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MANAGING UNCERTAINTY IN THE DIGITAL ECONOMY

Strategic and policy lessons from broadband development in Europe

FrancoAngeli

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INTRODUCTION

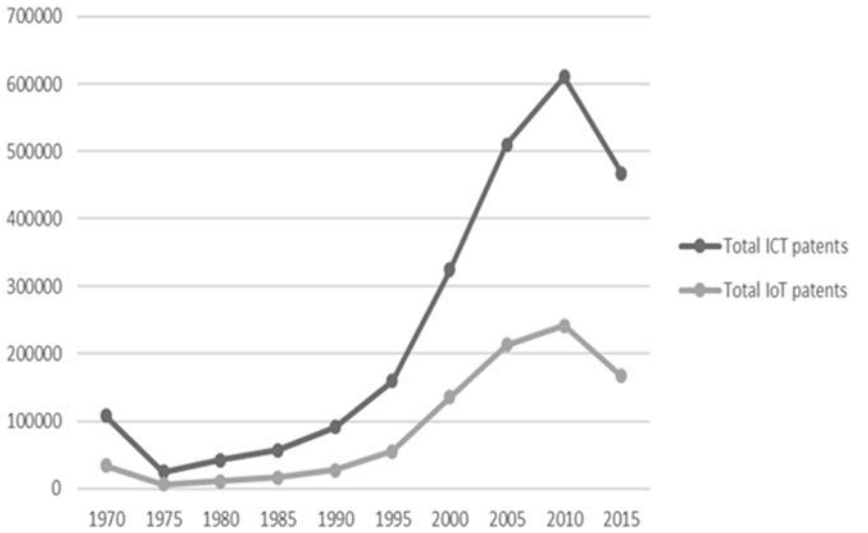
In the "*Economic foundations of strategy*" Mohoney (2005) investigates organizational economics adopting a strategic management perspective. Hence, he reviews five interrelated theories (i.e. the behavioural theory of the firm, transaction cost theory, property rights theory, agency theory, and (evolutionary) resource-based theory) to discuss their complementarities and distinctive features. In particular, he clarifies to what extent the business field of strategic management has contributed to advance the resource-based theory and dynamic capabilities by arguing that "sustainable competitive advantage requires an understanding of market frictions, and there is a large and well-developed economics research literature on market failure that students studying the economics of organizations can draw on" (Mahoney, 2005: 167). Thereafter, he points out that "[a]lthough the market failures literature is well developed, the organizational-failures literature is comparatively less developed, thereby providing research opportunities for students studying the economics of organization". In that respect, Mahoney (2005) identifies to what extent research in the resource-based theory and real options fields can contribute to evolve "the science of organization". In particular, real options can generate valuable insights on strategic flexibility at the corporate level. Similarly, other scholars look at real options as a valuable methodology to investigate the development of firms' resources over time. As an example, Bowman and Hurry (1993: 760) identify in the option lens "an economic logic for the behavioural process of incremental resource investment" and had employed this lens to show how firms' strategies emerge from their organizational resources and evolve over time.

This book aims to contribute to the ongoing debate on when and how to apply the real options thinking. It does so, by analysing the rationale and conditions under which real options can be applied in a high velocity industry (Bourgeois and Eisenhardt, 1988) as the broadband one. The choice of this industry relies on at least two main reasons: i) investment strategy is highly uncertain because of fast (and somehow) unpredictable changes in industry competitiveness, demand characteristics and levels, technology, and regulatory frameworks; ii) public-private partnerships (PPPs) have emerged over the last ten years to foster investments, especially at regional or municipal level, defining a new research area where managerial flexibility is needed to capture the value of uncertain strategies.

Accordingly, the book is driven by questions like: what are the strategic options a local government has to invest in Information and Communication Technology (ICT) infrastructure under conditions of high technological and user adoption uncertainty? How are current emerging trends in ICT infrastructures affecting the need for public policy intervention? What are rationales for municipalities to invest in ICT infrastructure? What is the role of users in adopting new ICT services running over theses infrastructures? This book aims to provide some answers to these questions by tapping into public policy literature, the economics of technological change, and the use of real options for strategic decisions under uncertainty. By doing so, the book defines to what extent the rationale for public policy intervention can be applied in contexts of radical technological change and high demand uncertainty. A public private partnership (PPP) perspective is adopted throughout.

Over the past thirty years, technological change in the ICT sector has rather been rapid moving from traditional (narrowband) telecommunications to broadband and finally to Internet of Things (IoT) technologies. The cumulative number of patents as an indicator for innovations in the sector has been exponentially growing with IoT technologies currently accounting for 1/10 of all innovations in the ICT (see Figure 1).

Figure 1 – ICT and IoT patents between 1970 and 2015, USPTO

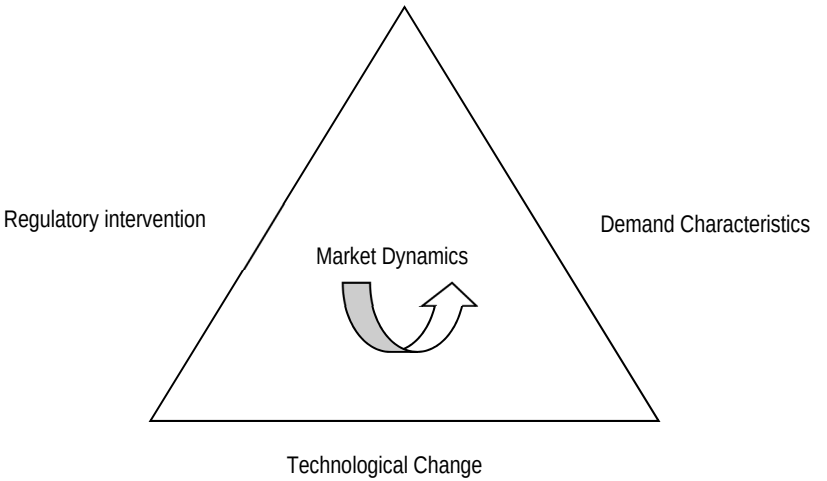


Most innovations in the ICT industry have been incremental, i.e. building on existing technologies, and just a few technologies have had a radical impact on the industry and society as a whole. Infrastructure development in ICT, i.e., the shift from narrowband to broadband technologies, in particular to fiber technologies (OECD 2008), has been such radical innovation which are considered as general purpose technologies (Grubesic and Mack 2015). The current challenge is to facilitate the emerging IoT technologies based on a well-developed broadband infrastructure (Rifkin 2014). The IoT has in fact the potential to merge virtual and physical words creating smart ecosystem where firms, citizens and institutions can digitize large parts of economic activities, increase quality of (customized) products and services and extract meaningful information from data. A study of the European Commission (EC) (2015) the market value of IoT in the EU will reach about EUR 1 trillion by 2020.

As shown earlier (Noam 1992; Sadowski 1996), technological change in ICT has been facilitated by shifts in the demand characteristics of users and regulatory intervention. Technological change as indicated in Figure 2 is affected by different forms of regulatory intervention ranging from public sector governance (as in the case of New Zealand see (Sadowski, Howell et al. 2013) to private public partnerships (PPPs). In addition, the demand characteristics of users are an important determinant driving infrastructure and service development in the ICT sector. These demand characteristics are related

to the existence of demand externalities (Miller 1997) as well as complementarities in the adoption of these technologies (Sadowski 2017). These forces have stimulated the market dynamics leading to even more innovations in the sector (see Figure 2).

Figure 2 – Pyramid of Market Dynamics in ICT



In the ICT sector, in contrast to other industries, infrastructure developments have been linked to public interest explanations. In other words, a well-developed high-quality ICT infrastructure has increasingly been considered as a public good. According to the public good perspective, governments have to define the public interest in NGA technologies in relation to issues such as the threat of digital exclusion of certain user groups or the emergence of a digital divide. However, in order to provide a rationale for intervention, governments have to identify market failures in emerging markets for ICT technologies which may arise due to a) the presence of scale effects and limited extent of competition increasing the chances of a return to natural monopoly, b) substantial investment costs providing insufficient incentives for companies to invest in these technologies and; c) lack in demand for complementary services in areas such as e-health or e-education. In the theoretical discussion on the inclusion of broadband in universal service obligations (Nucciarelli, Sadowski et al. 2014), these alternative arguments became apparent (see Chapter 2). From this perspective, the focus shifts in Chapter 3 to the extent to which users can generate sufficient

willingness to pay, their degree of digital literacy, etc. However, in contrast to the adoption of traditional ICT solutions aimed at differences in price and speed, advanced ICT technologies increasingly requires user involvement in the process of adoption. Advanced users affect the extent to which ICT technologies are adopted based on their status, their needs and their ability to propose new solutions (Sadowski 2017) (see Chapter 3). In Chapter 4, the book introduces public private partnership. It first acknowledges the relevance of PPPs in the extant literature and then it illustrates the main rationales of different types of PPPs. As a result, PPPs are presented as an alternative to direct government intervention and private initiatives. They offer, in fact, alternative funding mechanisms to account for the high uncertainties surrounding infrastructure technologies and demand risks and help allocating risks to the stakeholders that can better mitigate them. As a consequence, as alternative mechanism for implementing fibre infrastructure in the whole community (by balancing private and public policy objectives), PPPs can facilitate competitive entry at different layers of the network (by weighting open against closed access options) and for improving viability of the business model (by reducing demand uncertainty). In Chapter 5, the book presents the real options as a potential methodology to evaluate the strategic choices public and private stakeholders have to deploy NGNs. In particular, the chapter introduces some of the key features of real options strategic thinking and focuses on how binomial trees can capture the value of flexible strategies to mitigate different sources of uncertainties e.g. technology, demand, etc.). The chapter explains the advantages of a real options analysis compared to traditional (static) Net Present Value (NPV) calculations. NPV calculations are limited as they do not include the option to wait with investment decisions and learn until changes in the environment are more (or less) favourable. Based on a more dynamic view provided by real options theory, policy makers can include the option to wait with an investment (until the NPV is higher than the option to wait). In using the tools and methods provided by stock option models, real options theory proposes that decision makers can "buy" an option to invest in the future and, at the same time, are able to observe and to learn about the dynamics in dynamic markets and industries. In contrast to managers, however, policy makers should combine the real options analysis with an examination of the particular form of market failure that coexist together with uncertainty and irreversibility in these markets and industries. In a public policy context, real options analysis commences with an in-depth qualitative examination of the policy problem (studying the particular form of market failure) followed by static NPV calculations. Afterwards, the framing of the real options problem should pave the

way for real options modelling and analysis. In the case of municipal broadband networks, the "option to wait" will enable local municipalities to avoid the drawbacks of a negative NPV. The option to wait in the case of municipal networks allows to re-evaluate new investment decisions at each stage of expansion of the network depending on the demand for new telecommunication services. In the final chapter, the book will draw some managerial and policy conclusions with respect to facilitating technological change in era of Internet of things technologies.

1. THE REGULATORY FRAMEWORK

Introduction[1]

At least since the late 1980s, the discussion in Europe about public policy intervention in telecommunications has been driven by the assumption that market liberalization will increase private investment by facilitating entry of new firms and increasing competition (Fransman 2004). With the burst of the Internet bubble and the telecom bust in 2000, private investment seemed to stagnate. In order to provide incentives to private firms to invest in the sector, the role of public agencies had to be reconsidered. In acknowledging the problem of underinvestment in particular in new emerging broadband markets, the European Commission was driving a three-fold strategy to provide incentives for private investment:

- by reducing the role of the government in interfering in markets (State Aid Regulation);
- by defining areas in which intervention can reasonably be justified (Public Policy Justification);
- by defining targets for a future European digital economy (European Digital Agenda).

Recently the European Commission initiated with the European Electronic Communications Code (EECC) (CEU 2016) and with far-reaching plans for the Gigabit Society (CEU 2016) two new proposals to facilitate connectivity and create incentives for private investment in the European Union. The latest initiatives by the European Commission have to be put into the context of a strong belief that market-based incentives in conjunction with infrastructure competition have driven the broadband infrastructure over the past 20 years.

[1] Parts of this chapter have been published earlier in (Sadowski et al. 2009).

1.1. Reducing the role of Government intervention in Europe (State Aid)

If public sector entities intend to facilitate broadband deployment in Europe, they face the delicate task of putting forward legitimate reasons for intervention. With the full liberalization of the European telecommunications market in 1998, the entry of alternative network providers at all levels of the telecommunications network became possible. As a result, many utility companies from the energy, gas or water sector diversified in 1999 into the telecommunication market (CEU 1999; Sadowski and Runhaar 2000).

In order to enter these new emerging markets, alternative providers had to comply with the regulatory framework consisting of five Directives and two Regulations firstly established in 2002. These Directives and Recommendations defined in detail the regulatory framework for communications in Europe in areas such as general conditions of regulation (CEU 2002), access (CEU 2002) and universal service (CEU 2002). It was updated in 2009 (CEU 2009) and transposed into national legislation in the 27 Member States on 25 May 2011.

Since 2002, the European Commission (EC) has become increasingly interested in establishing whether alternative networks meet the strict criteria of Article 87(1) of the EU Treaty on State Aid and if they interfere with competition. Since 2003, the European Commission has been active in assessing the effects of alternative networks on broadband markets in Europe (see Figure 3). By the end of 2017, there were in total 153 decisions taken by the European Commission. From these decisions, 148 were "not considered as State Aid" or there were "no objections" against these projects. Against three projects, formal investigations were initiated. One was considered as State Aid and one project was withdrawn during the formal investigation (Sadowski, Nucciarelli et al. 2018).

Figure 3 shows that the number of State Aid decisions taken by the European Commission has been growing until 2012 and decreased afterwards. This has been due to changes in the European legislative and regulatory environment which provided more clarity about rules and regulation affecting private investment in broadband.

Two cases (Appingedam and Amsterdam) investigated by the European Commission had an important impact on the regulatory and legislative discussion in Europe. In addition, they were shedding some light at the market uncertainty surrounding investment in broadband infrastructure by new entrants. Just shortly after municipalities in Amsterdam and Appingedam publicized their intentions of developing broadband infrastructure in their local

areas, incumbent cable companies filed complaints with the European Competition Authorities and with Dutch courts in order to press for investigations into the extent to which these initiatives were compatible with State Aid legislations of the EU Treaty. In 2003, the European Commission had clarified that investment in municipal networks was justified if these initiatives were supporting economic growth in "white areas", in case there were no private investment or "grey areas" where private companies were unable to provide more than basic infrastructure and services. However, municipal investment was not justified in "black areas", i.e. zones where there are at least two competing telecommunication infrastructures. As all municipal areas in the Netherlands, due to the existence of a dual broadband infrastructure, were classified as "black areas" i.e. strict State Aid rules did apply. In Appingedam, the rollout of the municipal fibre network was suspended after Essent Kabelcom filed an injunction with a Dutch court in September 2004 and a formal complaint with the European Commission in November 2004. Two years later, the European Commission ruled that the Appingedam network involves "State aid to the foundation, the operator of the fibre access network and to providers of retail broadband services".

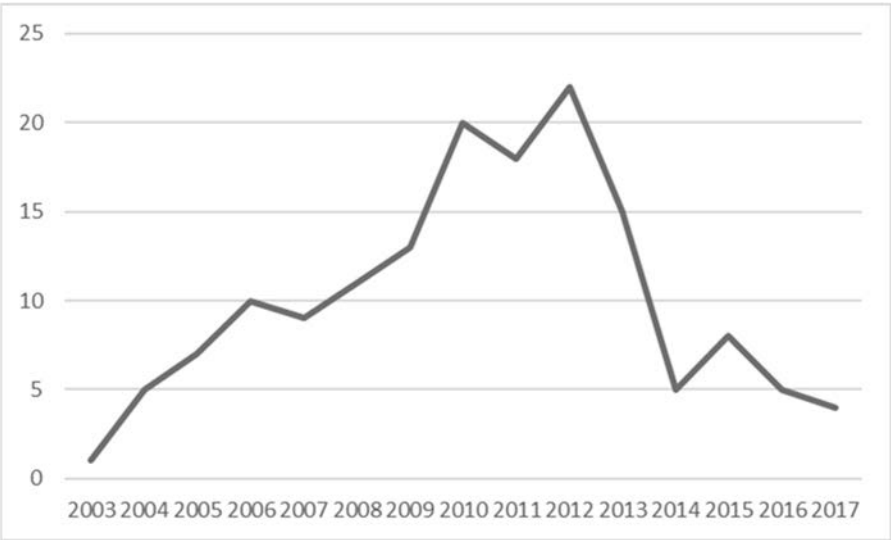
In the case of Amsterdam's citynet, the municipality asked the European Commission to confirm that the project did not entail State Aid as it confirmed with the Market Economy Investor Principle (MEIP). However, the cable companies filed in December 2005 a formal complaint with the European Commission against this argument. The MEIP actually allowed a public party to invest on similar terms compared to a private party in "black areas". Other options include a) public investment in the passive infrastructure and opening access up to all interested private parties on non-discriminatory terms, or b) the municipality delivered services as part of its Service of General Economic Interest (SGEI). After two injunctions filed by the cable company UPC failed in a Dutch court in June 2006 and January 2007, the rollout of municipal fibre network in Amsterdam started in October 2006. In December 2007, the European Commission officially approved Amsterdam's citynet as being in line with the MEIP. The MEIP was also officially included in the Broadband Guidelines of 2009.

In 2009, the European Commission (EC) changed, in a first step, its policy from taking ad hoc decisions on alternative broadband to providing a more systematic framework for the assessment of these networks. It adopted the Broadband Guidelines (2009/C235/04) to better define the role of public investors within the State Aid regulation (CEU 2009). In 2013, the European Commission moved further down the path of better describing areas where

government could still invest due to the lack of investment incentives for market parties (CEU 2013).

The modernisation of the State Aid regulations in 2012 (CEU 2012) and finally the Commission Regulation from 17 June 2014 calling for block exemption for certain types of broadband networks (CEU 2014) have been important milestones in reducing the role of government intervention by facilitating, in parallel, the growth of alternative broadband networks in Europe (Sadowski, Nucciarelli et al. 2018).

Figure 3 – State Aid Decisions by the European Commission (2003-2017)



1.2. Public Policy Objectives for Government intervention in Europe

With the Broadband Guidelines (CEU 2009; CEU 2013), the European Commission included not only the experience on State Aid decisions (e.g. on the market investor principle), but gradually incorporated also public policy objectives. Since the emergence of broadband in the late 1990s and 2000s, increasingly public policy justifications have been put forward to characterize these infrastructure technologies as public goods (Bar, Cohen et al. 2000; Sadowski, Nucciarelli et al. 2009).

As a public good, broadband should be characterized by non-excludability (no one can be excluded from consumption) and non-rivalry (consum-

ption by an individual does not reduce the availability of the good to others) (Picot and Wernick 2007). The first public goods characteristic has often been used in close correspondence with the concept of universal service to define a basic, affordable set of services available to consumers (CEU 2002; Nucciarelli, Sadowski et al. 2014). Recently, the second characteristic has been used to describe the "sharable" nature of infrastructure resources, i.e. the extent to which these resources can be accessed and used by multiple users at the same time.

In case of finite capacity, problems can emerge from rivalrous consumption which can be overcome by the management choices in favor of providing access to particular resources. The provision of private goods, in contrast, is based on the idea that a person can be excluded from consumption of a resource and that the resource is depleted when consumed. The market provision has been considered as the most efficient mechanism of allocating private goods given that the costs of exclusion are low. However, infrastructure resources cannot only be provided by public utilities or the market but there are a variety of private-public partnership models which are similarly suited to stimulate infrastructure development.

Within the Broadband Guidelines, public funding for broadband networks was in June 2012 addressed with the principle of Services of General Economic Interest (SGEI). This principle could be used by governments to justify public investment in areas where "private investors are not in the position to provide in the near future adequate broadband coverage to all citizens or users". In addition, it has been proposed that governments can even facilitate broadband development in areas falling outside the scope of SGEI by looking for ways to reduce the cost of deploying fiber (e.g. using duct sharing).

In 2015, the European Commission initiated a re-defined digital single market strategy (CEU 2015) focusing on better access, creating the right conditions and a level playing field for digital networks and innovative services and maximizing economic growth. Based on this strategy, the European Parliament asked the European Commission to propose a new framework that provide a better fit for the digital age aimed at higher investment, providing for more competition and stimulating innovation. In providing a better regulatory framework, the European Commission proposed the Electronic Communications Code on 14 September 2016, which should include the recent technological developments in telecommunications as well as changing needs of consumers in these markets with the objective to stimulate investment to reach connectivity targets defined for 2025 (European Parliament and European Council 2016).

European Commission's vision and policy actions to turn Europe into a Gigabit Society by 2025. The Commission's strategy on Connectivity for a European Gigabit Society, adopted in September 2016, sets a vision of Europe where availability and take-up of very high capacity networks enable the widespread use of products, services and applications in the Digital Single Market.

One of the most important aspects of the EU regulatory framework for electronic communications is the regulation of broadband access infrastructures – which form the basis for the entire digital economy and are therefore of particular technical and economic importance. In recent years, in a time of increasing digitalization, operators of first-generation broadband networks have been facing the need to upgrade their networks due to an overwhelming increase in demand for bandwidth and real time criteria. 'Next Generation Access' (NGA) broadband networks based on fiber-optic technology enable a massive increase in bandwidth capacity and the adoption of completely new services and applications on the demand side. Given sufficient availability and adoption, many consider this to be a promising way to increase long-term productivity and prosperity.

One fundamental goal of the European Commission (EC) and national regulatory authorities (NRAs) therefore is to accelerate the deployment of innovative and high-performance broadband infrastructures. However, given the high levels of investment that a comprehensive NGA deployment requires, providing sufficient investment incentives remain essential. Furthermore, if we take into account all the market developments to date related to actual NGA coverage and adoption patterns in most EU member states, it cannot be assumed that the existing market and competition conditions will result in broad-scale coverage – including rural areas – with NGA infrastructures and high take-up of NGA services in the foreseeable future. Assuming that NGA deployment indeed goes hand in hand with substantial welfare gains, the question thus arises as to which regulatory policies enhance (or diminish) investment incentives.

1.3. Defining Targets for the European Digital Economy

In 2010, the European Commission proposed in its Communication on European broadband to further assist the actions of national and local authorities deploying Next Generation Access (NGA) networks (CEU 2010). This Communication has been a major step forward in the direction towards the goals of the Digital Agenda for Europe (DAE). As stated in the DAE, the European Commission intends to promote the digital inclusion of all its

citizens and recognizes that broadband development is a valuable means of achieving this goal. In fact, broadband networks are considered a key factor in the transition towards an information society because they reduce the digital divide (CEU 2010).

In conjunction with the Digital Agenda for Europe, the European Commission has recently announced plans for an European Gigabit Society (European Parliament and European Council 2016). These plans are rooted in the belief that broadband infrastructures and services are of strategic importance for economic development, in particular coverage and adoption of broadband. As a key element in these plans, the European Commission proposes to improve the incentives of private companies to invest in both the deployment of high-capacity broadband infrastructures and to enhance adoption on the demand side through the design and implementation of an appropriate regulatory framework. According to the visions developed in its DAE and Gigabit Society plans, the European Commission published a detailed proposal for a Directive for a European Electronic Communications Code (European Parliament and European Council 2016), which will substantially revise the existing regulatory framework for communications markets.

With this new Directive, the European Commission is pursuing three core objectives: (1) equal baseline conditions for all market participants, (2) uniform application of the legal regulations across the European Union and (3) the provision of sufficient incentives for investment in high-capacity NGA networks (European Parliament and European Council 2016).

1.4. Rationales for Public Intervention

In the European Union, public intervention in telecommunications markets has been discussed in different ways:

a) by minimizing the role of government involvement in providing basic infrastructure services (State Aid Rationale);
b) by referring to the inadequacy of private investment in infrastructure and defining the conditions under which public policy intervention is reasonable (Public Policy rationale);
c) by focusing on problems surrounding unequal investment in digital infrastructure and services across the European Union (Digital Agenda Rationale).

The European Commission has developed these three rationales in parallel, partly with overlap, partly evolving independently. With the EECC, the European Commission is promoting the development of next generation