Towards broadband targets on the EU Digital Agenda 2020: discussion on the demand side of broadband policy

Chatchai Kongaut and Erik Bohlin

Chatchai Kongaut and Erik Bohlin are based at Department of Technology Management and Economics, Chalmers University of Technology, Gothenburg, Sweden.

Abstract

Purpose – *The purpose of this paper is to propose a guideline for the European Union (EU) to support high-speed broadband development based on economic frameworks and successful countries, Korea and Sweden. In the past decade, both policymakers and academic scholars have so far emphasised broadband policy mostly on the supply side. Increasing broadband adoption, nevertheless, is important for the EU to meet its Digital Agenda. Therefore, demand-side policy is also needed to stimulate high-speed broadband adoption in the EU.*

Design/methodology/approach – *This paper applies frameworks of network externalities and the information and communications technology ecosystem to provide a better understanding of the relationship between supply- and demand-side policies. In addition, Korea and Sweden, which are two successful countries in high-speed broadband development particularly their demand-side policy, are chosen as a comparative case study.*

Findings – *Both supply and demand sides are important to broadband policy to achieve the EU Digital Agenda 2020. It is also important for the policymakers to consider that demand-side policy should complement the implementation of supply-side policy, not substitute it. The demand side can be a great driver, especially with the development of content and applications for high-speed broadband.*

Originality/value – *This paper fills the research gap on broadband policy on the demand side which is currently limited in comparison to the supply-side studies.*

Keywords *Korea, Sweden, Digital agenda, Demand side policy, High-speed broadband*

Paper type *Research paper*

1. Introduction

About a century ago, developments in electricity and transportation networks had a great impact on the way people lived. Since then, the information and communications technology (ICT) sector has also increasingly affected people's everyday lives. ICT development has evolved into fixed telephone, mobile telephone, dial-up Internet, broadband and now fast/ultra-fast broadband. High-speed broadband networks have recently become even more important to most parts of the world. The success of the European Union (EU) Digital Agenda will improve innovation, economic growth and the daily lives of citizens, according to the European Commission (EC, 2010). The EU Digital Agenda has eight action areas, including *Fast and ultra-fast internet access* (*4th action area*) and *Enhancing digital literacy, skills and inclusion* (*6th action area*)[1]. The target for broadband penetration is for every European citizen to be able to access the Internet at a broadband speed of at least 30 Mbps, while the target for broadband speed is for more than 50 per cent of European households to be able to subscribe to the Internet with a broadband speed of at least 100 Mbps by 2020. To meet these goals, policymakers and academic researchers have analysed and suggested several policies.

Looking back at the past decade, academic studies and policy have so far focused mostly on the supply side. Most studies investigated, for example, the competition between operators, the use of local loop unbundling (LLU)policy, incentive for investment and

Received 12 February 2015
Revised 12 February 2015
Accepted 19 February 2015

The initial inspiration for this paper and some of its parts, mostly in Section 2, are based on the introductory paper of the corresponding author's thesis for the degree of licentiate of philosophy, Kongaut, C. (2014) Broadband Policy and the EU Digital Agenda: Demand and Supply Dimensions of Ultra-fast Internet, thesis for the degree of licentiate of philosophy, Chalmers University of Technology.

next-generation network deployment (some interesting findings are Bourreau and Dogan, 2005; Garcia-Murillo, 2005; Cave, 2006; Distaso *et al.*, 2006; Grajek and Roller, 2012; and Gruber and Koutroumpis, 2013). However, having Internet access on its own is not enough for the EU to meet its goals. The action area *Enhancing digital literacy, skills and inclusion* is also important for the EU to make European citizens adopt fast broadband. Demand-side policy is, therefore, also needed to stimulate high-speed broadband adoption in the EU.

While it is undeniable that supply-side policy is crucial for the EU to achieve these ambitious targets, demand-side policy has only been analysed very little. To fill this research gap, this study, therefore, focuses on investigating and analysing the demand-side policy in two successful countries in high-speed broadband development: Korea[2] and Sweden. This study aims to use these two countries as a guideline to support the policy recommendation for the EU Digital Agenda 2020. This study consists of six sections. Following this introduction, Section 2 explains the characteristics of broadband demand and an overview of broadband policy, emphasising the demand side. Section 3 explains two relevant frameworks, network externalities and the ICT ecosystem. Two case studies (Korea and Sweden) are presented in Section 4. Section 5 then provides discussions through the broadband ecosystem and explains how demand-side policy can support the EU Digital Agenda 2020. Finally, the last section, Section 6, suggests policy recommendations and future research.

2. Background

2.1 Broadband demand and relevant literature

First, it is important to know what the current broadband coverage and speed are in the EU. As of January 2013, 54 per cent of European households (rising from 49 per cent in January 2012) have been able to access high-speed broadband with speeds of more than 30 Mbps. Broadband subscriptions for speeds of more than 30 Mbps, however, are only at 4.2 per cent (an increase from 2.5 per cent in January 2012). Belgium has had the biggest increase, from approximately 10 per cent to 19 per cent, while Italy and Greece still only have minimal percentages of high-speed broadband. On the other hand, high-speed broadband of 100 Mbps is still very limited. Nevertheless, the percentage has increased from 1.6 to 3.4 per cent of total broadband adoption (EC, 2013). While the broadband access target of 30 Mbps looks achievable by 2020, the broadband uptake of 100 Mbps is still very far from the target of the EU Digital Agenda. While several supply policies have been implemented in Europe in the past decade, this evidence on the lack of demand suggests a need for more emphasis on demand-side policy.

The supply of broadband infrastructure, networks and content can be clearly separated by different suppliers even though some suppliers can provide more than one type of product. In comparison, the demands for broadband infrastructure, networks and content are closely interrelated, as the demand for content and applications from consumers passes through the demand for broadband infrastructure and networks. For example, the broadband demand from consumers is driven by the demand for content, which is dependent on various socio-economic characteristics as well as the availability of broadband (Falch *et al.*, 2006). This relationship between broadband demand and availability implies that broadband demand is also affected by the supply side. Therefore, understanding the determinants of broadband demand encourages more efficiency in implementing broadband policy, not only for demand-side policy but also for the supply side.

Since the late 1990s, studies have been conducted on the determinants of broadband demand to support policymakers in capturing any potential factors on the demand side. Madden and Simpson (1997) is among the early broadband demand studies. The authors applied Australian household data and found that household income and the installation fee were the main determinants of broadband subscriptions in Australia. More research on broadband demand was conducted in the 2000s when data became more available. For

example, Flamm and Chaudhuri (2007) analysed the demand for US broadband access and suggested that the broadband price is the main driver of broadband demand, and non-price variables affect both dial-up Internet and broadband but in different ways. Drouard (2010) studied broadband adoption and usage decisions in France. The author found that income and education determined the broadband adoption, while the online experience could determine the usage diversity. Srinuan and Bohlin (2013) analysed the broadband demand in Thailand and concluded that the availability of fixed telephone, income, gender, education and residential area affected fixed broadband adoption in Thailand[3].

The focus of the broadband determinants was mainly on fixed broadband due to data availability. However, some studies also aimed to analyse the demand for mobile broadband or mobile Internet. Okazaki (2006) applied cluster analysis to identify the determinants of mobile Internet adoption in Japan. The author found that adoption of mobile Internet was higher by males than female in Japan. The difference was also greater for administrative workers compared with students and part-time workers. In Sweden, Westlund and Bohlin (2008) analysed the adoptions and usages of mobile Internet. The authors found that low Internet speeds of mobile broadband were one of the main obstacles to mobile Internet adoption in Sweden at that time. Nevertheless, mobile broadband has become more developed in recent years. There are also studies on whether mobile broadband has the potential to substitute fixed broadband (see Cardona *et al.*, 2009; Srinuan *et al.*, 2012). With the explosive growth in smartphone usage, mobile broadband has become more important. Policy to stimulate broadband demand should, therefore, not only concern fixed broadband but also mobile broadband. Furthermore, several applications are currently available for mobile broadband. The driving of demand through the applications on mobile broadband is, therefore, expected to be one of main policies in the near future.

2.2 Demand-side policy and relevant literature

There are several demand-side policies, such as ICT literacy campaigns, promoting the use of online services; for example, e-government, e-commerce, e-health and e-education. Demand-side policy can be simply divided into two categories:

1 first, policy that aims to reduce the price of broadband and its related services; and

2 second, policy that aims to raise awareness of high-speed broadband value.

These two groups can be further simplified as price and non-price policies.

2.2.1 Price policy. Broadband demand can be considered as normal goods (including luxury goods) to price relationship. Considering broadband services as normal goods, when the price of the services is reduced, there will be greater demand for those particular services. Examples of price policy on the demand side include demand subsidies and tax reductions for the target groups. As mentioned in Section 2.2, an understanding of the broadband determinant is crucial to specifying the target socio-economic groups. The price policy on demand can also be set through other complementary services. Demand subsidies and tax reductions can instead be applied to computers, smartphones or even tablets.

Demand aggregation is another policy that collects consumer demand to ensure resource allocation. This policy can raise the bargaining power on the demand side. The greater the consumers' bargaining power, the lower the price is likely to be (Florence School of Regulation [FSR, 2011]). Broadband demand can also be stimulated through price policy from the supply side, such as competition between suppliers' networks, supply-side subsidies and tax reductions; however, this is outside the scope of this paper.

2.2.2 Non-price policy. Without changing the price, broadband demand can be stimulated by increasing awareness of its value. Consumer awareness can be increased through

content and applications for users. The demand for content can be promoted through the use of online services such as e-government, e-commerce, e-health and e-education. The demand for applications can be supported by campaigns to develop or subsidise projects for new applications. Killer applications such as Facebook, YouTube, Netflix and Spotify can generate demand from consumers. The development of user devices can also indirectly create demand for broadband, as these are complementary services for broadband. On the user side, to raise awareness, the policy needs to increase digital literacy. Digital literacy can be encouraged through education and training programmes for target groups. Lastly, governments can increase demand directly by also becoming users themselves.

Of the studies that focus on demand-side policy, few attempt to evaluate it. FSR (2011) and Belloc *et al.* (2012) have both done it well, though they aimed to analyse both supply and demand-side policy. FSR (2011) analysed broadband policy with a comprehensive literature review and empirical estimation and found that demand-side policy had significant positive impacts on broadband subscriptions at each stage of market development. The effects also increased along with the development of the broadband market. Belloc *et al.* (2012) had similar results, with demand-side policy becoming more effective as the availability of broadband infrastructure increased. The findings from both groups of authors showed not only that demand-side policy is important but also implied that demand-side policy is closely related to the supply side. There are other studies focusing on specific demand-side policy. E-government is one example of demand-side policy that has been studied in the past decade. Studies of e-government include ones by Bertot and Jaeger (2006) and Trkman and Turk (2009).

3. Relevant frameworks

3.1 Network externalities

When one's value of product or service depends on the number of users of the product or service, that product or service, therefore, is able to generate *network externalities*. Examples of this type of products or services are telephone, e-mail and Internet (Shapiro and Varian, 1999). In a similar way, the demand for broadband infrastructure can be driven through broadband content and applications. This relationship between broadband infrastructure and applications can be explained in the form of indirect effects of network externalities. Fast and ultra-fast broadband services generate a number of benefits through (positive) direct and indirect network externalities. First, the direct network externalities from broadband services are similar to the benefits of telephone services. The similarity is that the value of adopting broadband will increase along with the number of subscriptions. A high number of subscribers to broadband service increases the probability of others subscribing. For example, email and online messaging can be seen to have the same value as using voice telephone services. Furthermore, higher speeds of broadband service can provide a higher quality of sharing information, such as photos or videos (Atkinson, 2007). These direct network externalities implicitly show that it is important for people to acknowledge the value of broadband, which may not be explicitly clear to some potential adopters. Demand policy is therefore very important for increasing awareness of the value of high-speed broadband.

The second set of network externalities can be considered an indirect effect. The indirect network externalities come from the benefits of complementary services of broadband such as content and applications (FSR, 2011). While higher broadband penetration and greater broadband speed bring more sophisticated and useful content and applications, at the same time, the killer content and applications (currently, Facebook, YouTube, Spotify, etc.) have a probability of stimulating suppliers' incentives to provide more broadband connections as well as higher broadband speed. Video websites, such as YouTube, are a good example of how demand from consumers can drive supply. With the significant growth of this type of website, the current bandwidth and broadband speed may not be

enough. Consequently, broadband speed will need to follow the upcoming demand to prevent a collapse of Internet networks. With these indirect network externalities, new innovation of content and applications to attract the *killer applications* can also be used as demand-side policy.

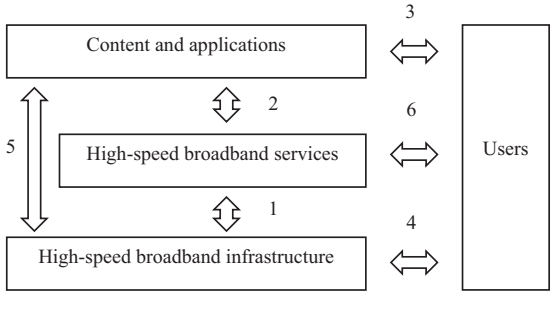
3.2 ICT ecosystem

With indirect network externalities, the effects between network (infrastructure) and service (speed), and content and applications can stimulate each other. Similarly, this idea can be explained when considering broadband as an ecosystem. The idea of using an ecosystem to explain the broadband market is supported by a study from the World Bank by Raja *et al.* (2010) and has also been used in several other studies. For example, Darby *et al.* (2010) explained the links between regulation and investment and job creation using an Internet ecosystem. Another study is Beltrán (2012) who applied a two-sided platform framework with the ecosystem concept to explain ultra-fast broadband networks in New Zealand. Furthermore, though not directly linked to broadband services but the ICT sector in general, Fransman (2007) has proposed a new ICT ecosystem that consists of four layers, with each layer being able to affect the others through six relationships. Four of the layers are network element providers, network operators, content and application providers and final consumers. The six relationships are those between each pair of the four layers. In a similar way, this paper looks at high-speed broadband, which is part of ICT as an ecosystem of high-speed broadband infrastructure, high-speed broadband services, content and applications and users, with six relationships between each pair (see Figure 1).

Furthermore, Fransman (2007) has illustrated that there are four influences: competition, regulation and law, financial institutions and other institutions. These four can affect the outcomes of the six relationships in the ICT ecosystem. This paper selects the influence from broadband policy, which ultimately affects to broadband competition, regulation and law in broadband market, financial institutions and other institutions. Developing Fransman's (2007) concept of indirect network externalities using the policy on different players of the broadband ecosystem, the effects of policy on outcomes can be multiplied (Figure 2).

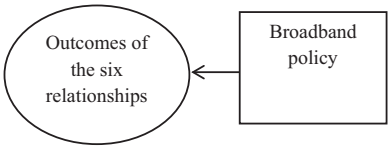
In the next section, the uses of demand-side policy are analysed further and presented through the success of two countries with high-speed broadband development. The case studies have similarities and differences in their policies. Comparing and investigating why the two countries have been successful with high-speed broadband will provide a better understanding of how demand-side policy should be used for the EU Digital Agenda 2020.

Figure 1 Broadband ecosystem



Source: Adapted from Fransman (2007)

Figure 2 Policy context of the six relationships



Source: Adapted from Fransman (2007)

4. Case studies on Korea and Sweden

For a comparative case study analysis, this paper uses Korea and Sweden, which have been successful in their use of demand-side policy, to elaborate on benefits and ways to implement demand-side policy. Sweden was chosen as an EU member state that has succeeded in high-speed Internet development, and Korea, which is not a European country, was chosen as it is very successful according to most broadband demand measurements. It is also very interesting to compare a country inside the EU with one outside it for a broader perspective on demand-side policy. Not surprisingly, Korea and Sweden are the top two countries in the ICT development index (IDI) from 2010 to 2012[4]. This IDI index is a combined indicator that not only measures ICT infrastructure development but also reflects the level of ICT use in society (ITU, 2013). Hence, this index can capture both the supply and demand sides of ICT services. Table I present the top ten countries in terms of IDI score from 2010 and 2012.

It is therefore interesting to analyse what broadband strategy, especially demand-side policy, these top two countries, Korea and Sweden, have implemented so far in their countries. It is also useful to investigate whether their policies are similar or different.

4.1 Demand-side policy in Korea

About 40 years ago, Korea was one of the countries with almost no ICT access. Now, however, Korea is one of the world's leading countries in terms of ICT services. The main contributions to Korea's success in ICT came from a succession of government master plans combined with a competitive market environment. The first national informatisation promotion plan was launched in 1996. Since then, there has been the Cyber Korea 21, e-Korea Vision 2006, Broadband IT Korea Vision 2007 and U-Korea master plans (Ovum, 2009). There are also several government projects to support broadband development and infrastructure on the supply side. Examples of government projects include the Korea Information Infrastructure initiative project, the Broadband Convergence Network initiative (BcN) project and the Ultra Broadband Convergence Network initiative (UBcN) project. In

Table I Top ten countries of the ICT development index (IDI) 2010-2012

Ranking	*Country (2012)*	*IDI (2012)*	*Country (2011)*	*IDI (2011)*	*Country (2010)*	*IDI (2010)*
1	Korea	8.57	Korea	8.51	Korea	8.45
2	Sweden	8.45	Sweden	8.41	Sweden	8.21
3	Iceland	8.36	Denmark	8.18	Denmark	8.01
4	Denmark	8.35	Iceland	8.12	Iceland	7.96
5	Finland	8.24	Finland	7.99	Finland	7.89
6	Norway	8.13	Norway	7.97	Luxembourg	7.64
7	Netherlands	8.00	Netherlands	7.85	Netherlands	7.60
8	UK	7.98	Japan	7.77	Japan	7.57
9	Luxembourg	7.93	Luxembourg	7.76	Switzerland	7.48
10	Hong Kong	7.92	Hong Kong	7.66	Singapore	7.47

Source: Information taken from ITU (2013)

addition, the early infrastructure competition between DSL and cable TV also significantly support broadband market in Korea at the early 2000s (Fransman, 2006).

Nevertheless, Korea's success is not only due to the supply side but also to key factors on the demand side. Broadband demand was created early by the government, at the development stage. E-government has been one of the main drivers of broadband demand, especially after the broadband infrastructure started to be implemented. Korea laid the foundation of e-government with computers already in the 1980s. However, e-government became more developed and focused from 2000 onwards. There are several e-government systems that can improve the quality of services and stimulate broadband demand in a country. For example, in Korea, the on-line e-procurement system (KONEPS) supports both efficiency and transparency in public procurement. The Information Network Villages (Invil) project aimed to close the digital divide by introducing e-commerce. The e-participation portal (e-people) encourages Korean citizens to participate in the decision-making process, and a comprehensive tax system (Hometax) allows citizens to manage tax transactions from home. As a result, Korea has become one of the most advanced countries in terms of e-government systems. Korea's e-government development index earned it the top ranking in 2010 and 2012, according to a UN evaluation (Ministry of Security and Public Administration, 2013).

As well as government service, education is a crucial sector that has so far encouraged broadband demand in Korea. ICT infrastructure and Internet access were implemented in all schools during 1996-2000. Consequently, all schools were connected to at least a local area network by early 2001. At that time, a transmission capacity of up to 256 kbps was implemented free, while higher speeds could be provided at a discounted rate. Since 1996, there has also been a free education system, namely, EDUNET, which contains thousands of online services and resources (related to education). With these demand-side policies in education, by 2002, young Internet users already averaged as much as 90 per cent, and the ratios of student Internet users in elementary school to university were all above 90 per cent (ITU, 2003). There were also many training programmes to raise citizen awareness of Internet services. In 2000, the Korean Government launched free basic IT training programmes for more than 10 million citizens, which is almost a quarter of the total population. The programme target was initially to train women outside the IT workforce; however, the programme was extended to also train men in the IT sector (Forge and Bohlin, 2008).

Mobile Internet also plays an important role in driving broadband demand in Korea. Mobile Internet service was launched in Korea in 1999. Accordingly, the 3G licence was issued to the main mobile operators in Korea in 2000 and mobile banking was introduced in 2003 (Ovum, 2009). The smartphone was introduced in Korea in 2009, while long term evolution (LTE) was launched commercially in mid-2011 (Jamie Ahn, 2012). While the introduction and development of mobile broadband networks have had a big impact on demand, content such as mobile banking, mobile commerce and other mobile applications, along with the Korean attitude to technology, has significantly stimulated the growth rate of high-speed broadband demand in Korea.

The success of demand creation by killer content and applications can be seen in Korean films, Korean music and, especially, online game industries. According to Kalning (2007), game editor:

> Online gaming is to South Korea what reality TV is to the USA: Huge. Really huge. An estimated 17 million people in the country of 48 million play games regularly.

The recent trend of online gaming in Korea, Massively Multiplayer Online Role-Playing Games (MMORPGs), also supports the demand for fast and ultra-fast broadband (Ovum, 2009).

4.2 Demand-side policy in Sweden

One of the reasons behind the success of Swedish broadband is that Sweden continuously developed its broadband strategies before the 2000s. Since 1994, ICT has been among the top priority agendas for the government (Hall and Löfgren, 2004). So far, the Swedish Government has released three broadband strategies, in 1999, 2005 and 2011. (There was also a proposal for a Swedish broadband strategy in 2007, but the content mostly discussed the broadband infrastructure for the supply strategy). Like most European countries, Sweden has focused most of its ICT development on the supply side. However, it combines some demand-side policy with development on the supply side as well as constant support for the use of broadband by Swedish citizens in their everyday lives.

In 1999, a government bill, *an information society for all* (Ministry of Industry, Employment and Communications, 2000), emphasised three areas:

1 greater security and confidence in IT;

2 greater competence in IT application; and

3 greater accessibility to IT services.

This bill introduced several programmes on demand-side policy, focusing on increasing IT education and providing basic IT skills for citizens in their everyday lives. Examples are the launch of IT programmes in schools and small businesses, and IT at universities. A "Governments IT policy Strategy Group" was also created, with two of its five priorities being ICT in school and in health care. E-government has also played an important role in driving broadband demand in Sweden. For instance, the Swedish Government has launched a project called "the 24/7 Agency" to promote the use of online public service. As a result of several initiatives during 2000-2003, the number of Internet users has increased to 82 per cent (from 76 per cent). The use of Internet in business and public sectors has also increased. During 2000-2004, 40 per cent of people aged 16-74 used Internet banking (up from 10 per cent), and during 2000-2003, 23 per cent of Swedish households (up from 12 per cent) used online shopping.

Later, in 2005, *From an IT policy for society to a policy for the information society: Summary of the Swedish Government Bill* (Ministry of Industry, Employment and Communications, 2005) was launched to follow up the previous government bill in 1999. New goals were set for IT for improved quality, sustainable growth and accessibility and security. Importantly, the demand side focused on the first sub-goal of "quality". Awareness of the value of IT services could be raised from the benefits and involvement of the IT sector through private and public e-services to other sectors as well as society in general. In the second sub-goal, "sustainable growth", several funds were provided to promote IT-related education programmes, e-commerce for SMEs, e-identification and development of telecommuting. The third sub-goal, "accessibility and security" focused more on supply for high-speed infrastructure to ensure emerging demand. Government initiatives in this government bill continued to focus on the health and education sectors. Examples include the Dagmar Agreement to encourage cooperation between health authorities and IT service development, the establishment of a group to propose IT policy for e-health, skill development for teachers in the IT field, follow-up of the use of IT in schools, etc. Not only have these initiatives aimed to improve the quality of other sectors, but, at the same time, they have also implicitly increased the demand for broadband services.

ICT for everyone – A digital agenda for Sweden (Ministry of Enterprise, Energy and Communications, 2011) was released in 2011. Its aim was for Sweden to lead the way in ICT usage to create further improvements and sustainable growth in other areas, such as social welfare, democracy and environmental impacts. Initiatives have been proposed in four strategic areas based on *the user's perspective*:

1 easy and safe use;

2 services that create benefit;

3 the need for infrastructure; and

4 the role of ICT in societal development.

The strategy on easy and safe use concerns digital inclusion and digital skills. While the majority of Swedes have already used the Internet, this initiative aims to help the elderly and disabled. The initiative also aims to improve digital skills for citizens of working age. In the area of services that create benefit, there will be a number of e-government projects to continue the development of public services. The focus is also on e-health and e-learning with the projects "National e-Health – the strategy for accessible and secure information in health care" and "Practical ICT and Media skills" for education. In the area of need for infrastructure, there are several plans on the supply side to develop it, and information security will be assured from the user's perspective. The last perspective, the role of ICT in societal development, is broadly aimed at developing society with the use of ICT, e.g. ICT for the environment, gender equality, research and innovation and freedom of Internet use.

In a nutshell, the success of demand-side policy in Sweden is mainly due to the emphasis and continuation of the use of broadband services in everyday life and in other sectors. As mentioned by Anna-Karin Hatt, Minister for Information Technology and Energy (Ministry of Enterprise, Energy and Communications, 2011), *"It will be possible for more service jobs to be done from home, raising quality of life, saving travel, time and money and reducing environmental impact"*.

4.3 Policy comparison

Sections 4.1 and 4.2 explain more about demand-side policy in Korea and Sweden. Both countries have also invested in and implemented a number of policies on the supply side. With the focus on the demand side, both countries have applied several tools to either reduce the price of broadband and its related services or raise awareness of the value of high-speed broadband. Both countries, especially the latter, have adopted content and applications through e-government and public services to raise people's awareness of broadband and extend it to high-speed broadband. Table II shows some of the demand-side policies categorised into price and non-price policies.

As shown in Table II, the strengths of the demand-side policy in the two countries are the content and number of applications that promote the use of broadband. With these promotions, the citizens feel more familiar with online services. When the network roll-out

Table II Presents the ways in which Korea and Sweden have implemented broadband policy on the demand side

Type of policy	*Korean Policy*	*Swedish Policy*
Price policy (reducing the price of broadband and its related services)	Purchasing and providing 50,000 PCs to low-income families on a four-year lease with free broadband for five years[a]	Tax deduction for companies on computer purchases
Non-price policy		
Digital literacy	Free basic IT training programmes for more than 10 million citizens	Raising IT literacy for school teachers
Increasing the value of high-speed broadband (promoting contents and applications)	A free education system, EDUNET	Funds for IT-related education programmes
	KONEPS and other e-government systems	Promoting the online public service "the 24/7 Agency"
	Information Network Villages (Invil) project to reduce digital divide	Promoting the use of ICT through other sectors, such as e-health and e-learning

Source: [a]Kushida and Oh (2006)

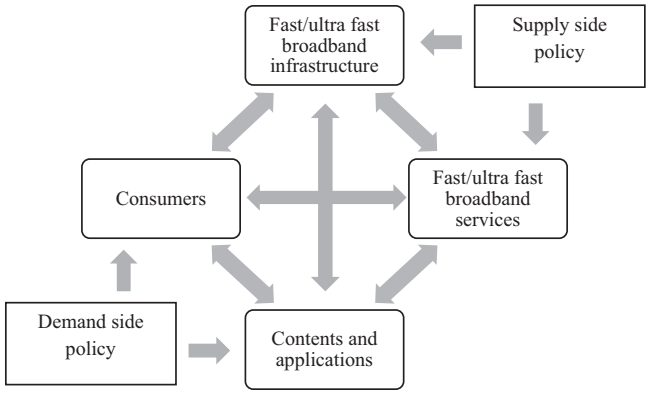
was implemented from the supply side, the demand could quickly stimulate the use of broadband in both countries. Nevertheless, the uses of demand-side policy differ slightly between the two countries. In Korea, people's attitudes are more adaptable to new technologies, and there has been a great increase in the adoption of several online services. In Sweden, the government has aimed to gradually relate online content and applications to every part of its citizens' lives, and broadband demand in Sweden has therefore continued to grow without killer applications, compared with Korea.

Even though Korea and Sweden have both implemented several demand-side policies, they have also implemented a number of supply-side policies. It is the use and timing of the demand-side policies in these two countries that put Korea and Sweden ahead of many others however. Furthermore, both countries have also recently successfully adopted mobile broadband. With the explosive growth of the smartphone, the countries are among the first to have exceeded 100 per cent mobile broadband penetration since mid-2012[5]. The roll-out of LTE networks in both countries also supports the lack of fixed broadband in some areas.

5. Discussion

On their own, supply side and demand-side policy may not help Europe meet the EU Digital Agenda 2020 targets. Rolling out high-speed broadband infrastructure is crucial, while the implementation of demand-side policy can significantly stimulate adoption and usage. Both the supply and demand sides are therefore important to consider in broadband policy to meet the EU Digital Agenda 2020 targets. To bridge the supply- and demand-side policies, the fast and ultra-fast broadband market is considered as an ecosystem. Figure 3, using the idea of Fransman (2007) and adapting from Raja *et al.* (2010), explains how policy can stimulate the broadband ecosystem. When a policy is implemented, the effects can go directly on the players in the broadband ecosystem and pass from one player to other players in the broadband ecosystem as well. However, implementing policy for all players can multiply the effects through the indirect network externalities in the broadband ecosystem. For example, supply-side policy alone will develop fast and ultra-fast broadband infrastructure, and networks may ultimately affect more users, but adoption is likely to be very slow and to vary between different groups of citizens. Hence, the use of demand-side policy for content, applications and users can reduce this gap by speeding up adoption and providing high-speed broadband on a larger scale. Broadband can generate both direct and indirect positive network externalities, and broadband can connect several important sectors such as health and education. It is therefore crucial to develop broadband policy that can reach citizens efficiently and equally.

Figure 3 Fast/ultra-fast broadband ecosystem with supply- and demand-side policies

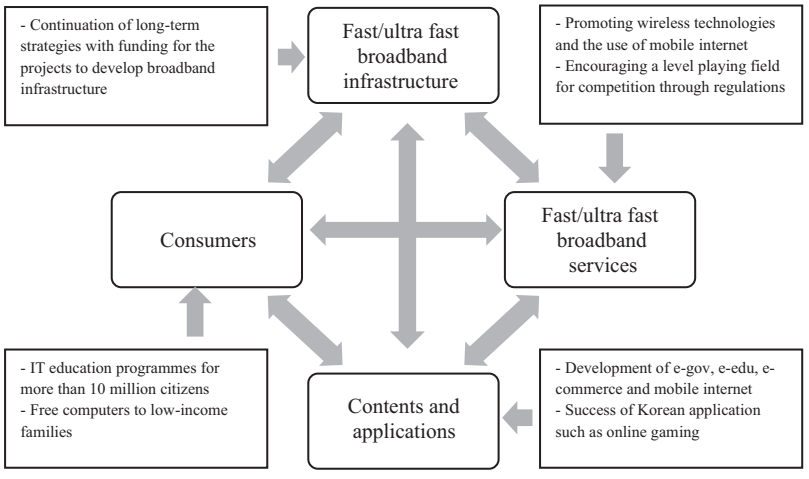


Source: Adapted from Raja *et al*. (2010)

As described in Section 4, Korea and Sweden have implemented both supply- and demand-side policies (although the supply-side policies are not emphasised in Section 4). Following the idea of the ecosystem in Figure 3, the supply- and demand-side policies from Korea and Sweden can both be implemented, according to the broadband market player in the high-speed broadband ecosystem, infrastructure and services on the supply side, and content and applications and consumers on the demand side, as in Figures 4 and 5.

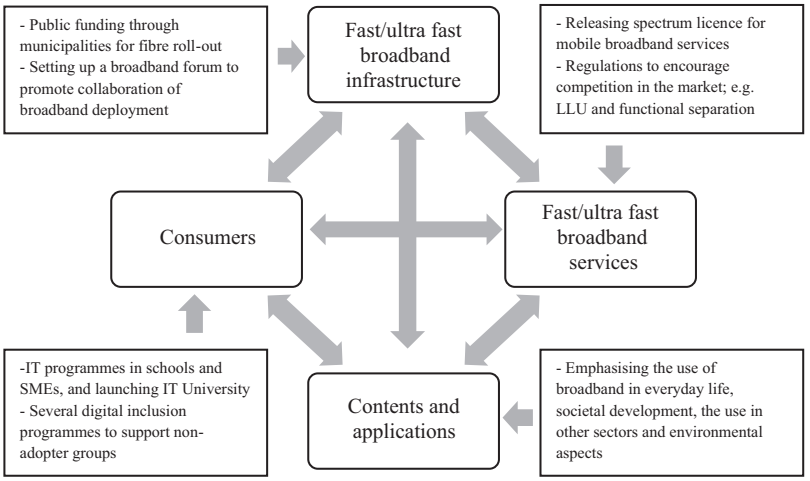
From Figures 4 and 5, using the successful countries as a guide, the EU could develop and implement the demand-side policy for each market player, which would ultimately support the EU Digital Agenda 2020, as in Table III.

Figure 4 Fast/ultra-fast broadband ecosystem with supply and demand-side policy in Korea[6]



Source: Adapted from Raja *et al*.(2010)

Figure 5 Fast/ultra-fast broadband ecosystem with supply and demand-side policy in Sweden[7]



Source: Adapted from Raja *et al*. (2010)

Table III Fast/ultra-fast broadband policy in Korea and Sweden

Fast/ultra-fast broadband ecosystem	*Policy*		
	Korea	*Sweden*	*Recommendations for the EU*
Supply-side policy			
Broadband infrastructure	Promoting a number of projects to develop high-speed broadband, such as BcN, UBcN and next-generation Internet Protocol (IPv6)	Rolling out the fibre network with government support through municipalities	Rolling out the fast/ultra-fast broadband infrastructure is crucial. Public funds may be needed. Technologies can differ, for example, fibre, DOCSIS 3.0 or VDSL, depending on the member state
Broadband services	Promoting alternative wireless technologies such as WiFi, WiMax, WiBro and Mobile-Fi	Releasing spectrum licence 800 MHz, 1800 MHz and 2600 MHz for mobile broadband service (4G/LTE network) Applying regulations such as LLU and functional separation	Providing various choices of services to consumers, especially the promotion of wireless services to substitute the use of fixed services Applying regulations to stimulate competition in the market; however, the choice of regulation and infrastructure (fibre, DOCSIS 3.0[a] and VDSL[b]) can differ depending on the member state
Demand-side policy			
Content and applications	Several developments in e-government, for example, KONEPS, e-people, Hometax Development of e-education with EDUNET (free)	Promoting the use of ICT through several sectors, such as business, health care, education, banking and online public services	Online public services, such as e-government, are the keys to encouraging the start of broadband usage. For fast/ultra-fast broadband, more complex systems such as online education or telehealth should be promoted
Consumers (end-users)	Increase digital literacy by providing IT education to more than 10 million Koreans Increase end-user devices by providing computers to low-income families	Increase digital literacy such as IT education for school teachers and funding for IT education programmes Increase the end-user devices with tax deductions for companies when purchasing computers for employees	Analysis of the determinants of fast broadband to understand non-adopter groups is important for policy to support particular groups. For example, financial support for the group on a low income or digital literacy support for the group lacking digital knowledge

Notes: [a]DOCSIS 3.0 is an upgraded technology on cable TV networks; [b]VDSL is an upgraded technology on copper networks with higher speed capacity

Figures 3-5 and Table III show that the supply- and demand-side policies are interrelated and reinforce each other. This combination of supply- and demand-side policy is supported by previous studies. One such study is by Izsak and Edler (2011). The authors suggest that innovation-related policy is the most efficient when there are combinations of policies that encourage innovation generation and demand for innovation. Similarly, for high-speed broadband services, both supply- and demand-side policies for high-speed broadband should be used equally by policymakers to stimulate the use of fast/ultra-fast broadband in the near future. While this paper illustrates that demand-side policy contributes to the high-speed broadband development in both Korea and Sweden, it is also important that demand-side policy does not aim to substitute supply-side policy; instead, demand-side policy should complement supply-side policy. With regard to the demand side, content and applications are the key to the success of both Korea and Sweden. To meet the EU Digital Agenda 2020, all European countries should focus more on content and applications, especially the use of e-government, e-learning and online public services.

In short, demand-side policy can be implemented along with supply-side policy for high-speed broadband adoption to meet the targets of the EU Digital Agenda 2020. It is also important for policymakers to consider that demand-side policy should complement the implementation of supply-side policy, not substitute it. The effectiveness of demand-side policy also relies on the

availability of high-speed broadband infrastructure. According to FSR (2011), if broadband diffusion is still low, demand-side policy is likely to have insignificant impacts. However, as mentioned by Belloc *et al.* (2012), demand-side policy has greater impact than supply-side policy when broadband diffusion has grown to a particular point.

6. Policy recommendation and future research

With the ecosystem relationship between supply and demand in the broadband market, both the supply and demand sides are important for the EU to meet its Digital Agenda in 2020. As presented in Table III, the policies for the EU to achieve its goals are as follows. First, for the infrastructure part, the stage of infrastructure roll-out is crucial to the supply side, while the demand-side policy can stimulate greater availability of high-speed infrastructure. The infrastructure can vary, depending on the member state and its situation, the area and the existing infrastructure. The development of fibre may suit some member states well, while data over cable service interface specification (DOCSIS) 3.0 or very-high-bit-rate digital subscriber line (VDSL) may suit others. For high-speed broadband services, the recent growth in smartphones implies that mobile broadband developments such as the LTE network will also support the EU 2020 broadband targets. The use of mobile broadband should be promoted, especially in areas where there is a lack of fixed broadband technology, to encourage greater use of broadband. Regulation of and competition for broadband services can differ between countries, depending on the culture, politics, economics and area. This study cannot cover the regulation and competition of broadband services however. A case study would be needed to provide in-depth understanding of the regulation and broadband services in each member state. For the demand side, as content and applications, and infrastructure have a chicken and egg relationship, as discussed in the indirect network externalities, consumers and, especially, content and applications, are the key factors to driving overall broadband demand. Online public services and new content and application development suited to EU everyday life are therefore crucial. Lastly, digital inclusion policy and campaigns are needed to reduce the number of non-adopters, such as the elderly, low-income groups and citizens with disabilities.

While this paper provides examples of countries that are successful in broadband development, it is also useful to analyse countries that have problems developing their broadband. An understanding of their obstacles could lead to solutions to particular problems. This study also does not quantitatively analyse the impacts of demand-side policy on high-speed broadband penetration. Future quantitative research would, therefore, be useful when more data on demand-side policy become available.

Notes

1. According to the EU Digital Agenda, there are also other action areas which can reflect broadband supply and demand; however, 4th and 6th action area are the most suitable to present broadband supply and broadband demand, respectively.
2. In this paper, Korea is used as a short form for the Republic of Korea (South Korea).
3. For a more comprehensive review on broadband determinants, see Section 2 in FSR (2011).
4. The ICT development index (IDI) is published by International Telecommunication Union as an indicator to measure the information society. The index is based on 11 indicators related to ICT access, use and skill.
5. Based on OECD (2013) statistic.
6. Compiled from Forge and Bohlin (2008).
7. Compiled from the reports from the Swedish Post and Telecom Authority (PTS) and government reports.

References

Atkinson, R.D. (2007), "The case for a national broadband policy", *The Information Technology and Innovation Foundation*, June, available at: www.itif.org/files/CaseForNationalBroadbandPolicy.pdf (accessed 16 January 2014).

Belloc, F., Nicita, A. and Rossi, M.A. (2012), "Whither policy design for broadband penetration? Evidence from 30 OECD countries", *Telecommunications Policy*, Vol. 36 No. 5, pp. 382-398.

Beltrán, F. (2012), "Using the economics of platforms to understand the broadband-based market formation in the New Zealand Ultra-Fast Broadband Network", *Telecommunications Policy* Vol. 36 No. 9, pp. 724-735.

Bertot, J.C. and Jaeger, P.T. (2006), "User-centred e-government: challenges and benefits for government web sites", *Government Information Quarterly*, Vol. 23 No. 2, pp. 163-168.

Bourreau, M. and Dogan, P. (2005), "Unbundling the local loop", *European Economic Review*, Vol. 49 No. 1, pp. 173-199.

Cardona, M., Schwarz, A., Yurtoglu, B.B. and Zulehner, C. (2009), "Demand estimation and market definition for broadband internet services", *Journal of Regulatory Economics*, Vol. 35 No. 1, pp. 70-95.

Cave, M. (2006), "Encouraging Infrastructure Investment via the Ladder of Investment", *Telecommunications Policy*, Vol. 30 Nos 3/4, pp. 223-237.

Darby, L.F., Fuhr, J.P., Jr and Pociask, S.B. (2010), *The Internet Ecosystem: Employment Impacts of National Broadband Policy*, American Consumer Institute for Citizen Research, Washington, DC.

Distaso, W., Lupi, P. and Manenti, F.M. (2006), "Platform competition and broadband uptake: theory and empirical evidence from the European Union", *Information Economics and Policy*, Vol. 18 No. 1, pp. 87-106.

Drouard, J. (2010), "Computer literacy, online experience or socioeconomic characteristics – what are the main determinants of broadband internet adoption and internet usage?", *Communications and Strategies*, Vol. 80 No. 4, pp. 83-103.

European Commission (2010), "A Digital Agenda for Europe", *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2010) 245 final/2*, August, 2010.

European Commission (2013), "Digital Agenda Scoreboard 2013", Commission Staff Working Document SWD(2013) 217 final, Brussels.

Falch, M., Saugstrup, D. and Schneider, M. (2006), "How to achieve the goal of broadband for all", in Preissl, B. and Müller, J. (Eds), *Governance of Communication Networks, Connecting Societies and Markets with IT*, Physica, Heidelberg, pp. 203-226.

Flamm, K. and Chaudhuri, A. (2007), "An analysis of the determinants of broadband access". *Telecommunications Policy*, Vol. 31 Nos 6/7, pp. 312-326.

Forge, S. and Bohlin, E. (2008), "Managed innovation in Korea in telecommunications – moving towards 4G mobile at a national level", *Telematics and Informatics*, Vol. 25 No. 4, pp. 292-308.

Fransman, M. (2006), "Introduction", in Fransman, M. (Ed.), *Global Broadband Battles: Why the US and Europe Lag Behind While Asia Leads*, Stanford Business, Stanford, CA, pp. 1-58.

Fransman, M. (2007), "Innovation in the new ICT ecosystem", *Communication & Strategies*, Vol. 68 No. 4, pp. 89-110.

FSR (Florence School of Regulation) (2011), "Study on broadband diffusion: drivers and policies", IRG, Independent Regulators Group, following the terms of reference within IRG(11)11 issued on 31 May 2011.

Garcia-Murillo, M. (2005), "International broadband deployment: the impact of unbundling", *Communications & Strategies*, Vol. 57 No. 1, pp. 83-105.

Grajek, M. and Roller, L.H. (2012), "Regulation and investment in network industries: evidence from European telecoms", *Journal of Law and Economics*, Vol. 55 No. 1, pp. 189-216.

Gruber, H. and Koutroumpis, P. (2013), "Competition enhancing regulation and diffusion of innovation: the case of broadband networks", *Journal of Regulatory Economics*, Vol. 43 No. 2, pp. 168-195.

Hall, P. and Löfgren, K. (2004), "The rise and decline of a visionary policy: swedish ICT-policy in retrospect", *Information Polity*, Vol. 9 Nos 3/4, pp. 149-165.

International Telecommunication Union (ITU) (2003), *Broadband Korea: Internet Case Study*, ITU, Geneva.

International Telecommunication Union (ITU) (2013), *Measuring the Information Society 2013*, ITU, Geneva.

Izsak, K. and Edler, J. (2011), "Trends and challenges in demand-side innovation policies in Europe", Thematic report 2011 under specific contract for the integration of INNO policy TrendChart with ERAWATCH (2011-2012), Technopolis-group, Brussels.

Jamie Ahn, J. (2012), "Broadband policy in South Korea: the effect of government regulation on internet proliferation", *Proceeding of the Pacific Telecommunications Council Conference 2012 (PTC'12), 16-18 January, Honolulu*.

Kalning, K. (2007), "Forget reality TV", in Korea, online gaming is it, msnbc.com, available at: www.nbcnews.com/id/17175353/#.Uuj3WaMV_IU (accessed 6 February 2014).

Kushida, K. and Oh, S.-Y. (2006), "The political economies of broadband development in Korea and Japan", SJC Discussion Paper: DP2006-002-E, available at: http://sjc-r.stanford.edu/research/publication/DP/pdf/DP2006_002_E.pdf (accessed 6 February 2014).

Madden, G. and Simpson, M. (1997), "Residential broadband subscription demand: an econometric analysis of Australian choice experiment data", *Applied Economics*, Vol. 29 No. 8, pp. 1073-1078.

Ministry of Enterprise, Energy and Communications (Sweden) (2011), "ICT for everyone – A digital agenda for Sweden", Stockholm, available at: www.government.se/content/1/c6/18/18/01/509f1b0c.pdf (accessed 2 February 2014).

Ministry of Industry, Employment and Communications (Sweden) (2000), "Government Bill 1999/2000", available at: www.epractice.eu/files/media/media_410.pdf (accessed 2 February 2014).

Ministry of Industry, Employment and Communications (Sweden) (2005), "From an IT policy for society to a policy for the information society: summary of the Swedish Government Bill 2004/05:175", Stockholm, available at: www.epractice.eu/files/media/media_208.pdf (accessed 2 February 2014).

Ministry of Security and Public Administration (Korea) (2013), available at: http://korea.go.kr/eng/sub/about_egov01.jsp (accessed 8 February 2014).

OECD (2013), "OECD broadband portal?", available at: www.oecd.org/sti/broadband/oecdbroadbandportal.htm (accessed 5 February 2014).

Okazaki, S. (2006), "What do we know about mobile internet adopters? A cluster analysis", *Information and Management*, Vol. 43 No. 2, pp. 127-141.

Ovum (2009), *Broadband Policy Development in the Republic of Korea – A Report for the Global Information and Communications Technologies Department of the World Bank*, Ovum Consulting, London.

Raja, S., Kim, Y. and Kelly, T. (2010), *Building Broadband: Strategies and Policies for the Developing World*, Global Information and Communication Technologies Department of World Bank, Washington, DC.

Shapiro, C. and Varian, H.R. (1999), "The Information Economy", in Shapiro, C. and Varian, H.R. (Eds), *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, Boston, Massachusetts.

Srinuan, C. and Bohlin, E. (2013), "Analysis of fixed broadband access and use in Thailand: drivers and barriers", *Telecommunications Policy*, Vol. 37 No. 8, pp. 615-625.

Srinuan, P., Srinuan, C. and Bohlin, E. (2012), "Fixed and mobile broadband substitution in Sweden", *Telecommunications Policy*, Vol. 36 No. 3, pp. 237-251.

Trkman, P. and Turk, T. (2009), "A conceptual model for the development of broadband and e-government", *Government Information Quarterly*, Vol. 26 No. 2, pp. 416-424.

Westlund, O. and Bohlin, E. (2008), "Mobile internet adoption and use: results from a national survey in Sweden", *Proceeding of the International Telecommunications Society 17th Biennial Conference, 24-27 June, Montreal*.

Further reading

Bollier, D. (2010), "Scenarios for a national broadband policy", *Report of the 24th Annual Aspen Institute Conference on Communications Policy*, The Aspen Institute, Washington, DC.

Corresponding author

Chatchai Kongaut can be contacted at: chatchai@chalmers.se