The involvement of utilities in the development of broadband infrastructure: a comparison of EU case studies.

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Abstract

Utility providers, such as energy companies and railway operators, have been long emphasised as driving competition and facilitating investment in broadband markets. Nevertheless, their involvement and contribution to broadband development has varied significantly over time. In the late 1990s, both local and national utilities engaged in the provision of broadband networks, but only few of them managed to establish themselves as major broadband providers. More recently, new projects involving national utilities have been announced in several EU countries, opening new scenarios for utilities' contribution to Next Generation Access (NGA) development. This paper aims to explore and identify the factors affecting the entry and the success of utilities in the European broadband market. Four case studies from four EU countries (Germany, Italy, Sweden and the UK) are investigated and compared, to highlight similarities and differences under the EU regulatory framework. This qualitative analysis takes into account the interaction of market, technology and policy factors, focusing on the impact of policy and regulatory measures. As a result, this paper provides fruitful insights into the relevance and effectiveness of public interventions in broadband markets. Public support and public ownership are identified as main drivers for the involvement of utilities in EU broadband markets, with regulatory measures and economies of scope exerting a limited and decreasing influence.

Keywords

Utility providers; broadband investment; broadband policy; open-access networks.

1. Introduction

Superfast broadband[1] is increasingly perceived as an essential service to foster economic growth and social development (Broadband Commission, 2015). The European Union committed to achieve universal access to 30 Mbps by 2020 (EC, 2010b) and to 100 Mbps by 2025 (EC, 2016c). However, a large number of European citizens are still unable to access next-generation access (NGA) networks[2], especially in rural areas (EC, 2016a).

Ad hoc policies have been, therefore, adopted to address those factors hindering the diffusion of superfast broadband (BEREC, 2016). Since the late 1990s, ex-ante regulation has promoted competition and investment by granting access to network's bottlenecks (Picot & Wernick, 2007). Furthermore, local and central governments have been actively supporting the supply of NGA networks where the market failed to provide superfast broadband access (Cave & Martin, 2010).

Alongside public authorities and broadband companies, alternative infrastructure providers have also contributed to NGA development (Gerli, Wainwright, & Whalley, 2017). In particular, utilities – such as electricity providers or water companies (see section 2 for a more detailed definition) – have often been involved in the provision of broadband services (Mölleryd, 2015; Troulos & Maglaris, 2011). They either acted as provider of passive infrastructures or retailed broadband in bundle with other utility services (Van Der Wee et al., 2011a)

The actual contribution of utilities to broadband development has varied across the EU. In some countries, such as Sweden, utilities are a key driver of NGA supply, but in other countries, such as the UK, their role has been limited (Ragoobar, Whalley, & Harle, 2011). Nevertheless, the synergies between utilities and telecommunications providers have been frequently emphasised by scholars (Gillett, Lehr, & Osorio, 2006), practitioners (Analysis Mason, 2008) and policymakers (BIS, 2010).

Over the past few years, a number of new projects involving utilities in the European NGA market have been announced. The Italian incumbent in the electricity distribution market established a new company to roll out fibre-to-the-home (FTTH) in more than 200 cities (EOF,

[1] Superfast broadband differs from basic broadband in terms of bandwidth and download speed. Consistent with EC (2010b), this paper defines superfast broadband as providing a minimum download speed of 30 Mbps.
[2] According to EC (2010a), next generation access networks are fibre-based access networks delivering high-capacity connectivity. They comprise a wide range of technologies, such as a fibre-to-the-cabinet (FTTC), fibre-to-the-building/home (FTTB/H), DOCSIS 3.0.

2016). Similarly, Vodafone and the Irish energy incumbent have partnered together since 2015 to provide 500,000 premises with FTTH (Telegeography, 2015). Furthermore, Orange signed an agreement with SNCF, the French railway operator, to use and resell capacity of the latter's fibre network (Telegeography, 2016).

Through a longitudinal case study analysis, this paper aims to explore the factors underlying the involvement of utilities in EU broadband markets. The framework developed, based on the market-policy-technology interactions approach (Van der Wee, Beltran, & Verbrugge, 2014), is applied to explore the role of utilities in four European broadband markets – Germany, Italy, Sweden and the United Kingdom. The analysis focuses on the policy dimension to understand how different regulatory and policy measures affect the utilities' decision to enter the NGA market.

In the remainder of this paper, the market structure and the regulatory framework of utilities and telecommunications markets are described in Section 2 and Section 3 respectively. Section 4 reviews the extant literature regarding utilities' contribution to broadband development, while the methodology and the framework underlying our analysis are explained in Section 5. The case studies are presented in Section 6 and discussed in Section 7. Finally, Section 8 outlines our concluding remarks and policy recommendations.

2. Market structure and public policy in European utilities markets

The term 'utilities' covers those organisations providing essential services such as energy (gas, electricity and heating), water and sewerage, telecommunications, transportation and waste collection (McNabb, 2016). Being perceived as public goods, these services have historically been under the control of public authorities: municipal utilities have existed since the late XIX century (Wollmann, 2013). After World War II, though, these industries were generally nationalised, resulting into the creation of nation-wide vertically-integrated public monopolies (Pollitt & Steer, 2012).

Market liberalisation, which started in the early 1980s, has radically transformed the structure of utility markets and the role of the public sector in these industries. National monopolies were, at least partially, privatised and markets were opened up to competition (Heddenhausen, 2007). Sectoral authorities have been established to regulate the open market and safeguard public interest in the provision of these essential services – see, for example, Coen & Doyle (2000) and EY (2013) for further details.

The markets for electricity and gas services have undergone significant changes over the past twenty years. In the late 1990s, the EU mandated the unbundling of national energy incumbents, to enable competition in the different stages of the value chain (Torriti, 2010). As a result, the production and the trade of energy are now competitive markets, while transmission and distribution networks are still either national, regional or municipal monopolies (Asquer, 2011).

The industry of water and sewerage services has also been object of regulatory interventions, but its integration at European level is still limited (Ménard, 2017). Significant variations persist across the Member States in the governance of water services. Historically controlled by publicly owned local monopolists, these services are currently either provided by municipal utilities or outsourced to private companies (Delimatsis, 2015).

Despite a constant trend towards harmonisation and integration at EU level, national utility markets still differ widely in terms of structure and network governance (EY, 2013). Competition has developed in the retailing of utility services, while the infrastructures are still either local or national monopolies. Networks providers can be either private, public or even mixed companies, as the implementation of privatisation varied significantly across the Member States (Heddenhausen, 2007).

3. Market structure and public policy in the European telecommunications market

Like other network industries, the structure of the telecommunications market has radically changed over the past 30 years. Ex-ante regulation has enabled service-based competition to develop in the retail markets, but the access networks are still a monopoly except for those areas where alternative infrastructures (cable or fibre networks) have been deployed (BEREC, 2016). Based on the work of Falch & Henten (2015), three phases can be identified in the policymaking of telecommunications markets at EU level (Table 1)

The first phase focused on the opening up of telecommunications markets to competition. The transformation from a vertically integrated monopoly to a competitive market relied on the enforcement of pro-competitive regulation, as defined by Directive 2002/21/EC.

Asymmetric obligations were imposed to incumbents with significant market power (SMP) to enable the new entrants to access network bottlenecks such as the local loop[3].

Table 1: Telecommunications policy in Europe

Legal sources	**Aim**	**Policy measures**
Before liberalisation		Full public ownership
2002/21/EC	Competition	SMP regulation (access/non-discrimination)
2010/572/EU	NGA promotion	Symmetric regulation
2014/61/EU		(Reciprocal) Access to existing networks
2013/C 25/01	Market failure	State Aid

Source: compiled by the author, based on Falch & Henten (2015).

The regulatory framework was successively updated to support the development of NGA networks. Recommendation 2010/572/EU introduced symmetric regulation, which extends access obligations to any operator in control of NGA bottlenecks (such as the terminating fibre), regardless of their market power (EC, 2013). On the other hand, Directive 2013/466/EU proposed lighter regulation on SMP operators adopting an equivalence-of-input[4] approach, with this being considered the most effective model to enforce non-discrimination obligations (Directive 2013/466/EU).

High emphasis was also put on the sharing of existing infrastructures and the coordination of civil engineering works. Directive 2014/61/EU encouraged Member States to establish single information points, in order to enhance the transparency about the availability and the location of physical infrastructures and facilitate the cooperation between telecommunications companies and other infrastructure providers. A principle of reciprocity could also apply, in order to let utility providers reuse existing infrastructures deployed for NGA rollout.

In addition to these regulatory measures, the European Union also endorsed supply-side and demand-side policies to support NGA diffusion (Briglauer & Gugler, 2013; Walterova & Tveit, 2012). In 2010, the Digital Agenda for Europe (DAE) set a number of targets that Member States are committed to achieve by 2020, including universal access to broadband and superfast

[3] The last mile between the phone exchange and the end-users' premises.

[4] It implies that access services are provided to internal and third-party users through the same process, on the same terms and conditions.

broadband (EC, 2010b). These targets were updated in 2016 towards achieving a "European Gigabit Society" by 2025 (EC, 2016c).

In order to achieve the coverage targets set by the DAE, central and local governments have undertaken a number of initiatives to bridge the access divide across the EU (atene KOM, 2014). In 2009, the European Commission adopted Guidelines for State Aid in broadband markets to ensure that public interventions in this market are compatible with article 107 TFEU[5] (WIK, 2011).

The guidelines were updated in 2013 to reflect the technological change from broadband to superfast broadband networks (EC, 2013). Public intervention is authorised only where either none or just one NGA network is expected to exist within three years. Subsided operators are subject to ex-ante regulation and obliged to provide their competitors with wholesale access to the publicly funded networks.

In 2016, a reform of the European Electronic Communications Code was proposed (EC, 2016b), to complement existing regulatory measures and address the ongoing trends in telecommunications, such as the transition to all-IP fibre-based networks and fixed-mobile convergence. In particular, the new framework aims to further encourage investment and competition by limiting the scope of ex-ante regulation to those areas where commercial arrangements do not deliver competitive outcomes and co-investment agreements are in place.

4. The role of utilities in broadband development

The contribution of utilities to broadband development has been widely explored and discussed by researchers and practitioners alike (Angelou & Economides, 2013; Gillett et al., 2006; Matson & Mitchell, 2006). The cooperation between utilities and telecommunications providers was identified as a facilitator of broadband deployment (Troulos & Maglaris, 2011), but utilities have also emerged as alternative network providers competing with the incumbents in the delivery of superfast broadband (Tadayoni & Sigurðsson, 2007).

Broadband networks are composed of three layers: the passive infrastructure (duct, trenches and poles), the active equipment (routers, DSLAM, etc.) and connectivity services (EC, 2014b). The largest proportion of rollout costs is due to the civil engineering works needed to deploy the passive infrastructure (Van der Wee et al., 2015). Consequently, the use of existing

[5] The article 107 TFUE lists the conditions that makes State aid compatible with the internal market.

ducts and poles has been encouraged as a means to minimise the costs of broadband networks (EC, 2014a).

Utilities have often made their passive infrastructures available to broadband providers for the rollout of fibre networks (BIS, 2010). Analysis Mason (2008) estimated that the reuse of existing infrastructures could reduce the costs of FTTH deployment in the UK by 25%. The model developed by Tahon et al. (2014) confirmed that the cooperation between broadband and utility providers generates considerable cost savings in the rollout, but these could be offset by greater transaction costs due to asymmetric information.

Furthermore, utilities have a long track record as providers of connectivity services. Many national operators, such as ENEL in Italy and SNCF in France, had developed long-distance fibre networks for internal use, which were employed for the provision of retail services after the telecommunications liberalisation (Falch & Lorz, 1999). In the early 2000s, local utilities in Europe and the US also entered the broadband market by installing city-wide fibre or wireless networks (Gillett, Lehr, & Osorio, 2004).

Economies of scope in infrastructure deployment and network management were identified as the main drivers of the entry of utilities in broadband markets (Angelou & Economides, 2013; Tadayoni & Sigurðsson, 2007). Furthermore, local utilities could also leverage their brand and their customer base to market bundles of services and achieve economies of scope in marketing (Angelou & Economides, 2013; Troulos & Maglaris, 2011). Public ownership also emerged as a key factor for utility involvement in broadband provision (Tadayoni & Sigurðsson, 2007; Troulos & Maglaris, 2011).

In the US, the control of utilities gave local authorities the financial capability to support the rollout of municipal networks (Matson & Mitchell, 2006), as the investment could be subsidised by the revenues from other utility services (Chaffee & Shapiro, 2008). This cross-subsidisation strategy was however contested as being anticompetitive (Arrison, Rizzuto, & Vasquez, 2007). Both Ford (2007) and Seamans (2012), though, found a positive relationship between the involvement of utilities and competition in broadband markets.

The EU regulation, instead, obliges municipal providers to invest on the same terms as private operators, thereby preventing cross-subsidisation (Sadowski, Nucciarelli, & de Rooij, 2009). Furthermore, most of the projects led by utilities in the EU have adopted an open-access model (Matson & Mitchell, 2006) and offer their passive infrastructures to multiple ISPs on a non-discriminatory basis (Van Der Wee et al., 2011a). This approach has enhanced competition

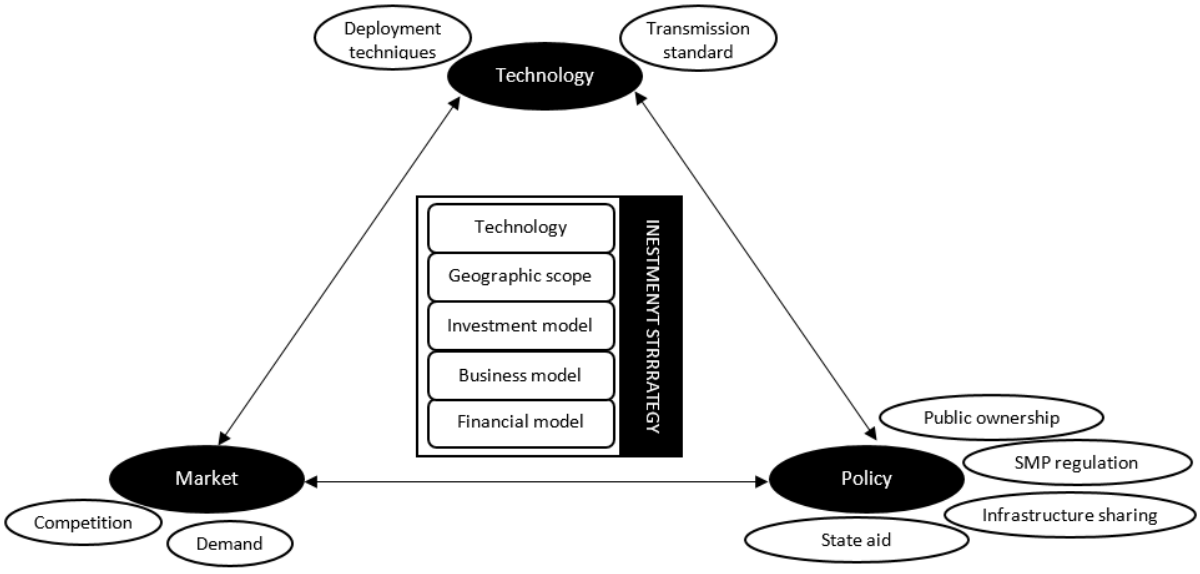
in the service layer and stimulated broadband diffusion, even though it could result into higher transaction costs (Van der Wee et al., 2015).

In summary, the literature frames cooperation between utilities and telecommunications companies as an enabler of broadband diffusion, by achieving economies of scope in network rollout and reducing the cost of infrastructure deployment. On the other hand, when utilities autonomously invest in fibre networks, an open-access model is considered as more likely to enhance competition and encourage broadband diffusion.

5. Methodology

As summarised in Sections 2 and 3, public policies in European utility markets have been defined by European institutions, but transposed to and implemented at a national level. A cross-country comparison is likely, therefore, to highlight how the role of utilities in broadband markets has varied across Europe under the same regulatory framework. Consequently, a multiple case study is adopted here to explore differences and similarities (Eisenhardt, 1989).

Figure 1: The Market-Policy-Technology framework



Source: derived from Van der Wee et al. (2014).

As suggested by Van der Wee et al. (2014) and shown in Figure 1, investment strategies in broadband markets are influenced by the interaction of three dimensions: market, policy and

technology. The former includes the demand for broadband services as well as competition in the provision of broadband infrastructure. The policy dimension, instead, comprises all the regulatory measures and other forms of public intervention in broadband markets. Finally, the technology dimension is related to innovation in both the passive and active layers of broadband networks, such as new deployment techniques or data transmission standards.

Our analysis focuses on the policy dimension to understand how regulations and other public interventions have affected the strategies of utilities in broadband market. As outlined in Figure 1, the policy dimension comprises all the measures discussed in Section 3 and summarised in Table 1. The investment strategy of broadband providers can be described in terms of technology, geographic scope, investment model, business model and financing model (Gerli et al., 2017).

Based on this framework, the involvement of utilities in distinct European countries is explored through a multiple case study (Yin, 2014) – see section 6. Documentation analysis is used as primary method (Yin, 2015), relying on a variety of sources. Company reports and press releases were employed to analyse the single cases, while policy reports, trade press and newspapers provided the relevant information to track the evolution of utilities involvement at national level.

6. Case studies

This paper applies the framework explained above to four European broadband markets: Germany, Italy, Sweden and the United Kingdom. These countries are geographically comparable and subject to the same regulatory frameworks, but differ in terms of broadband development (EC, 2017) and the structure of utilities markets (Heddenhausen, 2007). As a result, they provide a representative overview of European utilities market.

For each country, the role of utilities in broadband markets is analysed over time, with a specific focus on a single case study company: M-net (Germany), Metroweb/EOF (Italy), Utsikt (Sweden) and Cityfibre (UK). The national cases have been selected as the most relevant and representative in their country to exemplify the role and the approach of utilities to broadband markets. While the nationwide longitudinal analysis sheds lights on the contribution of utilities to broadband development in each country, the single case study enables an in-depth understanding of their drivers and strategies to emerge.

6.1 Germany

The German utility markets were long dominated by a number of large private companies (Wollmann, 2013). In parallel, and following the multiple functions taken up by local governments, municipal multi-utilities (referred to as 'Stadtwerke') were responsible for providing universal access to electricity, water and sewerage services (Greiling, 2013).

Though the EU market liberalization policy first led to a decrease in the responsibilities and geographical spread of the Stadtwerke, recent years indicate a comeback and "re-municipalisation" (Wollmann, 2013). As a result, public and private providers now coexist in German utility markets. For example, as of 2015, the distribution of electricity was under the control of three privately-owned regional operators, one Länder-owned regional company and 700 Stadtwerke (RAP, 2015).

There are multiple examples of Stadtwerke that also operate telecommunications networks, with the two most well-known being SWK (Stadtwerke Köln/Cologne) and SWM (Stadtwerke München/Munich). Municipalities are increasingly engaged in the delivery of FTTH to rural communities through their local utility providers or municipal special purpose associations (Wernick & Bender, 2016)

National utilities have also shown interest in broadband development. In the early 2000s, RWE's plan to provide BPL[6] failed due to technical and regulatory issues (Yuill, 2004). However, EWE and Innogy have recently announced a partnership with Deutsche Telekom to cooperate in the roll-out of NGA networks (Steitz & Käckenhoff, 2017). The incumbent will use the utilities' dark fibre to deliver superfast broadband in rural areas, but the networks will be open to other providers as well (Innogy, 2017).

In this paper, we investigate the specific case of M-Net, a telecom company owned by Stadtwerke München (SWM) and other Stadtwerke in Bavaria. SWM is one of Germany's largest energy suppliers, active in the city of Munich as well as the surrounding area. Apart from electricity, they provide natural gas, district heating, water, baths and public transport as well as telecommunications services since 1996 (Prinz, 2015).

[6] Broadband over Power Line is a method for data transmission over the power distribution network. It was retailed to residential customers as an experiment, but was never successful.

Initially a wholesale customer of Deutsche Telekom, M-net has been deploying its own fibre network since 2009, to address the increasing demand for high-capacity connectivity (FTTH Council Europe, 2012). The company aims to cover 70% of premises in Munich with FTTB networks by 2021 (SWM, 2016), but it is also deploying G.Fast[7] (Telegeography, 2017b)

M-net is vertically integrated as it offers both access and connectivity services. However, M-Net is not regarded as a company with SMP, hence no regulations on opening ducts or wholesale access to competitors apply to it. The company initially deployed its fibre networks in the dense urban city center, as investments there were low, but is now expanding to sub-urban and rural areas as well (SWM, 2016).

6.2 Italy

The market for utility services in Italy has historically been characterised by the coexistence of national and local monopolists (Argento, Grossi, Tagesson, & Collin, 2009). As of December 2015, the number of operators active in the distribution of electricity and gas was 137 and 234, respectively (AEEGSI, 2016a). The national energy and gas incumbents were privatised in the late 1990s, yet the Italian government still holds a majority stake either directly or through Cassa Depositi e Prestiti (CDP)[8]. Municipal utilities have also been partially privatised (Bognetti & Robotti, 2007).

In the late 1990s, both national and local utilities entered the telecommunications market. The former partnered with international carriers to resell retail services (Brezzi, 2004), but all these ventures were lately taken over by telecommunications providers (AGCOM, 2006). In contrast, local utilities did not only act as resellers of retail services but also started to build their own fibre networks as well (Mölleryd, 2015). The actual scope and value of their investments was, however, unclear and most of these projects are thought to have been abandoned (AGCOM, 2010).

The most successful and relevant experience was Metroweb, the network provider founded by AEM, the municipal utility in Milan (FTTH Council Europe, 2015). In 1998, AEM started

[7] G.fast is a transmission standard that combines fibre and copper, achieving a maximum download speed of 300 Mbps.

[8] Cassa Depositi e Prestiti is the National Promotational Bank, controlled by the Italian Ministry of Economy and Finance. It is a major shareholder in ENI (incumbent in gas market), Terna (national power grid), Snam (gas transportation) and Italgas (gas distribution). The major shareholder of Enel, the incumbent in energy market, is the Ministry of Economy and Finance.

to roll out a FTTH network while renewing its street lighting infrastructure. Fastweb acted as the commercial partner and the investment was largely funded through the listing of the company on Milan stock exchange (EPEC, 2012).

After Fastweb's left the joint venture in 2003 (FTTH Council Europe, 2015), Metroweb adopted an open-access model to the provision of dark fibre to major ISPs including the telecommunications incumbent (Amendola & Pupillo, 2008). Accordingly, Metroweb has never been imposed SMP regulation, but is, instead, subject to symmetric regulation (AGCOM, 2013).

In 2006, AEM sold Metroweb to a private investment fund, but the company was soon under public control once again, as it was acquired by a society controlled by CDP in 2011 (EPEC, 2012). One year later, the company announced a plan to provide 20% of the Italian population with FTTH (CDP, 2012). Its expansion was in fact limited to Torino, Bologna and Genova, where Metroweb cooperated with local councils (Mölleryd, 2015) and acquired the networks of local utilities (F2i, n.a.).

In January 2017, Metroweb was taken over for €714m by Enel Open Fiber, a joint venture between the energy incumbent (ENEL) and CDP (EOF, 2017d). In 2016, EOF announced a plan to roll out FTTH networks in 224 cities, as part of its project to install smart meters across Italy (EOF, 2016). The two plans separated from each other (Campesato, 2016) following the energy regulator's concerns about cross-subsidisation (AEEGSI, 2016b). Nevertheless, as of May 2017, EOF had built FTTH networks in nine cities, including those acquired with the takeover of Metroweb (EOF, 2017a).

EOF adopted the same business model as Metroweb. As of May 2017, the company has commercial partnership with four national and three local ISPs, providing retail services over its fibre networks (EOF, 2017b). Furthermore, EOF was awarded €1.4bn after winning the first auction for NGA deployment in white areas (Telegeography, 2017a). As a result, EOF will build and manage an open-access public network in a concession lasting 20 years. EOF has also signed an agreement with Regione Emilia-Romagna for the reuse of existing public infrastructures (EOF, 2017c).

6.3 Sweden

The utility industry in Sweden is largely controlled by public enterprises. The national power grid is owned by the Swedish government, which also controls one of the three regional

grids (Orbion Consulting, 2015). Local utilities are predominantly provided by municipally-owned limited companies, regulated by private law (Argento, Grossi, Tagesson, & Collin, 2009). Swedish municipalities are given wide planning powers and are relatively autonomous but need to abide by the 'cost price' and the 'equality' principles (Mölleryd, 2015). Accordingly, municipalities cannot make a profit from their business activities and must ensure the same treatment is given to any citizen (Argento et al., 2009).

Municipalities and utilities have been involved in telecommunications since the mid-1990s: Stokab, the FTTH provider fully owned by the city of Stockholm, is often cited as the textbook example of an open-access network (Van Der Wee et al., 2011b). The regional and national power grids also developed fibre backbone networks. Their deployments in rural areas were partially subsidised by the Swedish government (Orbion Consulting, 2015). As of 2015, 200 (out of 290) municipalities were covered by 180 local networks, providing 58% of fibre connections in Sweden (Mölleryd, 2015).

The increasing cooperation between local authorities has led to the integration of their networks, though the creation of a single platform for wholesale customers to acquire the related access services (Swedish Local Fibre Alliance, 2014). In fact, only 7% of municipal broadband providers are vertically integrated (Swedish Local Fibre Alliance, 2014). The focus of Swedish institutions on the provision of dark fibre has favoured the adoption of open-access business models (FTTH Council Europe, 2013), that is considered as an enabler of competition in the retail market (Mölleryd, 2015).

A specific example of utility broadband deployment is Utsikt Broadband, which was founded in 1995 and controls now a regional fibre network connecting three cities in Sweden: Mjölby, Linköping and Katrineholm. The fibre network connects over 50,000 homes and businesses and is owned by two energy companies, who in turn are owned by the respective municipalities (Ahl, 2017).

The network is operated in an open access manner – Utsikt offers both dark fibre access and wholesale connectivity and does not contract end-customers themselves. It is important to mention, however, that Utsikt started out as a vertically integrated operator, providing telephony and internet services as well. Facing competition from larger service providers, it decided to change its business model to open-access. The company is now reaching a larger customer base through over 25 service providers (Ahl, 2017).

Utsikt's infrastructure covers both urban and rural areas. The company was awarded public funds from the Swedish government and the European Agricultural Fund for Rural Development to connect 16 rural communities (Teliasonera, 2011). It is important to note, however, that overall, in 2014, public subsidies covered only 10% of local providers' investments, which are predominantly funded by revenues and loans (Swedish Local Fibre Alliance, 2014).

6.4 United Kingdom

Initially provided by either regional or national public authorities (Pollitt & Steer, 2012), utility services in the UK are currently controlled by private providers. Electricity is distributed by 14 regional networks owned by six private providers (Ofgem, 2017a), while gas distribution is managed by eight regional companies owned by four private providers (Ofgem, 2017b). Water and sewer services are provided by 26 private companies across England and Wales, while public monopolists are still operating in Scotland and Northern Ireland (Ofwat, 2017).

Broadband projects involving utility companies flourished in the early 2000s. Sewer and water companies were either offering open access to their infrastructures (BBC News, 2004) or partnering with ISPs (Wakefield, 2002), while energy utilities retailed ADSL or BPL[9] in Scotland (Jackson, 2003). In 2008, H2O, a telecommunications company, announced a plan to deploy FTTH networks through the sewerage in Dundee and Bournemouth (Williams, 2008). However, cooperation between utilities and telecommunication operators was the exception rather than the rule (BIS, 2010).

Most of these initiatives were later taken over by telecommunications companies (Ray, 2008) or abandoned due to contractual and legal issues (Hunt, 2010). H2O was bought out by its managers in 2011 and rebranded as Cityfibre. This new company does not directly engage with utility providers, but its growth strategy relies on the leverage of existing infrastructures previously developed by local network providers (Gerli et al., 2017).

Since 2011, Cityfibre has either acquired or built pure fibre networks across the UK, focusing on second-tier cities. It is emerging as a major competitor to BT in the provision of pure fibre metro networks[10] (PRISM, 2014), by offering passive and active services on an open-

[9] BPL was retailed to residential customers as an experiment, but was never successful.
[10] Metropolitan area networks (MAN) are backhauling networks interconnecting multiple users and premises across a metropolitan area.

access basis. As of December 2016, it runs 42 metro networks as well as FTTH networks in Bournemouth and York[11] (Cityfibre, 2017).

Local councils often act as anchor customers for Cityfibre's projects, though these have never benefitted from public funds (Oxera, 2013). The provider is not subject to ex-ante regulation and its use of regulated services is limited to passive infrastructure access (Jackson, 2017). Cityfibre has, however, recently lost an appeal against Ofcom's decision to impose a charge control on leased lines. This measure was seen as hampering Cityfibre's future investment in full-fibre networks (Competition Appeal Tribunal, 2016).

7. Discussion

Following the analysis of EU regulation and the longitudinal case studies, this section presents our findings and derives insights into the contribution of utilities broadband development in the EU. Our discussion focuses on three issues: the investment strategies of utilities involved in broadband deployment, the effects of policy measures on utilities' projects, the evolution of utilities as broadband providers in the EU.

7.1 Utility investment strategies in European broadband markets

The cases presented in Section 6 exemplify the variety of roles that utilities have played in the European telecommunications market since the liberalisation. In each of the four case study countries, utilities have engaged in the provision of either long-distance or broadband access networks. Nevertheless, their actual contribution to the development of broadband market has been uneven across the four countries (Table 2).

In Sweden and Germany, many local utilities have consolidated their position as major broadband infrastructure providers. In the UK, in contrast, national and local operators have divested from broadband market since the mid-2000s. The case of Italy is halfway between these two opposites. Of the many projects launched by utilities in the early 2000s, only Metroweb managed to establish itself as a major competitor of the incumbent, but the former energy monopolist has recently re-entered the broadband market with a nation-wide investment plan.

[11] The FTTH network in York is built by a joint-venture between Cityfibre, TalkTalk and Sky.

The first phase focused on the opening up of telecommunications markets to competition. The transformation from a vertically integrated monopoly to a competitive market relied on the enforcement of pro-competitive regulation, as defined by Directive 2002/21/EC. Asymmetric obligations were imposed to incumbents with significant market power (SMP) to enable the new entrants to access network bottlenecks such as the local loop.

Table 2: Market structure and role of utility providers in the four case study countries

		DE	IT	SE	UK
Local utilities	**Market structure**	Several private and municipal providers (Stadtwerke)	Several private and municipal providers	Several private and municipal providers	Limited number of regional private providers
	Involvement in broadband market	Many Stadtwerke are investing in fibre networks and providing telecom services	Many entered the market in the early 2000s, only few have been sustainable/are still operational	Municipal broadband networks provide 58% of fibre connections	Local utilities partnered with telcos in the early 2000s, but these projects were later abandoned/sold
National/regional operators	**Market structure**	Privately owned companies	Privatised companies partially owned by public entities	Privately and State-owned companies	Privately owned companies
	Involvement in broadband market	Autonomous projects in the early 1990s, now partners of the incumbents for the provision of dark fibre	Partners of telcos in the late 1990s. The energy incumbent is now deploying an open-access FTTH network	The three regional providers partner to provide fibre backbone	Partners of telcos to provide long-distance networks in the late 1990s.

Source: compiled by the authors.

Although different roles are evident across the four countries, the case study analysis highlights a number of recurring features in the investment strategies of utilities providing broadband. As summarised in Table 3, their technology, business models and geographic scope generally differ from those adopted by both incumbents and other commercial operators in broadband markets.

Since the late 1990s, utilities have been deploying full-fibre networks regardless of their investment model and their geographical focus. This approach is the opposite to the strategy of

European incumbents, that have preferred to deploy fibre until their street cabinets and rely on copper in the very last mile (Cullen International, 2016). The choice of FTTB/H also differentiates utilities from traditional ISPs, that have rarely developed their own independent infrastructures (Crandall, Eisenach, & Ingraham, 2013).

Table 3: The investment strategies of the four case study companies

	M-net	**Metroweb/EOF**	**Utsikt**	**Cityfibre**
Technology	FTTB since 2009	FTTH since its incorporation	FTTH since its incorporation	Fibre metro networks + FTTH (2 cities)
Geographic scope	City of Munich, Erlangen, Augsburg and the neighbouring rural areas	Initially, only Milan. Later, Genova, Bologna and Torino. EOF acquired Metroweb and plans to cover more than 200 cities + rural areas	Mjölby, Linköping and Katrineholm municipalities, including rural areas	40 cities across the UK
Investment model	Municipal company regulated by private law	Initially a municipal company, then a private company partially owned by public entities	Municipal company regulated by private law	Private company
Business model	Vertically integrated	Initially in partnership with an ISP. Wholesale-only since 2003	Initially vertically integrated. Now wholesale-only	Wholesale-only
Financial model	No taxpayers' funds	No taxpayers' funds except for deployments in rural areas	No taxpayers' funds except for deployments in rural areas	No taxpayers' funds

Source: compiled by the authors.

Furthermore, most of the utilities involved in the broadband market are wholesale-only operators, whereas the major broadband providers are vertically integrated. It must be noted that, although utilities generally entered the market as vertically-integrated providers or partners of telecommunications operators, they later adopted a wholesale-only business model.

This trend is confirmed by the most recent projects we examined: Utsikt, EOF and Cityfibre are operating on an open-access basis and do not directly compete in the retail market.

In terms of geographic scope, all the four case study companies have initially focused on the area they originally served as utility providers, but have later adopted different strategies to extend their coverage. Utsikt and M-Net have gradually expanded their networks into neighbouring areas, so as to also cover suburban and rural communities. On the other hand, Metroweb and Cityfibre have extended their footprint beyond their original area by either deploying new infrastructures or acquiring existing networks in the major cities across Italy and the UK respectively.

Based on the framework described in Section 5, the investment strategies of utilities in broadband markets are expected to be determined by market, policy and technology factors. The next subsection will, as a consequence, focus on the effects of policy dimension to analyse how the regulatory and policy measures described in Section 3 have affected the involvement of utilities and their investment strategies in the four case study countries analysed.

7.2 The effects of regulatory and policy measures on utilities' broadband projects

Utilities in broadband markets are subject to both energy and telecommunications regulations, with Germany being the only case study country with a single authority regulating both markets. None of the case study companies has been subject to asymmetric obligations, since these operators are not holding a significant power in broadband access markets. Having said that, they could potentially benefit from pro-competitive and pro-investment regulations, like any other operator in the EU electronic communications market.

However, the four case studies indicate that the impact of access regulation on these initiatives has been negligible, as the reliance of utilities on wholesale access to the telecommunications incumbents' networks is generally limited (see Table 4). Even utilities starting out as wholesale customers of the incumbents (like M-net) have later developed their own fully independent networks. Occasionally, they use regulated access to the incumbents' ducts and poles, but this approach is considered as supplementary to the development of fully independent infrastructures (Cityfibre, 2017).

However, utilities have recently opposed some regulatory decisions potentially affecting their investment strategy. For example, Cityfibre contested Ofcom's decision to regulate access to Openreach's dark fibre (Competition Appeal Tribunal, 2016). M-Net (2015), instead,

criticised BnetzA for allowing the incumbent to deploy vectoring on its copper lines. In both cases, the interventions of NRAs were seen as a threat to the sustainability of alternative infrastructure investment in future-proof fibre networks.

Table 4: The relevance of policy and regulatory measures for utilities' broadband projects

	Policy	M.net	Metroweb/EOF	Utsikt	Cityfibre
	Public ownership	The company is indirectly owned by multiple municipalities.	Initially owned by a municipal utility, then by the national promotional bank. EOF is partially State-owned.	The company is indirectly owned by multiple municipalities.	No, the company is entirely owned by private shareholders.
Competition	**Use of regulated wholesale access services**	Initially, relying on wholesale access to the incumbent's network. Later, developed a fully independent network.	No. Fully independent networks since its inception.	No. Fully independent networks since its inception.	Limited to ducts and poles.
	Non-discrimination regulation	No specific regulation in favour of open-access networks. The incumbent is vertically integrated.	The tender for State aid favoured open-access networks. The incumbent is vertically integrated.	Regulation favours open-access networks. The incumbent implemented equivalence of input in 2015.	No specific regulation in favour of open-access networks. Legal separation of the incumbent's network in 2016.
NGA promotion	**Symmetric regulation**	No	Yes	No	No
	Reciprocal access to existing networks	No	No	No	No
Market failure	**State aid**	No public funds awarded. Collaboration with the municipality for deploying a free Wi-Fi network.	Metroweb was not awarded public funds, EOF won the tender for deploying a public network in white areas.	Yes. Public funds were awarded to deploy fibre connections in rural areas.	No public funds, but strong partnerships with local councils.

Source: compiled by the authors

Cityfibre also contested the imposition of structural separation to BT, saying that it could reinforce the monopoly in the infrastructure market and increase the uncertainty for alternative investors (Cityfibre, 2015). In fact, non-discrimination regulation can influence the investment strategies of utilities in broadband market. For example, Utsikt's decision to become a wholesale-only operator was affected by Swedish regulation favouring open-access networks. The emphasis on vertical disintegration in the call for bids gave EOF an advantage in the tender for public subsidies in Italy and was, in turn, contested by the vertically integrated incumbent (CorCom, 2017).

With regard to regulation promoting NGA deployment, there is no clear evidence that these measures have either facilitated or incentivised the collaboration between utilities and telecommunications companies. The Broadband Cost Reduction Directive has been only recently transposed by Member States and further research will be needed to assess the effect of its application. However, it must be noted that none of the case study countries applied the principle of reciprocity envisaged in Directive 2014/61/EU that would have enabled utilities to access telecom networks to deploy their own infrastructure.

In fact, the current EU regulatory framework in the electronic communications market was designed to incentivise a shift from service-based to infrastructure-based competition (Cave, 2006). The relevance of ex-ante regulation is, therefore, limited for utilities that leapfrogged the 'ladder of investment' and directly compete with the incumbents in the provision of network access. Nevertheless, ex-ante regulation can indirectly influence the involvement of utilities in broadband development by affecting the size of their market and the sustainability of their business model.

State aid and public interventions to reduce digital divide have been more relevant for utilities, with a direct effect on their geographic focus and expansion strategies. Consistent with the EU guidelines, broadband deployments in urban areas have not benefitted from public grants or taxpayers' funds. Nevertheless, the allocation of public funds has enabled Utsikt and EOF to expand their investments to rural areas.

In general, utilities' projects have benefitted from non-financial support of public authorities. For example, Metroweb and EOF signed agreements with local authorities to quick the release of permits for civil engineering works, while M-net is partnering with the Munich municipality for the development of free public Wi-Fi networks (SWM, 2016). Acting as anchor tenants of its networks, local councils have been the strategic partners of Cityfibre. In

York, for example, the infrastructure deployed to connect the public sites constituted the foundation for FTTH development to residential users.

In fact, the liberalisation process has not untangled the strong relationship between utilities and public entities (see Table 4). The four case studies reveal that utilities are more likely to invest in the broadband market if they are, at least partially, owned by public entities. Consistently, the contribution of utilities to broadband diffusion has been more significant and systematic in Sweden and Germany, where local utilities are still controlled by municipalities. In contrast, their involvement has been limited in the United Kingdom where utilities are privately owned.

The four case studies are all private-law organisations and the public ownership did not influence the financial models of utilities investing in broadband markets. In compliance with EU discipline of State aid, their projects have not been financed by taxpayers' funds. Nevertheless, public shareholders are likely to influence their investment strategy, in terms of technology and geographic scope.

Most of municipal utilities have invested in fibre networks even when broadband technology was still under development and the demand for gigabit connectivity was unclear. The preference for developing FTTH/B networks rather than relying on regulated wholesale access could be explained by the higher propensity to innovation of publicly owned companies, also observed in other industries (Carreira & Deza, 2009; Munari, Oriani, & Sobrero, 2010). Furthermore, compared to profit-oriented investors, public shareholders are more likely to accept the longer payback period related to FTTH investments (Wernick & Bender, 2016).

The nature of the shareholders is also likely to reflect into the geographic coverage of utilities' projects. The case study companies owned by local utilities focused their investment on the respective municipalities and their neighbouring areas. The case of Metroweb shows that a utility's project may expand beyond its local footprint, once it is taken over by a national operator.

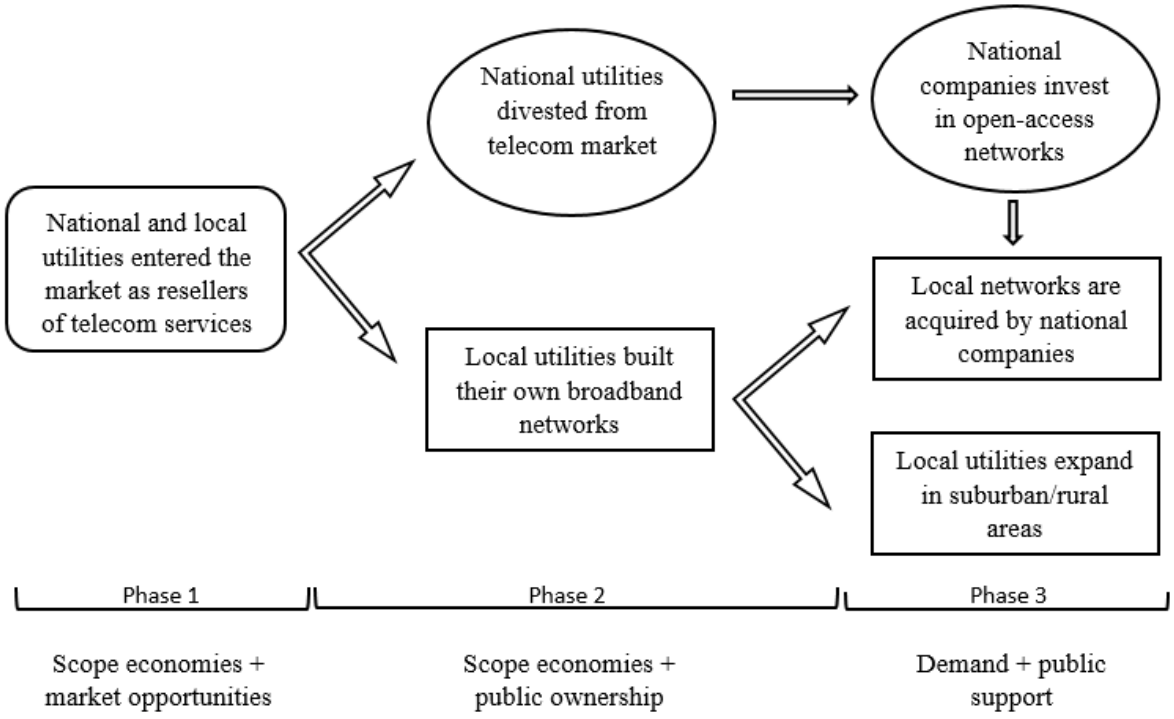
The structure and the autonomy of local governments has also affected the sustainability of public utilities in broadband market. The pro-activity of Swedish utilities reflects the extensive powers of municipalities to engage in business activities (Argento et al., 2009). In Italy, the decline of municipal broadband projects can be related to the increasing constraints placed on local governments' finance, that limit the ability of municipalities to engage in infrastructure network investments (Barbera, Guarini, & Steccolini, 2016).

In summary, the focus on the policy dimension has highlighted how the policymakers have affected the development of broadband projects by utilities. Public support and public ownership were found as the most influential drivers, while the relevance of regulatory measures was limited. Nevertheless, the influence of these policy factors has changed over time and across the four case study countries. Consequently, the position of utilities in the European broadband markets has also evolved, as discussed in the following subsection.

7.3 The evolution of utilities' involvement in broadband markets

Our analysis of investment strategies and policy drivers suggests that the involvement of utilities in the European broadband market has varied over time, being influenced by a variety of factors. From the longitudinal case study, three phases can be identified, as outlined in Figure 2. Our case studies confirm this trend across the four countries, despite the duration of each phase being not uniform.

Figure 2: The evolution of utilities' involvement in broadband markets



Source: compiled by the authors.

Following the liberalisation, in Phase 1 national and local utilities had the opportunity to reuse the long-distance and metro networks deployed for their internal use to provide telecommunications services to the retail market. As a result, the involvement of utilities in this phase was primarily driven by the economies of scope in network provisioning as well as market opportunities.

However, the enthusiasm of national operators soon cooled, resulting in their long-distance networks being sold to telecommunications companies in Phase 2. It had become evident that the provision of telecommunications services required specific skills and capillary networks, thereby reducing the scope for national utilities to be profitable providing just long-distance communications services (Falch & Lorz, 1999).

Since Phase 2, the contribution of utilities to broadband development has been primarily driven by public ownership and public support. Where local authorities have higher degree of managerial and financial autonomy, municipally-owned utilities have established themselves as major broadband infrastructure providers. In Phase 3, these providers have also expanded their coverage to suburban and rural areas within their traditional footprint.

In other countries, where local authorities have limited powers and resources, the role of local utilities has downsized in Phase 2. Nevertheless, new initiatives involving national operators have emerged across the EU in Phase 3, opening new scenarios to utilities' contribution to NGA development, as presented in the case of Italy.

The nation-wide projects in Phase 3 are encouraged by the escalating demand for high-capacity connectivity and the increasing support of public authorities for fibre rollout. Compared to Phase 1, national utilities now focus on the wholesale market acting as neutral infrastructure providers. They are still partnering with telecommunications companies, but their networks are open to multiple ISPs. Furthermore, they often acquire and integrate existing networks previously deployed by municipal or alternative providers.

As outlined in Figure 2, the relevance of scope economies has decreased over time. The coordination of civil engineering works is still an opportunity for infrastructure providers, as proven by the recent partnerships between telecommunications companies and national utilities in Germany and Ireland. However, the case of EOF suggests that these synergies may be less relevant than expected. The energy regulator's concerns about cross-subsidisation forced EOF to separate its FTTH rollout from the installation of smart meters. However, this has not stopped the company's plans to deploy fibre networks.

Therefore, our analysis shows that the involvement of utilities in NGA development is increasingly driven by a combination of market and policy factors. On the one hand, national and local utilities can achieve a first-mover advantage in addressing the increasing demand for faster broadband, as both incumbents and their competitors have focused on hybrid rather than full fibre networks. On the other hand, utilities can leverage their strong relationship with local and national governments that are increasingly supporting the development of ultrafast broadband in compliance with the targets set by the EU.

8. Conclusions

This paper provided a comprehensive overview of utilities' role in the European broadband markets. Since the telecommunications were liberalised, both national and local utility providers have been involved in the provision of both long-distance and access networks. Although the similarities in their investment strategies, the contribution of utilities has varied significantly across the EU and over time.

The involvement of utilities in EU broadband markets can be described in three phases. Initially, both national and local utilities leveraged the telecommunications networks developed for their internal use to provide voice services in the retail market. In Phase 2, the participation of national utilities drastically downsized while local utilities started to deploy municipal broadband networks in several countries. These projects have been further expanded in Phase 3, when many national operators have also re-entered the market, as providers of open-access networks in partnership with telecommunications companies.

Across these three phases, public support and public ownerships have been the most influential policy drivers, while ex-ante regulation has had a negligible effect on the investment strategies of utilities. The relevance of economies of scope has reduced over time, as utilities are increasingly encouraged to enter the NGA market by the demand for superfast broadband and the emphasis placed on digitisation by local and national governments.

The contribution of utilities to broadband development has been more significant in those countries where utilities are, at least partially, owned by public entities. However, the economic viability of their broadband projects has never relied on taxpayers' money, in compliance with the EU regulation. Although public funds were occasionally awarded to utilities' deployments in rural areas, non-financial support from public authorities (acting as anchor customers or easing the release of permits) has been a more relevant driver.

By exploring the factors affecting the investment strategies of utilities in broadband markets, this paper provided helpful insights into the effectiveness of policy and regulatory measures adopted so far in the EU. Our analysis can, therefore, contribute to the ongoing debate over the reform of Electronic Communications Code and help identifying new measures to enhance the effectiveness of public interventions in NGA markets.

Further research is, however, needed to predict and assess the role of utilities in the long-term. The development of recent projects needs to be monitored to evaluate their actual scope and contribution to NGA diffusion. Such analysis should be extended to other Member States, to enhance the generalisability of our findings and take into account the impact of more recent policies. Furthermore, a comparison between EU and non-EU countries could highlight the impact of different regulatory frameworks on the investment strategies of utilities investing in broadband markets.

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