns about lack of investment cannot simply be linked to access charges having been set too low.[81] As we have argued above, one of the main reasons why higher access charges may not lead to greater investment incentives is that the regulated firm often can earn higher returns without making investment. Whilst higher charges **enable** the regulated firm to earn the revenues that would pay for the investment, they **do not require** the firm actually to make these investments. Often, incumbent network operators will be able to earn enough to pay for substantial network investments while continuing to use their legacy networks to provide services.

Of course, this would not be possible in a competitive market. In order to retain customers – both their own downstream customers and demand from access seekers – network operators would have to invest in new in-

81 This explanation is suggested by Copenhagen Economics (2013), who argue that regulators in Europe have focused on the reduction of prices rather than on the promotion of investment, and that this has led to lower prices but to too little investment. Copenhagen Economics accept that this is "not an artefact of the regulatory model of unbundling" but that "based on practical experience, regulators tend to be on the safe and conservative side – for instance by preferring to keep access prices to the low end and avoid accusations of being too lax on the national incumbent."

frastructure or infrastructure upgrades to match the quality of their competitors' networks or their cost advantages.[82] In the case of monopoly, this pressure is lacking, and it cannot be easily replicated through access regulation. This poses a substantive challenge for regulatory policy.

Differentiating access charges for legacy and NGA networks would incentivise investment, but the scope for this is limited

One obvious solution is to reduce the amounts that incumbents can charge for access to their legacy infrastructure, but allowing them to earn a higher return on access to upgraded or newly built networks, would be a solution to this problem. However, the extent to which such differentiation is possible is likely to be limited.

This is because services provided over legacy networks and over new infrastructure compete at the retail level, and the premium that services delivered via NGA infrastructure can command may be small. The sustainable retail price difference depends on whether there are services that would make full use of NGA capabilities. As long as there is no tangible benefit for customers from having a high-speed connection, the premium they will be prepared to pay for FTTH/B connections over (upgraded) xDSL connections is likely to be small, and requiring incumbents to provide access to their copper network at a low price will simply make FTTH/B connections less competitive.[83] Any difference between regulated charges for access to legacy copper networks and NGA infrastructure must be limited by the retail price difference of services delivered over the corresponding infrastructures.

Neumann and Vogelsang (2016) propose a regime where cost-based charges are determined for a modern equivalent asset network (which would be an

82 The point at which existing assets may have to be upgraded or discarded depends on the extent to which the operating cost of using the legacy infrastructure can be covered. Where operating costs can be covered, the assets will continue to be used, but any investment cost that has not been recovered at that point will have to be written off. Where even operating costs cannot be covered, the assets become economically stranded (see Laffont and Tirole, 2000 for a more detailed discussion)

83 This dilemma is discussed in detail in DotEcon (2012) in relation to incentives to invest in fibre deployment. The paper also considers various options for increasing the 'fibre premium'.

FTTH network), but are then differentiated to reflect the differences in the capabilities of this network and the actual infrastructure deployed in the provision of access services (e.g. the legacy copper access network). The applicable discount (the 'performance delta) would have to be determined on the basis of the difference in retail prices of services delivered over the respective infrastructures to ensure that both types of networks compete on a level playing field.

Where infrastructure competition keeps a check on overall prices, a retail-minus approach might be used

Where there are competing infrastructures (such as cable networks or fibre networks deployed by new entrants) that provide an effective constraint on retail prices, an alternative to using cost-based access charges in combination with a retail-price determined performance delta would be directly to adopt a retail-minus approach.

Such an approach would equally result in access price differences that reflect the difference in retail prices of services delivered over different infrastructures. It would maintain the benefits from retail competition resulting in more choice and innovation by competitors who rely on access services (and also deal with margin squeeze concerns). However, it would not exert any control on price levels, and would therefore only be appropriate where infrastructure-based competition can be expected to constrain overall prices. Moreover, great care would need to be taken in order to identify the correct retail product for a particular access service in order to avoid distortions of competition.[84]

5.2 Looking beyond access charges

Looking further than the level of access charges, it is important to ensure that regulatory obligations are imposed in such a way that minimises any

84 Such an approach would not work, for example, for the pricing of access to dark fibre, which would allow the access seeker to provide a range of services; there is not a single corresponding retail product that could be chosen as a starting point.

potential detrimental impact on access providers. This should of course be a general principle of good regulatory policy, and covers the following aspects.

It is important to minimise regulatory risk

Regulatory intervention can create additional risks that can have a detrimental impact on investment incentives. In particular, concerns about 'regulatory takings' can have a chilling effect on investment. This means that regulatory bodies should be clear about the approach they will take to access regulation at the earliest opportunity, and refrain from making substantial changes at later points. This means of course that regulators have to take a long-term view on what policies would be appropriate in an uncertain future. In some cases, this may involve taking a position on where natural monopoly bottlenecks will remain, and what technologies and network infrastructures are most likely to meet future needs.

Technology neutrality is a good principle – but it may not be possible to have truly technology neutral measures, which needs to be acknowledged and considered properly

Though technological neutrality is a good principle for regulatory policy, regulators should acknowledge that it is sometimes difficult, if not impossible, to comply with this principle. There are few policy measures that do not affect technology choice, and it would seem to be more appropriate to acknowledge this fact and take a considered position rather than to purport to regulate in a technology neutral way. The recent debate about the widespread introduction of vectoring in Germany and its impact on competition and technology choices provides a clear example of this.

Vectoring: technology choice and regulation

The plans of German incumbent Deutsche Telekom to increase the speed available on its existing network infrastructure through the introduction of vectoring has drawn much criticism from competitors. The European Commission opened an investigation into the proposed decision by the German regulator (BNetzA) to permit Telekom's vectoring plans[85], which led BNetzA to withdraw its draft decision and re-submit revised proposals in light of the commission's concerns.[86]

Vectoring is a technology that allows operators to control cross-talk between various copper strands, which results in degraded performance. By eliminating such cross-talk, traditional copper wires could deliver speeds up to 100Mbps. Current vectoring implementations require that all copper lines fed from a particular local exchange are controlled by a single provider. This means that local loop/sub-loop unbundling would no longer be possible in exchanges where vectoring is deployed.

Critics have argued that vectoring is not future-proof as it will never match the capabilities of FTTH networks, and that the use of vectoring makes the roll-out of such networks less attractive, leading to delays and potentially preventing the deployment of competing infrastructure by new entrants. Moreover, the introduction of vectoring would effectively reduce the scope of regulatory obligations as it would render the provision of unbundled loops to competitors technically unfeasible. These concerns reflect the view that the planned use of vectoring on a large scale might not reflect the relative merits of the different technologies, but rather be driven by the fact that it would protect Telekom from competing FTTH deployment and limit the Scope for LLU competition.

Regardless of what decision will eventually be taken, it is clear that regulatory control (or the relaxation thereof) will have a direct impact on technology choice. This is somewhat inevitable.

The vectoring example also shows that the common argument that *"market players are best placed to make this [technology] choice in that they better understand the likely cost of deployment, willingness to pay for high speed broadband and risks involved in different choices"*[87] is potentially misleading. Technology choices are also driven by strategic considerations in terms of future market position and any opportunities that might exist for escaping regulation. Therefore, it will be difficult, if not impossible, to establish a truly technology neutral framework – and it may be better to acknowledge this fact than to pretend otherwise.

Technology choices – in particular by incumbents – might be driven by strategic considerations

Therefore, regulators might consider setting explicit investment requirements or creating incentives through making revenues conditional upon investment (as also proposed by Neumann and Vogelsang, 2016).[88] Such explicit requirements are likely to be more effective than attempts to stimulate investment through differentiated access charges, given that the

85 'European Commission opens an in-depth investigation into German regulator's plan to allow Deutsche Telekom to upgrade its network' (ec.europa.eu/digital-single-market/en/news/european-commission-opens-depth-investigation-german-regulators-plan-allow-deutsche-telekom); see also www.spiegel.de/netzwelt/web/vectoring-25-verbaende-protestieren-gegen-telekom-ausbau-a-1088466.html

86 'German regulator to resubmit proposal to EU on vectoring' (www.euronews.com/business-newswires/3208059-german-regulator-to-resubmit-proposal-to-eu-on-vectoring/); see also 'Bundesnetzagentur räumt Bedenken der Europäischen Kommission zu Vectoring aus' (www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Allgemeines/Presse/Pressemitteilungen/2016/160616_Vectoring.pdf?__blob=publicationFile&v=2)

87 Plum Consulting (2016)

88 Alternatively, one might consider an approach based on the definition of a regulatory asset base (RAB) where the regulator decides what investments should be recoverable. Such an approach is used in other industries (e.g. airport regulation, where only investments that the regulator deems to be efficient may be allowed when calculating the permitted level of aeronautical charges). Such measures would obviously not sit well with the principle of technology neutrality.

spread of access prices that is sustainable may be very small and may actually understate the incremental value of new NGA infrastructure.[89]

Providing more flexibility to negotiate access agreements is beneficial and can promote risk-sharing

Focusing on regulatory approaches that do not require frequent adjustment also means being less prescriptive about the range of access products that have to be offered, and giving more freedom to access providers and access seekers to negotiate terms and conditions for particular services. Such additional flexibility might cover aspects as diverse as

- the withdrawal of access services (which might involve compensation of access seekers for having to write off obsolete equipment, given that the risk of obsolescence of equipment and investment made by the access seeker is entirely within the control of the access provider[90]); or

- discounts for long-term commitments from access seekers that reflect the degree of risk sharing between access provider and access user; the German 'Kontingent-Modell' is a good example of such arrangements (see box below), which are and should perhaps become more widespread and easier to implement (though the debate about the model also shows that

89 There are many reasons why the difference in the willingness to pay does not fully reflect the potential incremental value of NGA infrastructure. Willingness to pay is small if there are few services that would make full use of the enhanced capability of NGA infrastructure, but theses services may not be developed if the underlying infrastructure is not in place. This implies a co-ordination problem that could require policy intervention. There may also be insufficient transparency about what different technologies actually deliver. For a more detailed discussion, see DotEcon (2012).

90 This is an issue, for example, when an incumbent operator such as Portugal Telecom decides to switch off the copper network entirely (see 'Portuguese incumbent to ditch copper network by 2020', www.telegeography.com/products/commsupdate/articles/2016/03/10/portuguese-incumbent-to-ditch-copper-network-by-2020/). Commentators have noted that "switching the copper off isn't a trivial decision: not only does it still serve many customers today ... but it is also in many cases resold to competitors through unbundling. These competitors have had to invest in DSLAMs and other pieces of equipment to run their own networks on that unbundled copper. A decision to switch the copper off means that they might be entitled to some compensation, but also that there needs to be an alternative." ('Time To Think About Switching That Copper Off?', www.diffractionanalysis.com/opinions/2016/03/time-think-switching-copper-off)

the introduction of such flexible pricing arrangements can raise concerns about discrimination and potential foreclosure.)

Alternative risk sharing models

Uncertainty about future demand for high-bandwidth services (both in terms of its timing and the willingness to pay of customers for speed) affects access providers and access seekers in different ways. Whilst the access provider will have made investments that are sunk and may have to be written off, or where pay-back is much delayed compared with expectations, access seekers have much more flexibility. In the extreme case, they obtain access on a 'pay as you go' basis. Access providers would benefit from commitment from access seekers – and access seekers might be happy to commit provided they are compensated for their willingness to share in the investment risk in the form of more attractive charges.

The German 'Kontingentmodell' has been developed from a proposal of incumbent Deutsche Telekom. For a pre-agreed monthly fee, it offered access seekers who would make an upfront payment the right to obtain access to a pre-specified number of VDSL lines (the contingent). The regulator initially prohibited this model on the grounds that it resulted in falling prices per access line with an increasing number of lines, which in turn might make the roll-out of alternative infrastructures (FTTH) by competitors less attractive, and could not be justified by risk-sharing considerations as the investments in the underlying network infrastructure predated the introduction of the pricing model.[91] In response, Telekom made modifications to the pricing model (including, amongst others, a reduction in the minimum size of the contingent, an increase in monthly charges, and a right to terminate the agreement if the access seeker moved from VDSL to NGA lines), and the model was subsequently approved by the regulator.[92]

But such arrangements work only with an effective regulatory back-stop

However, it is important to remember that such flexibility only works if it is backed up by strong regulatory obligations. Commercial agreements are not a substitute for regulatory access obligations. On the contrary, the latter are necessary to enable the former.

Access seekers will only be able to negotiate effectively if they have a viable fall-back option. The example of the US Navy's Space and Naval Warfare Command securing extended support for Windows XP from Microsoft may indeed show *"the scope for commercial negotiation to reach an efficient outcome"*[93] – but few access seekers are in a comparable position.

This means that there need to be explicit obligations to provide clearly specified access products at a regulated price to which access seekers could revert if negotiations fail. The number of access products covered by such obligations can be kept small, but the products specified must provide commercially viable opportunities for access seekers. It may also be possible to allow access providers and access seekers to modify this list, subject to mutual agreement (and subject to being able to resort to the regulatory authority in order to address the risk of hold-up).

What access products should be on that list, and on what terms they need to be provided, may well vary from market to market in light of market conditions and should be a decided on the basis of consultation with both access providers and access seekers. In this sense, there may well be scope for changing access obligations and potentially reducing the number of products that are subject to regulation as well as the regulatory burden on incumbents to seek approval for changes in prices and changes in the range

91 'Bundesnetzagentur untersagt vorläufig Entgeltmodell für VDSL-Bitstromanschlüsse' (www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2012/120402EntgeltmodellVDSL-Bitstromanschluss.html)

92 'Bundesnetzagentur hat keine Bedenken gegen geändertes Preismodell der Telekom im VDSL-Bitstrombereich' (www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2012/120704_VDSLBitstrommodell.html)

93 Plum Consulting (2016)

of products. However, access regulation must not become less effective in terms of enabling competitors to come into the market and provide innovative and attractive services at an attractive price for the benefit of customers and the economy overall.

5.3 Conclusions

We have shown the benefits that access regulation generates, and the risks that would be faced should access regulation be removed. Over the past decade, access regulation in Europe has fostered vibrant competition, bringing innovation, more choice, lower prices and almost ubiquitous coverage, contributing to Europe's economic position, its competiveness and overall welfare.

As the focus turns to ensuring that the opportunities offered by NGA networks will be realised, policy makers need both to encourage the investment needed for the deployment of such networks and to maintain strong competition. Well-designed access regulation does contribute towards achieving both of these objectives.

We consider that differentiating regulated charges for provision of access to legacy and NGA infrastructure would provide investment incentives that are lacking where access charges include returns on investments that need not actually be made. However, we acknowledge that the scope for such differentiation is limited by the difference in retail prices for services provided over legacy and NGA infrastructure.

Access charges should be based on the cost of a modern network, with an appropriate discount applied to providing access to legacy networks. In light of linkage with retail prices, setting access charges for the legacy infrastructure on a retail-minus basis could be appropriate where infrastructure competition can be expected to provide an effective check on retail prices

overall.[94] Given that the sustainable retail price difference may be small, regulators could set more explicit requirements in terms of investment.

We see considerable benefit in allowing access seekers and access providers more flexibility to negotiate commercial agreements that are in their mutual interest. However, it is important to recognise that such negotiations only work if they are backed up by well-defined access obligations that offer access seekers a reasonable and commercially viable fall-back option. Commercial agreements between access seekers and access providers offer the promise of greater flexibility and novel models of risk sharing – but they are not a substitute for access regulation. The nature of access regulation may change, but there is a continuing need for access obligation to safeguard competition and promote investment.

94 Neumann and Vogelsang (2016)

ANNEX A
A SIMPLE ANALYSIS OF THE IMPACT OF COMPE-TITION ON PRICES

We have estimated a simple linear model of prices for different types of service bundles at different speed brackets, based on data from the European Commission's Digital Agenda Scoreboard Key Indicators dataset.

Specifically, we have used information on the monthly price of standalone internet access, of fixed broadband internet access offers including and of internet access, fixed telephony and TV bundles and on the Herfindahl index for broadband competition for the 28 EU member states plus Iceland

and Norway. Whilst price data is available for the period from 2007–2015, the HHI data only covers two years (2013 and 2014).[95]

From this data (and omitting missing observations), we obtain a total of 557 observations covering two years, three service bundles, four speed brackets (8–12Mbps, 12–30Mbps, 30–100Mbps and 100Mbps and above) and 28 countries. Though technically a panel data set, our observations cover only two years, and therefore we use a pooled OLS model (including a year dummy) to estimate the following simple linear relationship:

$$\log(p) = \alpha + \theta_1 \log(HHI) + \theta_2 service + \theta_3 speed + \theta_4 year + \in$$

The results are shown below:

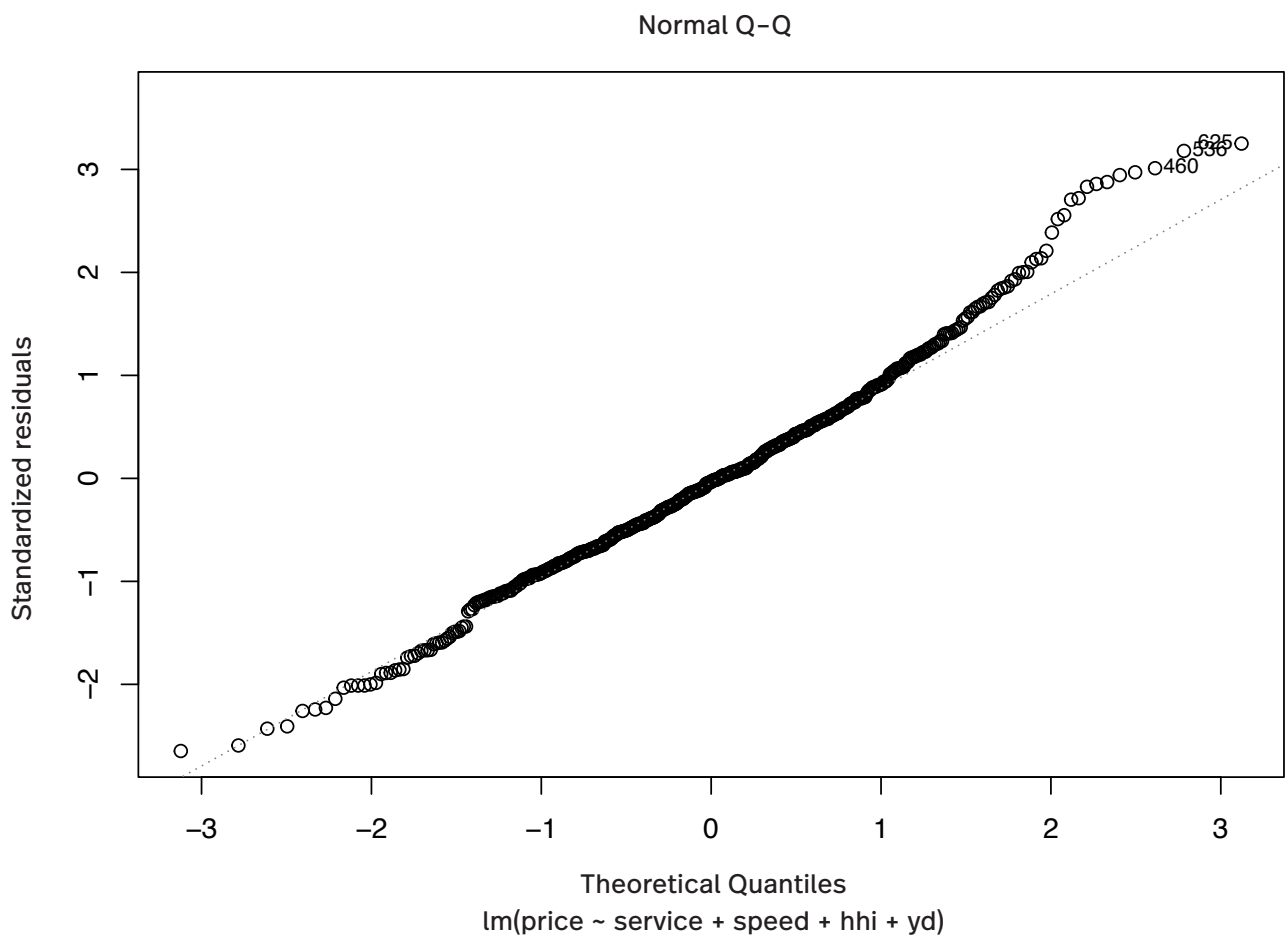
```
Residuals:
     Min       1Q   Median       3Q      Max
-0.87681 -0.21941 -0.01075  0.19059  1.07727

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                      4.29542    0.07157  60.014  < 2e-16 ***
serviceInternet, Telephone & TV  0.18609    0.03581   5.197 2.86e-07 ***
serviceInternet only            -0.39330    0.03479 -11.306  < 2e-16 ***
speed12-30Mbps                  -0.07275    0.03974  -1.830  0.06773 .
speed30-100Mbps                  0.11186    0.03975   2.814  0.00507 **
speed100Mbps and above           0.54308    0.04365  12.440  < 2e-16 ***
hhi                              0.60529    0.05285  11.453  < 2e-16 ***
yd2014                          -0.08430    0.02872  -2.935  0.00348 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.3338 on 549 degrees of freedom
  (163 observations deleted due to missingness)
Multiple R-squared:  0.5421,  Adjusted R-squared:  0.5362
F-statistic: 92.84 on 7 and 549 DF,  p-value: < 2.2e-16
```

95 For more detail see digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators/indicators#broadband-take-up-and-coverage

With the exception of the coefficient for the 12–30Mbps speed bracket, all coefficients are significant at the 99% level, and the F-statistic indicates that they are jointly significant. The distribution of the adjusted residuals is reasonably close to a normal distribution (though with a somewhat longer upper tail).



The coefficients show the expected sign, with prices increasing with bundle size[96] and speed, and having fallen slightly from 2013 to 2014.

The results suggest a strong impact of increasing concentration on prices. Moving from a market in which the incumbent telecoms operator holds a 50% market share, and the remainder is split between a cable operator (30%) and two strong entrants with 10% each (HHI = 0.36) to a duopoly where the market is split 70/30 (HHI = 0.58) could result in prices increasing by up to 30%.

96 Average prices for Internet-only offers are slightly less than 40% lower than the price of a bundle of internet access and fixed telephone services. Adding TV to the service bundle increases prices by almost 20%.

ANNEX B
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