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Do market failures hamper the perspectives of broadband?

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Abstract in English

As broadband telecommunication is seen as a source of productivity gains, the European Union and other regions are encouraging the deployment of a secure broadband infrastructure. In the Netherlands, there is some concern whether the supply of broadband capacity will meet the strongly increasing demand. This report analyses the broadband market and asks whether a specific role of government is necessary. The main conclusions are that presently, given current broadband policy, no considerable market failures exist. Firms have adequate incentives to invest in broadband, partly induced by specific regulation of access to the local copper loop. Hence, there is no need for changes in current broadband policy. Market failures in terms of knowledge spillovers are taken care of by other policies. As the broadband markets are very dynamic, unforeseen developments may emerge such as the appearance of new dominant techniques and market players. The best strategy for the government, in particular the competition authority, is to continuously monitor these markets, making timely intervention easier when needed.

Key words: Broadband, network industries, market failure.

Abstract in Dutch

Breedband wordt beschouwd als een belangrijke bron voor productiviteitsgroei en verbetering van de levensstandaard. Een van de belangrijkste doelen van de Europese Unie is om de ontwikkelingen van breedbandinfrastructuur te stimuleren. In Nederland bestaat ongerustheid of de markt wel zorgt voor voldoende breedbandcapaciteit om aan de sterk groeiende vraag te kunnen blijven voldoen. Dit rapport behandelt de vraag of de markten inderdaad genoeg hun werk doen en welke specifieke rol er eventueel is weggelegd voor de overheid. De belangrijkste conclusies zijn dat er geen marktgebreken bestaan die aanpassingen vergen van het huidige breedbandbeleid. Bedrijven ondervinden voldoende prikkels om te investeren in breedband, mede door specifieke regulering van de openstelling van het aansluitnetwerk. Marktgebreken rond bijvoorbeeld kennisoverdrachten worden aangepakt via ander beleid. De markten rond breedband zijn erg dynamisch, waardoor in de toekomst onvoorziene marktgebreken zouden kunnen opkomen in de vorm van een dominante techniek of dominante marktspeler. Voor de overheid is het daarom zinvol om de breedbandmarkten voortdurend te blijven volgen zodat zij direct kan ingrijpen als dat nodig mocht zijn.

Steekwoorden: Breedband, netwerk industrieën, marktfalen.

Een uitgebreide Nederlandse samenvatting is beschikbaar via http://www.cpb.nl.

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Preface

This CPB document focuses on potential market failures in the deployment of broadband in the Netherlands and asks whether government has a specific role in that respect. Given the predicted benefits of broadband, the European Union and other regions are encouraging the deployment of a reliable broadband infrastructure. There is some concern about whether the supply of broadband capacity will meet future (consumer) demand. The Dutch government, encouraged by questions from members of Parliament, has asked the CPB to conduct an analysis of market failures on markets for broadband. This document systematically builds up a theoretical framework for potential market failures in broadband markets. These potential market failures are analysed for the Netherlands by studying telecom regulations and using national data where available. Additionally, international experience and research findings of other institutes are used to complete the analysis.

The project team included Machiel van Dijk, Fred Kuijpers, Bert Minne, Machiel Mulder, Joost Poort (SEO Economic Research), Arnold Verkade and Henry van der Wiel (project leader). Besides the authors – i.e. Machiel van Dijk, Bert Minne, Machiel Mulder, Joost Poort and Henry van der Wiel – Fred Kuijpers and Arnold Verkade did a great job in collecting data and providing statistical assistance, while Fré Huizinga and Taco van Hoek gave valuable feedback during the project.

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F.J.H. Don
Director

Summary

The question

The telecommunication industry, and in particular the broadband market, is changing rapidly, providing customers with more options to exchange sound, video and data. These communication streams are transmitted along networks that become faster, better and cheaper. It is widely recognised that the benefits of broadband in terms of lower transportation costs can be large for an economy in terms of productivity.

Broadband is diffusing rapidly worldwide. The number of subscribers per capita has increased considerably across industrialised countries since the early 2000s. In the Netherlands, it has grown rapidly as well, giving the Dutch a lead position internationally.

As broadband telecommunication is seen as a source of productivity gains, the European Union (EU) and other regions are encouraging the deployment of a secure broadband infrastructure. In line with the advices of the OECD and the EU, the basic principle of the Dutch government is that investments in broadband infrastructure – including the choice of technology – as well as the development of applications should be left to the market. There is, however, some concern that these developments will be insufficient to match the increasing demand for broadband. Particularly, insufficient investments in (new) infrastructure appear to be cause for concern. This report, therefore, addresses the following issue: *Given current policy (including regulation) on broadband, do market failures hamper future deployment of broadband?* In order to answer this question, this report applies a welfare-economic approach using qualitative and quantitative insights.

Main conclusions

This report concludes that market failures on the market for broadband in the Netherlands are limited to market power and, to some extent, to an increase in spillover effects of knowledge. Current regulation by OPTA adequately deals with the issue of market power, particularly with respect to market access to the local (copper) loop. Spillover effects of knowledge are tackled by R&D-subsidies such as the WBSO. These subsidies are more effective and efficient in correcting this market failure than broadband subsidies. If the R&D-subsidies are considered insufficient, then they can be raised.

This report finds no evidence of other market failures that would call for specific government intervention. Given current regulation, the markets for broadband in the Netherlands function well in terms of competition (static efficiency) and innovation (dynamic efficiency). Hence, the best policy is to rely on market forces. However, market conditions may change due to changing technologies and increasing demand. The government, in particular the competition

authority, should therefore permanently monitor the broadband markets for any evidence of market failures that may require government action. In the future, for instance, a natural monopoly network might emerge if one broadband technology requiring huge investments outperforms all other technologies. In that case, regulation should ensure that market power is not abused. Finally, being a producer of (semi) public services such as education, the government can contribute to a further development of broadband by applying it to its own production process, if this raises productive efficiency.

Method

This report uses the welfare-economic approach. The outcome of markets is optimal from a welfare perspective as long as no market failures exist. If market failures exist, then government may consider intervening if government failures are smaller than those market failures; i.e. if the benefits of intervention exceed the costs. This document, therefore, systematically builds up a theoretical framework of potential market failures in broadband markets. Subsequently, these potential market failures are analysed for the Netherlands by studying Dutch telecom regulations and using national data where available. Additionally, international experiences, research findings of other institutes and interviews with parties directly involved are used to complete the analysis. The results of this analysis are employed to assess whether changes in current policy are required.

Besides being a policy maker, the government is an economic agent as well. This function is also analysed.

Broadband definition

In technical terms, broadband is often referred to in terms of high speed, always-on connection and two-way capability. Presently, a number of network infrastructures are available for broadband, of which the copper lines and the coax cable are the most important ones. Broadband is a dynamic notion with buzzwords ranging from ISDN via ADSL, ADSL2+ to VDSL and glass fibre. In a welfare economic perspective broadband is neither a specific infrastructure nor a specific technique, but a capacity of a telecommunication network to transport masses of data from one point to another at a highly efficient way. In that case, broadband can be seen as an investment in communication, generating a flow of returns in (future) value added.

Where do the Netherlands stand?

Internationally, the performance of the broadband market in the Netherlands is quite good. The penetration of broadband is among the highest in the world. This performance partly flows from fierce competition between cable and DSL technology, both of which are presently available to approximately 90 percent of all homes. Other broadband networks are virtually non-existent in the Netherlands. Another factor behind the performance of the Netherlands is the regulation of the telecommunication industry. The regulator, OPTA, regulates part of the telecom industry to overcome market power problems and to stimulate competition.

Potential market failures in broadband markets

Various market failures may apply in the market for broadband. As part of the telecommunication industry, the broadband network industry is a special industry due to the typical characteristics of networks (i.e. network infrastructure, essential facility and economies of scale). Theory provides many arguments for potential market failures, which can be classified as abuse of market power by the owners of the networks, network externalities, production externalities and consumption externalities. Market power may result in allocative inefficiencies leading to higher prices and less use of broadband than in a perfect market. Network externalities are related to the value of the network. The more people are connected, the more interesting it is for others to become connected. Production (consumer) externalities arise if activities of producers (consumer) generate benefits or costs, which are not taken into account by the producer (consumer). Finally, the market may lead to a social or geographical digital divide, which may be regarded as less desirable from a welfare point of view. If these market failures emerge, they are a reason for governments to consider intervention.

All in all, broadband network industries are prone to various market failures. This is not the case for content provision and the manufacturing of transformation equipment. These are often global markets, with low entry barriers, and in which many players are active that continuously introduce innovative content, applications and equipment. This report, therefore, mainly focuses on the broadband network industries including the Internet service providers (ISPs).

Market power: current competition, regulation and innovation incentives

The Dutch regulator of the telecom industry (OPTA) is charged with addressing potential market power and with the possible trade-off between static and dynamic efficiency. If markets are statically efficient, prices of products do not distort efficient consumer decisions and production takes place at the lowest possible costs (given all available technologies). Dynamic efficiency refers to the development of product innovations or process innovations in the form of lower production costs. Both may enhance welfare.

Regulation generally aims to deal with market power. However, less market power could negatively affect the incentives to invest, because a trade-off may exist between static and dynamic efficiency. The presence of this trade-off depends on specific market conditions. Based on European directives, OPTA distinguishes three relevant markets within the provision of broadband through the copper infrastructure: the market for unbundled access, the market for wholesale broadband access and the retail market. The market for unbundled access and a part of the market for wholesale access, namely the high-quality market, are regulated.

Unbundling and access fees regulate the market for (unbundled) access to the copper local loop in order to overcome significant market power of KPN. In this case, unbundling means that other firms have access to the local loop.

Here, a trade-off exists between static efficiency and dynamic efficiency. The trade-off is due to the presence of high fixed costs of the infrastructure. High post-innovation profits are needed to recover the costs of innovating the network, but above-marginal prices can distort efficiency of consumer decisions. The current method of access pricing, based on actual average costs, is dynamically efficient, as it gives both the incumbents and entrants incentives to invest in the local loop. Entrants will only invest in an alternative infrastructure if that is more efficient than using the network of the incumbent. Otherwise, this 'make-or-buy' decision which (potential) entrants face stimulates the incumbent to improve efficiency and performance of its own local loop. Consequently, the current regulation of the local loop does not bias the investment decisions of both incumbent and (potential) entrants making use of the copper local loop.Therefore, a price based on average costs seems to be a good compromise between static and dynamic efficiency. The markets of access to the local loops of cable, glass fibre and wireless connection are not regulated because firms with significant market power are absent.

Wholesale broadband access is the product that a network owner delivers to a service provider. The market for *wholesale broadband access* actually consists of two relevant market segments according to OPTA. The distinguishing feature between these two segments is the contention ratio (in Dutch: overboekingsfactor), i.e., the ratio of guaranteed to maximal bandwidth. The level of contention determines which services can be offered at the retail level. A high contention ratio indicates a high quality. In particular, data communication services require high levels of quality, whereas broadband services mostly require lower levels of quality. In practice, this means that cable networks cannot supply data communication networks, because of their low contention rates. OPTA regulates the high-quality part of the wholesale access market since KPN has significant market power. Similar to the market for unbundled access, static efficiency is increased due to current regulation of this market, but sufficient incentives remain for entrants and incumbents to improve the network.

In the market for low-quality wholesale access, a trade-off between static and dynamic efficiency does not exist. Competition has led to considerable investments in glass fibre backbones to such an extent that there is large overcapacity of these networks at present. Consequently, static efficiency is high. Further, the costs of deploying existing spare capacity are rather modest. Hence, investments in new capacity do not require high investments, which supports dynamic efficiency.

The *retail market* is not regulated because firms with significant market power are absent. Competition appears to have led to both static efficiency and dynamic efficiency. At present, end-users can choose from a large variety of transmission speeds, transmission qualities and alternative means of telephony. Moreover, new service providers enter the market. Competition appears to have stimulated investments in innovation as well, as shown by the continuous improvements in download speeds at even lower costs.

All in all, given present regulation, market power does not appear to hamper broadband deployment in the Netherlands. Therefore, there is no need to change regulation. Roughly, these conclusions are supported by foreign government policies and conclusions of economic studies conducted in other countries.

Network externalities

E-mail externalities are one example of a positive network effect related to broadband networks. The more people are able to e-mail, the more interesting it is for others to become connected and use e-mail as well, and the higher the value of the network will be.

At present, the size of the *network externalities* in the markets for broadband is probably not that large. Consumers use broadband particularly for their 'intrinsic' demand such as downloading music and films. Upstream activities are still in their infancy even where capacity is sufficient available. Hence, for most activities that are currently being used, the number of other consumers that also have a fast connection is irrelevant.

The existence of *network externalities* does not automatically result in a market failure as network firms can internalise part of these externalities by taking into account the extension of the network when setting prices for its clients. Moreover, the market may respond itself by jointly developing standards and interconnection of networks. In the Netherlands, positive network effects are materialised due to compatible and interconnected networks. Network providers and Internet Service Providers (ISPs) have sufficient incentives to comply with international standards and interconnect their networks for Internet traffic exchange, taking into account the possible need for compensation for elements such as traffic flow, number of routes and the cost of international transmission. Since many ISPs are more or less equally sized in practice, the peering agreements between ISPs in the Netherlands often do not include an exchange of money.

Production externalities

Although empirical evidence is lacking, it is likely that broadband produces *positive production externalities*. First, research and development (R&D) activities by telecom firms themselves could result in new knowledge. If the innovating telecom firms cannot appropriate the benefits of this new knowledge, others will free ride, which is an externality. Second, broadband could raise the knowledge spillovers from all kinds of industries and universities to other parts of the economy. It is likely that broadband increases the positive spillover effects by providing better access to external know how. This means that for a given level of knowledge creation, more knowledge may spill over to external parties due to a more advanced communication network. Although these externalities may justify government intervention, they do not justify government stimulation of broadband deployment. After all, it is the knowledge creating activities, like R&D, that generate the positive externalities. Policy makers should be aware that the government already takes account of these externalities in the form of R&D-subsidies like the WBSO. If the latter are considered insufficient, then they can be raised. Moreover, broadband subsidies are less effective and efficient than R&D-subsidies in correcting the market failure. The latter are directly targeted at the issue at stake.

Consumption externalities

Broadband may stimulate telework and, in doing so, may generate *consumption externalities*. If broadband deployment raises the importance of teleworking, externalities might occur due to less road congestion or even increased labour supply, as telework allows some people easier access to the labour market, leading to a reduction in social benefits and taxes. Road users and, from an environmental and social point of view, society at large will benefit from telework, but will not pay the broadband user for it. Although this effect might exist, subsidising teleworking is not the most efficient policy to address this externality. Alternative policies (e.g. road pricing and labour market policies) are more effective and efficient as these measures directly focus on the inefficiencies (in case of road congestion), or inequalities (in case of access to the labour market) that generate the market failures.

The size of this externality depends on the extent to which a much higher transmission capacity of the communication infrastructure will induce more teleworking. However, one may wonder whether current facilities such as ADSL are not already sufficient for teleworking. Furthermore, other factors, such as the attitude of employers to teleworking, may be much more important than high-speed data connections.

Equity issues

With respect to equity, we do not find evidence for a substantial geographical or social digital divide in the Netherlands. Broadband is available in almost all regions. Most consumers can choose between roughly 80 Internet subscriptions in densely populated areas and between approximately 30 in remote areas. To some extent, there is a social digital divide. Elderly people are underrepresented in broadband access. In the course of time, this social digital divide will decline due to cohort effects. Nonetheless, the government may consider stimulating elderly to find access to the World Wide Web by awareness programs and education.

Monitoring developments is best policy

The main lesson of our analysis is that market failures are limited and mainly related to market power on the copper local loop and production externalities. Regulation by OPTA and R&D-

subsidies, respectively, seem to address both market failures adequately. Hence, in principle, there is no need for additional policy measures. These conclusions are based on the analysis of the current broadband market, but are also likely to be valid in the near future. Current economic policy also provides sufficient incentives to invest in broadband. Changes in this policy are, therefore, only needed if changes in market failures become evident. Although unforeseen developments may occur, we conjecture that such failures will emerge gradually, if at all.

In addition, broadband policy is no free lunch. Firstly, subsidies would have to be financed by taxes, which distort the economy. Next, government may not outperform the market if intervention involves choosing or preferring certain technology options. Finally, the allocation of subsidies requires manpower. Government policy, therefore, may involve considerable costs. The reasoning that “it may not help, but it won’t hurt either” cannot defend government action. This conclusion applies at both the national level and the local level. Further, policy measures can hardly be founded on the presence of market failures according to this report.

We conclude that the most efficient policy is to permanently monitor the broadband markets in order to determine whether additional measures will need to be taken. Continuous monitoring is required in order to be able to respond rapidly with regulation and supervision if firms with significant market power in broadband markets would emerge. It is possible that one dominant broadband technology will become apparent in the future resulting in a natural monopoly network. In that case, regulation has to ensure that market power is not abused. However, the option for regulation should not give rise to uncertainty, as this may negatively affect current investment decisions. Certainty about future regulatory conditions and access tariff structures can be very important for potential investors now.

Government as producer of public services

Besides being a policy maker, the government is an economic agent as well. It produces (semi) public services such as education, health care and national security. As such, it can have two aims related to broadband: an efficient production process of semi-public services and act as launching customer. Both aims can contribute to a further development of broadband. However, since the market for broadband appears to work well, the emphasis should be placed on efficient production. In this regard, the performance of the Dutch government in using tele-communication is modest compared to other countries. Particularly on e-government services, the Netherlands performs weaker than many other EU-countries.

1 Introduction

"Mr. Watson -- come here -- I want to see you" (first words by telephone by Alexander Graham Bell, March 10, 1876).

1.1 Background

Broadband important for communication

Broadband is another phase in communication between people. Although telecommunication over longer distances probably started long ago with smoke signals and roll of drums, it really took off in 1876. Then, Alexander Graham Bell invented the telephone that could transmit speech electrically. Initially, it was limited to the next room, but it rapidly deployed over longer distances. Nowadays, we can easily switch between conversations over short and longer distances –*tele*communication– using different devices including broadband. A new world of communication manifested itself.

Since the invention of Bell, the telecommunication industry has undergone an amazing revolution with customers nowadays exchanging sound, video and data at a fast rising speed. Recent developments in information communication technologies (ICT) and electronic commerce has enlarged the demand for the deployment of broadband infrastructure networks and the use of broadband Internet connections. These communication streams are transferred along networks with bandwidth becoming broader and broader over time. People download large amounts of information streams, and increasingly make use of distributing information by themselves (upload). Developments like triple play (i.e. telephone, radio/tv and Internet all in one package) and online gaming make broadband the more interesting. In technical sense, broadband is a dynamic notion with buzzwords starting from ISDN via ADSL, ADSL2+, SDSL leading to VDSL. Moreover, at present, different network techniques are available such as copper lines, coaxial cables, wireless and glass fibre.

Broadband important for productivity

Broadband can be an important driver for productivity as well. Broadband is an enabler for other production factors, especially ICT. Broadband provides PC's and laptops access to the Internet and its facilities. As commonly argued, ICT has all the characteristics of a general-purpose technology and it could at least temporarily produce higher productivity growth rates. In general, broadband can be a mean of productivity growth through improvements in production processes, reductions in transaction costs and innovations like new service applications via broadband infrastructures (i.e. content). A number of studies puts forward consistent evidence for a positive relationship between broadband and economic performance.[1]

[1] See e.g., Allen Consulting Group, 2003 and CEBR, 2003.

Although the broadband market is still in its very early stages of growth, it radically developed in recent years. The number of subscribers per capita has increased considerably since the early 2000s across industrialised countries. In the Netherlands, it has grown rapidly as well and the Dutch international position is among the best of the world.

Policy interest and concerns

The notion that governments should somehow be involved in the deployment of broadband is mainly based on the widely recognised belief that the benefits of using broadband can be large for an economy in terms of growth and productivity. Many governments expect broadband will strongly raise welfare. At the famous Lisbon summit in 2000, policy makers acknowledged the Internet as a powerful source of productivity gains and of improvement in living standards. In that respect, the action plan eEurope 2005 proposed a two-edged strategy for governments:

- Promoting services, applications and content in key areas such as government, e-learning, e-health and e-business,
- Stimulating the deployment of a secure broadband infrastructure, creating a positive environment

The Dutch government aims to hold a leading position in the field of broadband in Europe and worldwide in 2010 (see de Breedbandnota / the Broadband Policy Paper, Ministry of Economic Affairs, 2004)). The government regards broadband as a strategic condition for structural economic growth. Broadband can make a substantial contribution to strengthening the economy and solving social problems. In order to achieve its ambition, the government aims to give a strong impulse to the Broadband Policy Paper:

- The development and application of services and high-potential broadband applications in the private an public domain
- The development of (a) high capacity connection network(s) with substantial national coverage in 2010.

The government takes the view that the market holds primary responsibility for investments in further development of the new generation of broadband-type infrastructures and development of accompanying services. The government pursues a technology-independent broadband policy. It leaves the choice of technology to market parties (see also box).

Major concerns broadband report

The Dutch government expects that the growing capacity demand will create problems in terms of the total volume traffic per network connection (the 'first mile' or the 'last mile'). The present main networks (backbone) are glass fibre networks and provide enough capacity for the time being. The main restraints and potential risks in the field of infrastructural development are: exploitation of existing networks, relatively weak equity position of telecom and cable companies, poor investment climate, competition issues, fragmentation and security of supply, delivery and continuity. The main obstacles and risks in the field of services development are lack of scale and copyright aspects.

There is concern about the investment incentives of telecom and cable companies in new technologies. This concern is partly linked to the burst of the Internet bubble and poor investment climate. These companies may prefer exploiting their investments already made in copper and coax networks as far as possible instead of investing in new technologies. Moreover, financiers might have become less willing to invest in network innovation having in mind recent experiences. The competition issues are related to different aspects of the broadband market structure and the necessary (future) regulation in terms of access to networks. Will there be competition for or on the market? Is duplication of network unattractive? And if so, what are the consequences of a (natural) monopoly? The fragmentation issue is particularly related to the fear that different broadband infrastructure technologies lead to technical and organisational problems including the threat of local monopolies.

Opinions of the parties involved are mixed. As a flavour of two opposing opinions, we sketch some examples. Some believe that the capacity of the current broadband network will not be sufficient, even if improvements will be made and upgrading will take place. To their opinion, governments should do more to speed broadband rollout. For instance, a number of reports on the Dutch case recommend that the government should financially facilitate developments in (new) infrastructure.[2] There are also some local government initiatives to financially support the deployment of a new broadband network. For instance, the city of Amsterdam wants to support the construction of a fibre optic access-network.

Other Dutch reports and important market players state the opposite, that policy (including local governments) should not financially intervene.[3] For instance, the Vecai, the branch organisation of Dutch cable companies, asserts that the Netherlands is characterised by sufficient competition. If upgrading or enhancing of the broadband network is necessary, the market should drive the rollout of broadband, not the government. According to Vecai, a fibre network in the last mile to the home is not necessary, because the current cable networks offer enough capacity to meet future demand.[4]

Public debate about the role of government with respect to broadband deployment is by no means a typically Dutch affair. Governments in many developed countries consider investing in broadband projects and various countries have done so in the past.

[2] See, e.g., Advies van de impulscommissie Breedband, 2004, and two advisory reports of commission Andriessen, 2004.

[3] See, for instance, Passenier, 2005.

[4] Platform Nederland Breed, 2004.

1.2 Two main research questions

The main objective of CPB in this report is to analyse what the role of Dutch government could be in efficient broadband deployment. In this context, this report addresses two main questions:

- Where do the markets of broadband (networks and services) fail in the Netherlands, and are these markets interrelated? What kind of market failures can be deterred?
- If markets are found to fail, to what extent will a change in policy reduce these market failures? What policy measure will be the most efficient way for Dutch policy makers to reduce market failures?

In order to answer these questions, we apply a welfare economic approach. This approach assumes that results of markets are economically optimal from a welfare perspective as long as no market failures exist. Therefore, the first question essentially boils down to the following question. Do firms have sufficient incentives to invest in future broadband capacity with regard to obtaining an optimal future social-economic welfare? Answering the two key research questions, this report analyses Dutch regulations and institutions, uses qualitative and quantitative information, collects international experience and research findings of other institutes, and, finally, employs interviews with parties directly involved.

The welfare economic approach has two important implications for reading this report. First, the report does not address the issue to what extent market failures may hamper reaching actual targets of authorities. The targets imposed by public authorities are sometimes based on a political perspective, such as 'the Netherlands should be European frontrunner in 2010', or 'the citizens in our town should have glass fibre to their homes in 2010'. These types of targets do not necessarily contribute to future welfare, because it can be very costly being at the front (see box).[5]

Maximising welfare versus maximising international performance

This report focuses on the optimal welfare with respect to broadband. As argued, economic theory states that welfare is optimal if there are no market failures. From a welfare economic perspective being the best (i.e., most advanced) has no value in itself. Being the best may be the final outcome of a welfare analysis based on market failures, however, it is not a starting point. The basic difference between proponents of aiming at being the best and proponents of aiming at improving economic welfare is that the former do not mention or take into account that public funding might be more efficient and effective if it is spend on other purposes. The latter may produce more welfare. A welfare economic approach takes account of alternatives.

[5] Moreover, although these goals are more or less concrete, it is questionable whether it is advisable to have such specific goals without clearer information on the use of broadband, the technical and economic details of its deployment in an international perspective.

Second, this report mainly assesses the question to what extent the market fails today, in order to consider a change in government policy now. At the end of this report (chapter 6), we focus on potential market failures in the future and the consequences for policy today.

Time horizon report

As the focus of this report is mainly on investments and on whether (current) market failures arises, the time horizon of the report is not unlimited. It is related to the average service life of new investments in broadband equipment. Depreciation of these investments is based on an average service life of 3 to 5 years. Hence, indications to the future include at most five years.

Focus policy on market failures and equity issues

In general, economic policy entails two main triggers: efficiency and equity. For efficiency, competition between firms typically yields an efficient allocation, except when there are market failures. In that case, governments should aim to reduce them as much as possible.

This report systematically constructs a theoretical framework of potential market failures, indicators and consequences for policy (chapter 3). Particularly, broadband is a network technology facing potential market failures. For instance, market failures might occur if firms have excessive market power related to large economies of scale of networks. Consequently, prices for broadband are too high compared to the case of more fierce competition.[6] Other potential market failures are the existence of network externalities, the hold-up problem of investments, production and consumption externalities, and information asymmetry. But not only a pure economic point of view is taken into account in this report. A social point of view in terms of equity is accounted for as well. The latter, for instance, is related to the issue whether broadband creates a digital divide among socioeconomic and demographic dimensions.

If we detect market failures, the analytical framework can be used as guideline for policy consequences (chapter 4 and 5). In aiming to reduce particular market failures, policy makers should explicitly take into account two options: current policy and alternative policies including ones not directly related to broadband. Before changing the current broadband policy, policy makers should weight costs and benefits of these new policy measures including alternative policies that might be more effective. Moreover, government intervention is justified if market failures exceed potential government failures. This report, however, does not entail a cost benefit analysis of a specific policy measure.

1.3 Definition broadband

How does this report define broadband? This report regards broadband as a factor of production linked to investments in backbones, local loops and telecommunication equipment supporting

[6] In economic terms, prices deviate more from marginal costs in case of less competititve markets.

the transmission of content. This economical concept is indirectly linked to technological characteristics like the amount of speed and compression and material.

Technical definition

In general, broadband is a type of network infrastructure connecting people and firms. In fact, it is the continuously available connection suitable for good quality of content, such as audio-video applications and the exchange of large data files. Technically, broadband refers to an ‘always on’ data connection with a large transmission capacity. ‘Large’ here means a connection allowing for high-quality audio and video applications as well as allowing users to exchange large data files.[7] The OECD[8] defines broadband in a similar way, viz: ‘Broadband is characterised by high speed, always-on connection and two-way capability and can support applications in e-commerce, education, health care, entertainment, and e-government’.

Upstream and downstream transmission speed

Broadband is frequently referred to in terms of upstream or downstream speed. This transmission speed is the bandwidth of broadband, expressed in the number of transferred bits per second. The exchange of content has two directions. The upstream capacity is the speed of the customer to the provider. The downstream speed is the speed at which the end-users receive the content. In practice, consumers need more downstream than upstream speed, because e-mailing and surfing needs less upstream speed. Except for video telephony and peer-to-peer networks, most services presently do not depend on high upstream speed (see e.g., Client Research, 2005). To put it differently, consumers are more users than providers of content. Therefore, consumers usually demand asymmetric speed (such as ADSL). In contrast, the business sector usually sends and receives roughly the same. Therefore, many firms demand symmetric speed (for instance SDSL).

Changing concept

Although the various definitions appear to be straightforward, they are problematic and constantly under revision over time. Moreover, they differ between countries and, hence, hamper international comparisons. ‘Broadband’ is not a fixed notion, as it instantaneously changes over time. The consequence is that what is called ‘broad’ today, is called ‘medium’ or even ‘small’ tomorrow. Likewise, what broadband is in one country is called midband elsewhere.[9] In the course of the last ten years, the transmission or access speed has risen considerably. Currently, providers increase the available speed to 20–25 Mbps (buzz word: ADSL2+).

[7] This definition is based on ‘De Breedbandnota’.

[8] OECD, 2003a.

[9] The minimal transmission speed that qualifies as broadband differs largely between countries. Different definitions affect statistics of homes passed and users dramatically, but also determine which technologies are taken into account. Most reports consider ADSL (xDSL), and cable to be broadband.

Economical view on definition broadband

For a welfare economic analysis, a technical definition is not appropriate. A functional description of broadband in terms of a production function is better. The key function of broadband is to (rapidly) transmit content from one point to another and backwards creating value added, or stated otherwise, economic welfare. This report uses investments in broadband as main link to (future) welfare.

In general, the input of more capital stocks and more employment generate an increase in production (gross domestic product). Taking depreciation into account, investments in broadband enlarge the broadband capital stock. Improvements in broadband are reflected in higher speed or lower transmission prices. Higher speed is a component of more input in investment volume, lower prices lead to more demand. More speed and better compression techniques give a higher quality of investment, which economically can be translated into more investment and the enabling of creating more welfare. Hence, this report argues that the material or network is less a determinant.

1.4 Structure of the report

The plan of the report is as follows. Chapter 2 provides a brief overview of the international position of the Netherlands and describes the main issues of the current Dutch policy. Readers already familiar with this background knowledge can easily skip this chapter and go to chapter 3. The topic of chapter 3 is the theoretical framework of market failures, indicators and policy consequences. Each market failure is comprehensively discussed using explicit examples with regard to broadband. This framework also provides appropriate roles for public authorities in this industry. Several policy measures are discussed which could deal with these market failures. Moreover, we depict sources of government failures. However, policy instruments may give rise to a trade-off: more static efficiency may reduce dynamic efficiency. This potential trade-off is considered as well in chapter 3.

Taking the theoretical framework as a guideline, chapters 4 and 5 systematically discuss the Dutch case using empirics where possible to find out whether market failures are at stake. Both chapters particularly explore to what extent there is evidence for a lack of incentives to invest in future network capacity of broadband and if a change in government policy is required. These chapters also take an international perspective and highlight main policy issues discussed in other countries where broadband deployment has an edge on. To be more precise, the competitive situation in the Netherlands is the subject of chapter 4. It presents current facts and figures with regard to the extent of competition on the Dutch performance on broadband. It also reflects on current regulation and competition policies. Chapter 5 discusses all kind of externalities with respect to the Netherlands. It also assesses the existence of a digital divide.

Chapter 6 summarises the main policy lessons of this document, check its robustness with regard to future market failures and apply these lessons to (local) government initiatives. This chapter also elaborates on the government as economic agent producing (semi) public services.

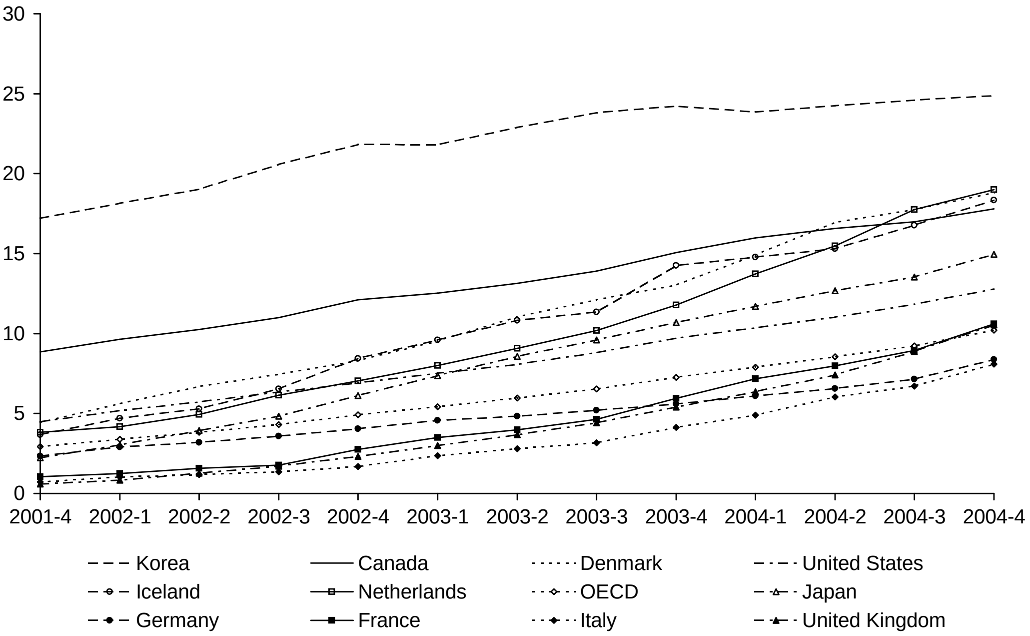
2 Where do the Netherlands stand?

The Dutch penetration of broadband is among the highest in the world. The Netherlands probably owes this favourable position to fierce competition between cable and DSL technology, both of which are presently available to approximately 90 percent of all household. Broadband using technologies with extreme speeds, however, are virtually non-existent in the Netherlands. In general, the Dutch government primarily hold market parties responsible for investments in further development of the new generation of broadband-type infrastructures and development of accompanying services.

2.1 Introduction

This chapter presents facts and figures of the current situation, and sketches current policy. The first part of this chapter provides a brief overview on the international position of the Netherlands regarding the availability and use of broadband. Readers already familiar with the outcome of this analysis can skip this part. The second part of this chapter briefly discusses the current Dutch broadband policy of the central government. Further details are discussed in the next chapters.

Figure 2.1 Number of broadband subscribers per 100 inhabitants, 2001-2004



Source: OECD, 2004e.

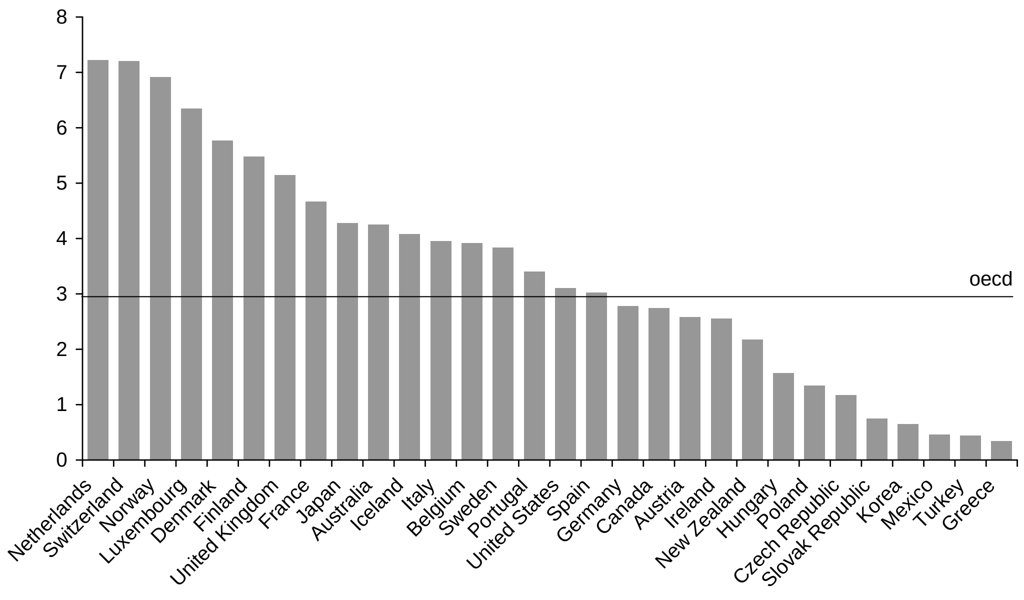
2.2 Adoption and use of broadband

2.2.1 Penetration of broadband infrastructure

From an international perspective, the rapid development for the Netherlands is not unique. All over the world, and in particular in developed countries, the adoption of broadband defined as DSL, cable and fixed wireless has been growing at a tremendous rate. The OECD reports that by December 2004, there were 118 million such broadband subscribers in the OECD area, compared to 82 million a year earlier and 3 million at the end of 1999. This adoption speed of a new communication service is the fastest ever experienced, even faster than mobile telephony.[10] Figure 2.1 gives the recent development in the number of broadband subscribers relative to the population for the G7, as well as the top five countries with the largest broadband penetration by December 2004.

The Dutch penetration of residential broadband shows an increase from 3.8 subscriptions per 100 inhabitants in 2001 to 19.0 in 2004. This growth path is substantially steeper than the OECD-average, in particular since the end of 2003. Accordingly, the Netherlands climbed from a fifth to a second position within this group of countries. Korea is the undisputed leader in terms of broadband penetration, being at least three years ahead of the rest. Note that these figures understate the actual broadband adoption by the population by a factor 2–3, since a single broadband subscription suffices for all members of a household.

Figure 2.2 Net increase of number of broadband subscribers per 100 inhabitants, 2003-2004



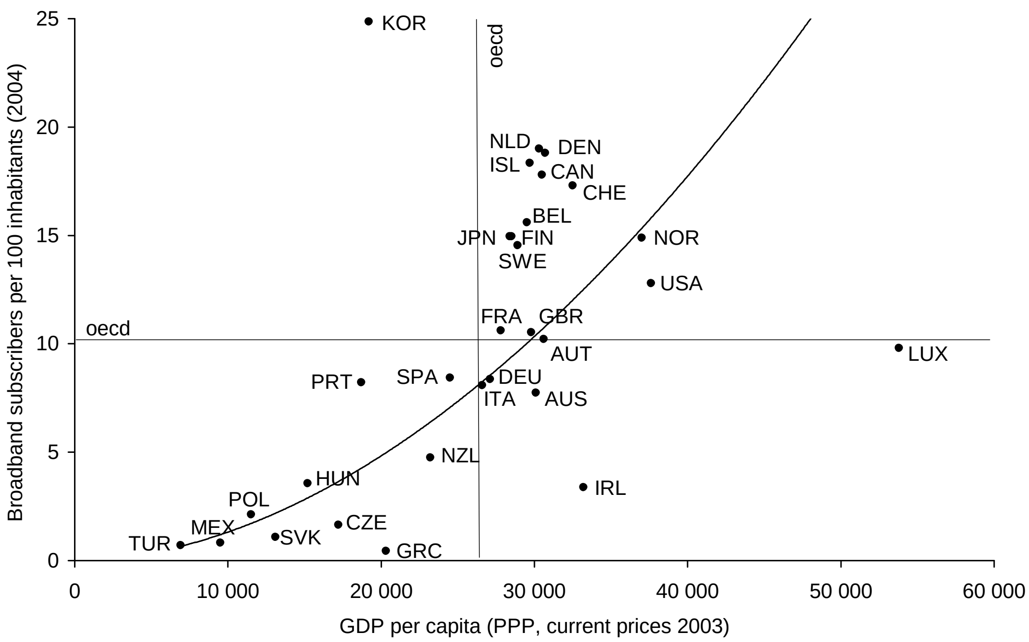
Source: OECD, 2004e

[10] OECD, 2004b, pp. 6.

However, Korea is reaching a saturation point. This is illustrated in figure 2.2, which shows that current Korean growth levels are among the lowest in the OECD. The Netherlands, on the other hand, recorded the largest growth level between 2003 and 2004, more than twice the OECD average.

Figure 2.3 shows that there is presently a strong (exponential) correlation between broadband penetration and income level in countries. This scatter makes it particularly interesting to identify the outliers: countries that have low or high penetration levels relative to their income. Once again, the position of Korea is striking, but also the Netherlands appears to have a high penetration relative to income levels. Luxembourg and Ireland are negative outliers.

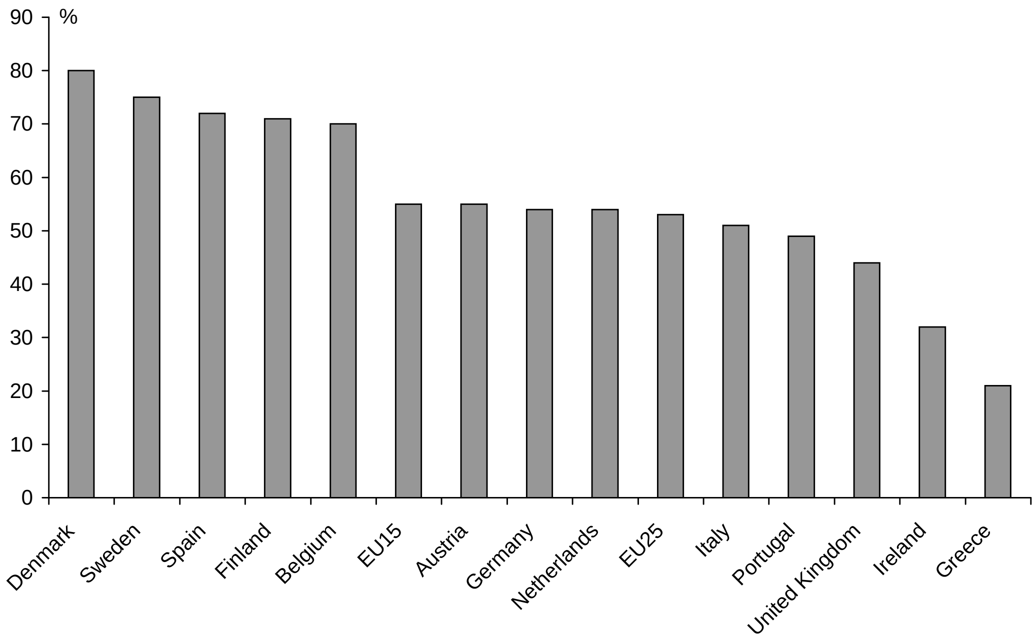
Figure 2.3 Per capita income versus broadband uptake in OECD



Source: OECD, 2004e.

Whereas the Netherlands record the largest residential broadband penetration in Europe, penetration to enterprises is close to the European average (see figure 2.4). Probably, the industry structure and the average size of firms are important elements that determine the international position.

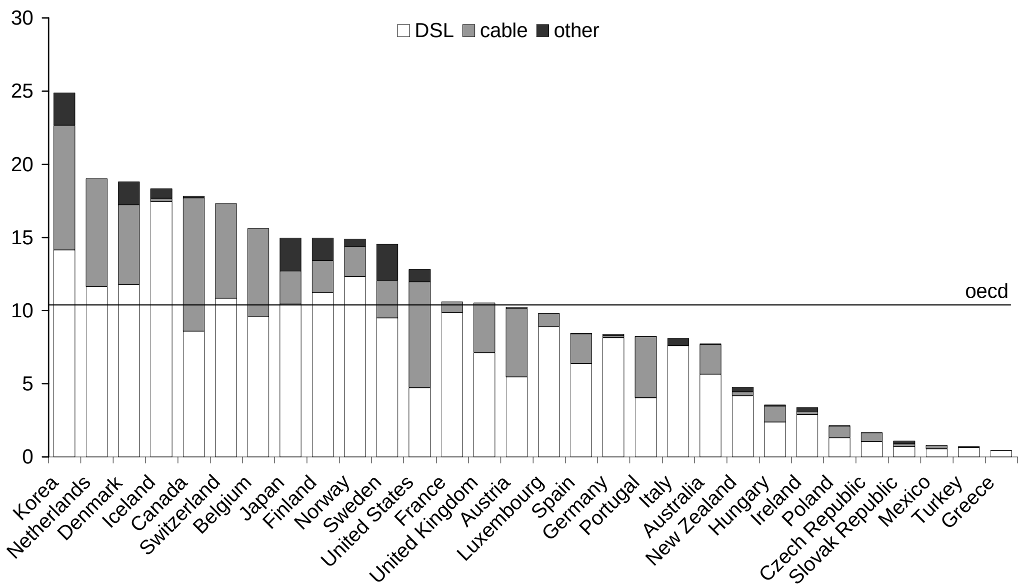
Figure 2.4 Broadband penetration to enterprises, 2004



Source: Eurostat 2005, data for France and Luxembourg are unavailable.

It is most likely that the Netherlands owes its favourable position in broadband penetration to fierce competition between cable and DSL technology, both of which are presently available to approximately 90 percent of all homes.

Figure 2.5 Broadband subscribers (per 100 inhabitants) by technology, December 2004



Source: OECD, 2004e.

However, broadband using technologies with higher speeds, most prominently fibre optics, are virtually non-existent in the Netherlands. Figure 2.5 illustrates this by giving a breakdown of broadband penetration by technology. Korea, Japan, Sweden and the United States have a relatively large market share of ‘other’ technologies.

Recently, Telecompaper (2005) benchmarked high-speed broadband developments in a selected number of leading countries within Europe and Asia Pacific.[11] It concludes that fibre-optic access is not available in the Netherlands on a scale that is comparable with Sweden or Italy, let alone Japan, South Korea and Hong Kong. Japan leads in high-speed broadband: 85% of households have access to downstream transmission speeds larger than 9 Mbps. According to the report, Sweden is the leading country with respect to *very* high-speed broadband: 19% of households have access to transmission speeds larger than 27 Mbps. High-speed broadband in Sweden and Italy is delivered over fibre-based networks. However, Quintel (2004) points out that the companies supplying the fibre infrastructure, Fastweb and B2 Bredband, have so far failed to make a profit, and derive the majority of their revenues from business customers. Korea relies on ADSL2+ and VDSL over copper local loops. Japan combines ADSL2++ and fibre-optic connections.

Telecompaper also makes some comparisons of monthly subscription flat rate fees. Up to transmission speeds of 4 Mbps, subscriptions fees are comparable to those in France, Italy and Sweden. For larger speeds, Dutch fees increase while fees in other countries remain unaltered.

Regarding high-speed broadband in the Netherlands, two final observations should be made:

- The broadband market changes very rapidly, and the high-speed broadband market even more so. With the introduction of ADSL2+ in the Netherlands last summer, the availability of high-speed broadband (as defined by Telecompaper) took off, while subscription fees for speeds up to 20 Mbps are not substantially higher. Other countries also record turbulent developments (Telecompaper 2005, pp. 10-11).
- Differentiating subscription growth rates between transmission speeds reveals that growth in the Netherlands mainly took place for downstream transmission speeds up to 1 Mbps. Subscription rates at larger speeds remained stable or even shrunk since the beginning of 2004 (Telecompaper, 2005, pp. 7).

2.2.2 Broadband service development

Generally speaking, the development and adoption of broadband services in the Netherlands has been slower than one would expect when looking at infrastructure penetration rates. For comparing service development, a potentially endless variety of indicators can be looked at. Below some major areas are highlighted, namely buying and selling via the Internet, entertainment services, and telecommuting.

[11] The countries studied are: the Netherlands, France, Italy, Sweden, Japan, Hong Kong, and Korea.

- *Buying and selling.* By 2003, 29% of all Dutch enterprises purchased via Internet (54% of large enterprises and 28% of small and medium enterprises). This puts the Netherlands in 9th position, below the EU-15 average of 34%. Selling via the Internet was relatively more common in the Netherlands: 19% of all enterprises (31% of large enterprises and 18% of SMEs) sold via the Internet, compared to the EU-15 average of 12% (Eurostat, 2005).
- *Entertainment services.* Telecompaper (2005, pp. 12-13) compares the development of broadband entertainment and communication services such as IP TV and IP Telephony. Within the benchmark group, the Netherlands is lagging in the development of IP TV and related services. However, Versatel recently started such services and KPN plans to introduce IP TV by the end of 2005.
- *Teleworking.* The Netherlands ranks first when it comes to home-based teleworking. According to Collaboration@Work (European Commission, 2003) about 9% of the Dutch employed population teleworks for at least one day per week, while more than 20% is engaged in 'supplementary teleworking'. Denmark comes second and the United States third. On average, a 2% of the EU-15 employed population is teleworking for one day or more, while 7% is teleworking supplementary.

2.2.3 International differences and market failures

The empirical comparison shows that there can be large differences between countries in terms of penetration and use of services. Do these differences suggest market failures in lagging countries? The answer is not straightforward. Diversity between countries can be due to a number of other reasons. First, differences in population density are important. In urban areas, it is cheaper to roll out new networks. Second, as can be seen from figure 2.3, there is a strong correlation between broadband penetration and income level in countries. Finally, different preferences and culture may be important factors in this regard as well.

To take up one example, the Korean case does seem to indicate that a head start in broadband deployment can be bought by government action. Korea is one of the examples where the government had a very active (financial) role in supporting broadband. Having said this, information on the costs and benefits of this head start remains a missing element in this story. No explicit justification of Korean broadband policy in terms of market failure was encountered in the literature. Therefore, the questions what the current situation would be without public funding, and whether Korea's leading position is efficient from a welfare economic point of view remain unanswered.

2.3 Current policy on broadband

2.3.1 Central government

This report analyses whether or not there are market failures on the markets for broadband, conditional under the current broadband policy. The central government accounts for its current broadband policy in three main reports:

- Breedbandnota (Ministry of Economic Affairs, 2004 a and b),
- A letter to the Parliament in reaction to an advice of the 'Impulscommissie' (TK 2004-2005, 266 43, nr 57),
- The government's point of view on the ICM-memorandum (Ministry of Economic Affairs, 2004a).

The main line in policy can be summarised as follows. Starting point of the broadband policy is that well operating markets guarantee maximal welfare, fair chances for all parties and optimal freedom of choice for consumers. Market parties hold primary responsibility for investments in further development of the new generation of broadband-type infrastructures and development of accompanying services.[12] The reports by the government mention explicitly that it is not a task of public authorities to opt for a specific broadband technology. This corresponds with recommendations by the OECD and the European Union. For instance the OECD stated that the private sector is attributed the primary role, while the government's role is said to lie in ensuring competition, encouraging investment, and looking after access to all communities: "Public financial assistance could complement private investment where appropriate, provided it does not pre-empt private sector initiative or inhibit competition."[13]

The Dutch government considers as its task to shape favourable preconditions for broadband development. Specifically, it mentions three main tasks. The first task is a new Telecommunication law, which adequately deals with problems of market power (see chapter 4). The second task is coordination (see chapter 5 and 6). As examples, the government notes mention coordination of digging, coordination of local authorities in order to avoid fragmentation, bundling of current expertise on broadband, and promoting a univocal broadband policy of the government and local authorities. The notes also refer to promoting the use of open standards, and considering coordination of bundling demand of targeted groups, such as education, health care, and safety and environment in order to create sufficient mass of demand.

The third task is that public authorities should consider investment in broadband (applications) in order to supply their services to the public better and cheaper, such as fast connections between public institutions (see chapter 6). Involvement of the government requires

[12] Note that the government defines broadband in the functional way, not in speed, compression or material of the wires.
[13] OECD, 2004c, pp. 4.

that the benefits to society exceed the costs and that these benefits cannot be achieved by the market itself (see ‘Kabinetsreactie op Advies Impulscie’).

The government takes the view that municipal and provincial authorities and housing corporations can play an important and useful role in the development of broadband, in partnership with market parties. Public authorities should be careful where it comes to financial participation in broadband initiatives. This involves risks of market distortion. The Dutch government therefore holds the opinion that in these situations participation of public parties should be well motivated and the consequences for the market should be considered. Therefore, the government considers it undesirable if public funds are used to compete with market parties without a thorough justification in terms of clear positive external effects.(see section 6.3 for further discussion).

2.3.2 Other policy issues

The role of government as policymaker is broader. It also includes other issues like copyrights, security (e.g., cybercrime, spam and privacy issues), reliability (e.g. network disruption), and health issues such as radiation of telecom equipment.

These issues are not directly the subject of this report, but they may be important external conditions for broadband. They might hamper to some extent the development of broadband. For instance, there is concern about the consequences of radiation of UMTS for health. Local authorities hesitate granting permission for new antennas. To secure transparency on this issue, the Dutch ministry of economic affairs provide information. Another example are the problems related to digital copyrights or, broader defined, intellectual property rights. This problem may frustrate the take-off of applications such as music downloading and video streaming. This issue goes definitely beyond the boundaries of national governments. The interested market parties, including EU-governments, are working this out on an international level to find a solution for the trade-off issue. On the one hand, intellectual property rights provide firms incentives to create content, since they are able to internalise adequate compensation. On the other hand, free access is optimal in terms of knowledge diffusion as it can be used worldwide. CPB (2002) concluded that the national government options could focus on to be cautious to intensify patent protection and alert competition policy to cope with market power.

2.3.3 Regulation

Besides technology, regulation also affects structural changes in the telecom industry. Similar to other countries, the Dutch telecom industry was deregulated and liberalised in 1997 with the enactment of the Telecommunication Act. The latter, among others, included the foundation of a ‘watchdog’, i.e. OPTA, to monitor this industry. OPTA defines markets, identifies parties on these markets with significant market power, and determines the obligations to be assigned to these parties pertaining to interconnection, network access and tariff regulation. In 2004, the

Telecommunication Act was further adapted. Henceforth, regulation policies are more based on economic principles and OPTA conducts market analysis to monitor market dominance.

3 Theoretical framework

Network industries are prone to market failures. As the broadband industry exhibits network characteristics, market failures may cause inefficient levels of broadband deployment. This chapter presents an overview of the potential market failures in broadband and discusses various policies that deal with these market failures.

3.1 Introduction

This chapter discusses the theoretical framework that underlies the analysis of this report. The framework is employed to explore potential market failures in the broadband industry and to define appropriate roles for public authorities in this industry. The question that we aim to answer in this chapter is: what factors could private parties encounter that lead to inefficient investments in the capacity of (local) broadband infrastructure and inefficient development and deployment of broadband communication and application services?[14]

As the broadband industry is part of telecommunications in general, we first pay attention to the latter. In section 3.2, we describe the structure of the telecommunications industry. Afterwards, in section 3.3, we introduce the theoretical notions of economics of network industries. Subsequently, we give an overview of sources of potential market failures in section 3.4, and analyse policy measures that could deal with these market failures in section 3.5. Section 3.6 concludes this chapter by summarising the main findings.

3.2 Structure of the telecommunication industry

The telecommunication industry provides facilities and services that enable users to communicate and transfer information over long distances.[15] Although telecommunication over long distances can take many forms, ranging from smoke signals to data transmission by satellites, every completed form of telecommunication involves the production of information, its transmission and the reception of it. In modern telecommunications, information is usually transmitted in digital form, loosely speaking a stream of zero's and ones. This requires that before and after transmission, the information must be transformed from its original form (written text, sound, and video) to digital data and vice versa. Figure 3.1 structures several activities of the telecommunication industry.

The start and the end of the chain of activities consist of customers and firms using the telecommunication infrastructure for communication or transfer of information called content. In telecommunication, every user can be source as well as destination of flows on the

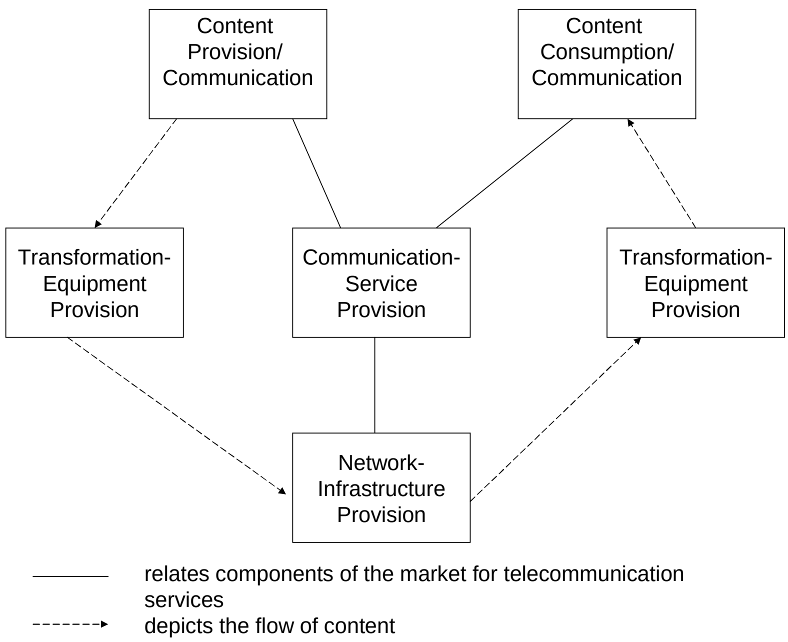
[14] This chaper is a theoretical discussion of issues related to potential market failures. In that respect, it does not explicitly discuss issues that are related to the Netherlands in particular. These are highlighted in chapters 4 and 5.

[15] Because of these two categories of use, i.e., communication and transfer of information, the sector is also called communication and information industry.

infrastructure. This aspect distinguishes traditional telecommunication from traditional broadcasting. In the past, every service of the industry used a specific infrastructure, e.g. phone was handled by copper lines and television by frequencies or cable. Recently, digitalisation enables several types of infrastructure to facilitate different type of services. As a consequence, markets for media and telecommunications, such as radio, television, phone and Internet, horizontally integrate.

In order to transport content from producers to customers, it has to be transformed. Audio or video has to be transformed into movement of electrons, digital data or radiofrequencies, and *vice versa*. The provision of transformation equipment is, therefore, a crucial activity in the chain of telecommunication activities. Examples of this equipment are telephones, modems, routers, television sets and radio pylons.

Figure 3.1 Structure of the telecommunications industry



The provision of the network infrastructure is another essential activity in telecommunication. This activity consists of investing and maintaining the hardware for the transport of digital data, as well as management of data traffic on this infrastructure that enhances efficient infrastructure use. Various types of infrastructure can be applied for the transmission: some of these are so-called fixed while others are wireless. Fixed usually refers to communication by cables or copper lines. We discern backbone networks for long distances, and local loops, which connect the final customers to the backbones. In contrast, wireless technologies transmit data ‘through the air’. Contemporary mobile telecommunication networks apply both technologies: a backbone of cables that connects several antenna's which, in turn, provide the communication services to the end-users.[16]

The final activity is the provision of communication services. This activity includes two basic functions: firstly, connecting persons wanting to communicate or producers and consumers of content, and secondly, organising the stream of data between these users. In the market for Internet, for instance, providers first arrange the connection of customers to the worldwide web and, afterwards, they take care of the data flows to and from customers.

Although all these activities are relevant for telecommunication, only the provisions of network infrastructure and communication services actually constitute the market for telecommunications. Statistical offices and regulatory authorities hence do not include the markets for transformation equipment and content provision in the definition of telecommunication.

Broadband in the telecommunication industry

The provision of broadband services affects all components mentioned in figure 3.1. First of all, broadband services require high-capacity infrastructure, i.e., networks with high data-transmission capacity. This can be achieved by upgrading the capacity of existing copper and coax networks, or by investing in alternative techniques, such as glass fibre. In case of wireless technologies, infrastructure providers can similarly aim at increasing the capacity of their allocated spectra, or opt for new spectra. This latter option usually implies that new licenses need to be obtained, as the use of most frequencies is not free.

Content provision for which broadband is specifically apt generally consists of the supply of technologically advanced content and applications. Given the current technological standards, examples of broadband content are high quality, multi-channel audio and full-colour, high-resolution video. A distinction can be made between client-server content provision, where users download broadband content from a central (commercial) server, and content distributed through peer-to-peer networks, where users exchange content among themselves.

Transformation equipment is also essential in broadband service provision. In order to benefit from high quality audio and video communication, transformation-equipment needs to be able to process the large information streams into high quality pictures and sound. This applies to both the user-interface (e.g., TV, computer screen), as to decoders and modems.

Communication service providers, finally, provide broadband access and manage the large stream of data related to high quality content and communication.

No market failures in content provision and equipment manufacturing

The structural characteristics of the market for transformation equipment and the market for content provision are very different from the characteristics of the market for broadband

[16] Note that the distinction between network and end-user equipment can be discretionary.

infrastructure and service provision. As we will explain below, the latter are typical network industries, which are prone to various market failures. This is not the case for content provision and the manufacturing of transformation equipment. These are often global markets, with low entry barriers, and in which many players are active that continuously introduce innovative content, applications and equipment.

In virtually all countries, content provision and the manufacturing of transformation equipment are not subject to sector-specific regulation. Apparently, standard competition policy is regarded to be sufficient to guarantee sustainable competition in these markets. This is not the case for the markets for telecommunications infrastructure and service provision. Many countries have installed regulatory bodies that deal with legislation specifically aimed at potential market failures in telecommunication.

For instance, in the regulatory framework for electronic communication networks and services of the European Union, the Commission has identified 18 products and service markets “in which ex ante regulation may be warranted.” The provision of content and the manufacturing of transformation equipment are not part of these.

For these reasons, we will not separately analyse the market for transformation equipment and content provision. We only give attention to these markets if it is necessary for our analysis of the market for broadband communication services.

3.3 Telecommunications industry as a network industry

3.3.1 Characteristics of network industries

The telecommunications industry is traditionally viewed as a network industry, like energy and railways. Network industries have three fundamental, mutually related characteristics that make them different from other sectors (CPB, 2004). These characteristics are:

- The presence of network infrastructures;
- Which form essential links in the related chain of activities, and
- Which coincide with substantial economies of scale.

Below, we concisely elaborate on each of these characteristics.

Presence of network infrastructure

Telecommunication infrastructure sometimes gives rise to network externalities. From the perspective of consumers, network externalities arise if “one person’s utility for a good depends on the *number* of other people who consume this good” (Varian, 2003). This holds in particular for the communications industry, where each newly connected consumer raises the value of the system to consumers already present. Due to the positive effect on total value, this network externality is viewed to be positive.

Another typical characteristic of a network infrastructure are increasing returns to scale and scope in network size: “a greater number of complementary products can be supplied - and at a lower price - when the network grows” (Tirole, 1988). This also applies to the development of the network: the more developed a network is the cheaper extending the network generally is. In a well-developed telecommunication system for instance, extending the system to more locations within the same area incurs relatively low costs due to the small distances that have to be covered.

Essential facility

The network infrastructure forms an essential facility in the industry meaning that the infrastructure is a necessary input for activities of sectors using the infrastructure and that the infrastructure cannot (economically or technically) be duplicated by competitors (Worldbank, 2000). Suppliers of telecommunication services need an infrastructure such as local loops, support structures as poles and conduits, telephone numbers or frequency spectrum.

The essential character of a facility depends, however, on the perspective from which a sector is viewed. In the telecommunication industry, technological developments have brought forward several alternative techniques for telecommunication, making one specific technique less essential. Due to the digitalisation of information, existing cable and (mobile) telephone networks are more and more able to perform the same functions. This implies that none of the existing networks can be deemed essential, at least in the short run, although some parts of existing networks are still essential, such as the local loop of copper lines in many countries. It depends on both the sustainability of the current market structure (can several networks continue to coexist) as well as the future demand for telecommunication services (will the current networks become technologically obsolete) whether or not a telecommunication network will become an essential facility again.

Strongly related to the essential-facility character of networks is the high level of interdependence between users of infrastructure, i.e., in the case of telecommunications, the producers and consumers of content and the service providers. Consequently, use of the infrastructure requires much coordination in order to prevent accidents on the tracks, black outs in the supply of power or disturbances in telecommunication services. Moreover, the closely links between infrastructure activities and operational activities could cause economies of scope, i.e. integrating these activities in one firm could be more efficient than conducting these activities in separate firms.

Economies of scale

Network industries coincide with significant economies of scale due to the high level of fixed costs and (very) low marginal costs. If investments in a network infrastructure have been made, these costs are mainly sunk, i.e., these costs cannot be recovered. The huge fixed costs and the scale effects related to it make it uneconomical to double networks in most countries. As a consequence, networks are often natural monopolies.

Whether or not a communication network is a natural monopoly depends on the level of fixed costs relative to demand. Interestingly, both fixed costs and demand have been subject to substantial change over the last ten to fifteen years in such a way that a monopoly has become less ‘natural’. Consider, for instance, the market for fixed telephony. This market used to be a clear example of a natural monopoly. The fixed costs of setting up a telephone network were so high that only one network could be economically exploited. However, the introduction of the GSM standard gave rise to an alternative technology, i.e. mobile telephony, with much lower fixed costs. There are still economies of scale, but generally the market for telephony is no longer regarded as a natural monopoly nowadays.[17]

Lower fixed costs thus decrease the tendency to natural monopolies. But the same applies to a higher demand. As mentioned, due to digitalisation of content the existing cable and telephone networks can nowadays perform similar communication services. This implies that the economic value of these networks has increased. Hence, the ratio of fixed cost relative to demand for a given network has considerably improved. It is unclear how many competing networks could co-exist. The fact that we now have two competing networks to most Dutch households is, to some extent, coincidental and does not automatically imply that this number is sustainable. Nevertheless, given the increased demand for telecommunication, it has become less ‘natural’ to have only one supplier of a fixed telecommunication network.

Conclusion on telecommunications industry

Contrary to other network industries, the telecommunications industry is characterised by several, competing networks, such as cable, copper, and wireless. Ongoing technological developments enhance this competition. Each of these networks shows network externalities and economies of scale. As a result of the existence of competing transportation technologies, none of the current network constitutes an essential facility. In this respect, the telecommunications industry is not a typical network industry anymore. In the future, however, if a superior transportation technology solely would survive the essential-facility component returns.

3.4 Sources of market failures

Due to the characteristics of network industries, the market for telecommunication may fail to produce to most efficient outcomes. The most important market failure is the existence of market power. Other potential market failures are the existence of externalities, the hold-up of investments and asymmetric information.

[17] It is open for discussion whether mobile and vast telephony are full substitutes.

3.4.1 Market power

The presence of network externalities and economies of scale in the provision of essential facilities gives advantages to the (incumbent) firms. These advantages, which were enhanced by legal arrangements giving incumbent firms dominant positions in the industry, include the following (Worldbank, 2000):

- Control of essential facilities
- Economies of established national networks which cannot be matched by new entrants for many years
- Vertical economies, i.e. economies of vertically integrated production facilities, such as local access networks, national long-distance networks, and international networks
- Control over network standards and development
- Cross-subsidies, e.g. of local access services by international services as occurred in many countries
- Switching costs resulting in customer inertia, including both specific expenses, such as purchases of new telephones, modems or decoders, and inconveniences caused by, for instance, dialling extra digits and dealing with two telephone bills

The dominant position following from these advantages gives the unregulated incumbent several options for strategic behaviour in order to raise its own profits. According to the Telecommunications Regulation Handbook (Worldbank, 2000), a dominant telecommunications operator can increase its profits by:

- Refusing or delaying essential facilities to competitors
- Providing services or facilities to competitors on discriminatory terms or at excessive prices leading to allocative inefficiencies as these prices exceed marginal costs and, hence reduce the level of consumption
- Predatory pricing or cross-subsidisation of competitive services with revenues from network services
- Bundling of services on competitive markets with services related to essential facilities
- Increasing switching costs by actions to “lock-in” customers

Lack of transparency

If consumers do not have adequate information about characteristics of supply they will likely not take the optimal consumption decisions. A lack of transparency may be induced by a large variety in product characteristics, such as in mobile communication, making consumers uncertain about which offer meets their wishes most adequately and which product will become the dominant one (see above on network externalities). Insufficient transparency is, therefore, a source of switching costs, as it creates a hurdle for switching to another supplier. Related to this is the existence of first-mover advantages for incumbent firms, as consumers are more familiar with these firms than with new firms entering the market. All of these issues enhance market power.

3.4.2 Externalities

Activities in the telecommunications industry can give rise to several types of externalities. Generally, these externalities consist of production externalities, consumption externalities and network externalities.

Production externalities

Production externalities arise if activities of producers generate benefits or costs that cannot be taken into account by the producer. In the debate on broadband, several authors claim that the broadband industry has many benefits which the industry cannot internalise. Ferguson (2002), for instance, mentions impacts of broadband on productivity, redistribution of income, wealth and power, national security, and environment. However, as soon as benefits accrue to a broadband user, they can be incorporated in the price of broadband. These benefits should then no longer be regarded as externalities. Government intervention to encourage the development of broadband is only justified if externalities cannot be internalised.

What rents, resulting from broadband, cannot be internalised? Firstly, we can think of telecom firms that develop new techniques and applications for broadband communication. This knowledge may spillover and telecom firms might not be able to appropriate all rents. Secondly, there may be a positive externality resulting from a higher degree of other knowledge spillovers from other industries or universities (see box). Given that knowledge is to some extent non-rival and non-excludable, the creation of knowledge involves some positive externalities. A more advanced communication infrastructure might stimulate the efficacy of this spillover process and lead to a higher rate of innovations. To some extent, the users to which the knowledge spills over will be willing to pay for this. A private (knowledge creating) firm will, hence, be able to incorporate this part into his price. It remains an empirical question, however, what part of the extra economic rents resulting from a higher degree of knowledge spillovers cannot be appropriated by private firms.[18]

The use of broadband by firms other than those in telecommunication could well lead to higher productivity in these firms. A number of studies[19] have argued that in particular small and medium-sized enterprises could gain substantially from a more advanced communication network, e.g. by increasing their e-commerce activities. The economic rents from this are, however, highly appropriable. Efficiency gains by commercial firms using broadband are not

[18] Another question concerns the policy implications. A higher degree of knowledge spillovers increases social demand for knowledge creation and hence widens the gap between the social and private optimal level of knowledge creation. This would strengthen the case for subsidising knowledge creating activities. We will come back to this issue in chapter 5.

[19] For an overview, see Ministry of Economic Affairs, 2004a.

external to the transactions between them and the suppliers of broadband, but are fully accounted for in the demand for broadband.

Knowledge spillovers

Knowledge spillovers suggest that the social rate of return exceeds the private rate of return. Knowledge spillovers include blue prints like patent information, scientific literature and imitation of products. Broadband enables firms and consumers to gather information more easily from all over the world. But how does it create production externalities or spillover effects? Mainly, it goes through two channels. First, some (codified) knowledge for firms with access to the Internet is open to all (non-excludable) and downloading does not deplete the knowledge (non-rivalrous). So, this knowledge is free of charge. Consequently, this type of knowledge spills over from creating or founding firms to other firms (i.e. either competitors or firms in other industries). The latter can use this knowledge to create new products or processes.[a] Another channel for knowledge spillovers is that competitors can imitate products of others from the moment these products are launched on the markets. Creating or innovative firms, however, cannot always fully internalise these economic benefits from both channels. Hence, creating firms can become reluctant to invest in creating knowledge (e.g. via R&D) themselves as long as they cannot fully internalise the benefits. From a welfare perspective, this is not optimal. So, a dilemma arises between knowledge creation and knowledge diffusion (see CPB, 2002).

[a] Note that this process can go on and on, and hence, knowledge accumulates and may spread over the whole world.

Activities of the broadband industry can also result in negative production externalities. An obvious example of this externality consists of the impact of *digging activities* on other economic actors. Constructing a particular network infrastructure affects options of other infrastructures, both in telecommunications and in other network sectors, such electricity and natural gas. As each network firm benefits from coordinating these activities, market parties are able to deal with this part of the externality. As construction activities usually hinder more actors, such as citizens, because of road obstructions, government involvement can be an efficient measure to deal with this externality.

Consumption externalities

Consumption externalities arise if activities of consumers generate costs or benefits for other consumers, which are not taken into account by the consumption decisions. A negative consumption externality arises if, for instance, a high consumption level of one user negatively affects the speed or quality of the telecommunication services available to the others. But, if the other users are sharing the same network providers, this externality is internalised by the network provider.

A positive consumption externality that might be generated by the use of broadband is less road congestion. If workers can have a good connection from their home to their office facilities, or if teleconferencing becomes a good substitute for physical meetings, people will need to travel less for their businesses.[20] Road users and, from an environmental point of view,

[20] See also TNO, 2005.

society at large will benefit from this but will not pay the network firm for it. The same applies to a possibly higher labour participation rate due to teleworking.

Network externalities

Network externalities arise when the utility of a consumer of using a network depends on the number of other consumers that make use of the network. The existence of network externalities does not automatically result in a market failure. A market failure could emerge if market parties are not able to internalise these effects. In the telecommunications industry, network firms take into account the impact of an extension of the infrastructure on total (consumer) value, provided that this firm is subject to proper regulation.[21] Due to network externalities, consumers that are already connected to the network are willing to pay for an extension of the network. As a result, networks firms can internalise network externalities.

Network externalities result in market power if they give (incumbent) large suppliers a competitive advantage above new entrants or firms having significantly smaller networks. This potential advantage results from the *path dependence* of choices: given the existence of network externalities, it is most efficient for consumers to choose the dominant technique or the dominant network. Interconnecting networks, however, would solve this issue. A potential customer would then be indifferent between unequally sized networks, because he will be able to communicate with subscribers from other networks anyway.

What incentives do market parties (i.e. internet providers) have to interconnect their networks with respect to broadband? By interconnecting, network suppliers'clients can reach more people, and more people can reach them. This increases the willingness to pay for the existing clients, which results in higher revenues. Also here, externalities from interconnecting networks can thus be fully internalised. This even extends to the positive externality imposed by a new client from one network (say, A) on the clients of an interconnected network B. Network A can internalise the increased benefits for its existing clients by their higher willingness to pay, and it can internalise the increased benefits for the clients of B through asking higher interconnection fees[22] from network B.

Hence, theoretically network externalities related to the interconnection of different networks can be internalised by market parties. But under certain conditions this reasoning may not hold. If one network is much larger than the other one, the larger network may choose not to interconnect to the smaller network. In stead, it may try to attract clients from the smaller network to switch to his network. The more successful it is, the larger it grows, and the easier it gets to also attract the remaining customers. Such a process is likely to end up in a monopoly, which is good with respect to network externalities (they will be fully internalised), but bad with respect to market power. If such a situation is likely to unfold, regulators can decide to

[21] I.e. if the network firm has incentives to internalise spillovers.

[22] In practice, transaction costs may impede this. We will come back to this issue in chapter 5.

enforce interconnectivity. But if the market consists of sufficiently many and more or less equally sized players, these players will have sufficient incentives to interconnect. Enforcing interconnection is then redundant.

Two other potential inefficiencies resulting from network externalities are *excess inertia*, i.e. users waiting to adopt a new, superior technology, and *excess momentum*, i.e. consumers rush to an inferior technology (Tirole, 1988). The background of both phenomena is that consumers' utility of consuming a good depends on the level of consumption by other consumers. Consumers who are uncertain about the consumption choices of other consumers wait in order to obtain more information on which type of good will be consumed most. This could lead to excess inertia, meaning that the level of total consumption is below the optimal level leading to insufficient use of economies of scale.[23] In broadband, excess inertia can be a problem if, for instance, an inferior old transmission technology remains the dominant technology simply because it is the standard technology that everyone uses. Despite the presence of a more advanced technology, nobody switches to it due to its incompatibility with the old technology.

The opposite of this inefficiency is excess momentum,[24] where the total level of consumption of a certain type of good exceeds the optimal level. This effect is also called domino effect or snowball effect, making clear that consumers decide to purchase a good solely because others have done it before. Given the presence of switching costs, excess momentum is rather unlikely in communication technologies.

In the case of a new broadband transmission technology, such as a wireless local loop or fibre to the home (FTTH), excess inertia is not necessarily an issue for the following three reasons. First of all, a faster access technology will not be fully incompatible with a less advanced technology. The users of the old technology, say ISDN, will still be able to communicate with the users of the new infrastructure, e.g. the glass fibre infrastructure. Only for those applications that require two-way broadband communication, such as high-quality video telephony, incompatibility can be a serious issue.

Secondly, network externalities do not play a role in all economic activities that take place through the infrastructure. For instance, the individual willingness to pay for a connection that would allow a consumer to quickly download large data files from a commercial supplier, such as movies, does not depend on the number of other consumers that have a high-speed connection. There is, therefore, also an 'autonomous' demand for high-speed connections.

Finally, market parties have means to deal with this market failure as well, as a large part of the network externalities can be internalised by the network firm. For instance, a network

[23] Cabral (2000) mentions the switch from AM to FM broadcasting in the late forties as an example. "Most people saw FM as a superior technology. However, fear of getting stranded with a useless (and expensive) FM receiver kept consumers from making the switch, which in turn kept broadcasters from making the switch, which in turn kept manufacturers from making the switch.

[24] Given the presence of switching costs, excess momentum is rather unlikely in communication technologies.

provider could subsidise new customers up to the point that its total number of subscribers exceeds the so-called critical mass. From that point, the number of existing users is large enough for other consumers to join the new technology as well. Another option for market parties to deal with this externality is jointly developing standards, making consumers less uncertain about the future dominant technique.

In conclusion: in theory, excess inertia may lead society to be stuck with an old and inferior technology. However, in the market for broadband (one-way) compatibility, ‘intrinsic’ demand and firms’ strategies to internalise adoption externalities mitigate this problem. It is an empirical question to what extent the magnitudes of these factors are sufficient to overcome excess inertia in broadband telecommunication.

3.4.3 Hold-up of investments

The strong, mutual dependence of infrastructure provision, service provision and consumption of telecommunication services, can give rise to a hold-up problem. Ex ante, i.e. before any investment in networks has been made, both providers of services and consumers fully depend on the network-firm’s decision whether or not to invest in the essential facility. Ex post, i.e. when the investment in the network infrastructure, i.e. the so-called passive infrastructure, has been made, the network firm fully depends on firms investing in the so-called active infrastructure, such as routers, and users using the services, because of the sunk-cost character of the relative large investments in specific assets.[25] In the telecommunication industry, this may imply that potential infrastructure providers refrain from investing in networks because of their expected weak position vis-à-vis telecommunication service providers after investments have been made. The existence of this potential hold-up problem has been an incentive for vertical integration of infrastructure and service provision into one firm. After all, the hold-up problem does then not exist at all as all effects can be internalised. If the industry is, however, not vertically integrated, regulation determines investment conditions, including the treatment of the hold-up issue (see next chapter).

Besides its effect on market power, a lack of transparency can also result in an inefficient supply of capital to the industry. If investors and banks have incomplete information on future demand for products produced by the industry or on future abilities of the firm to operate efficiently, they could be hesitant to supply capital to the industry. Hence, the lack of sufficient information can also hold up investments.

[25] The importance of the hold-up problem in these industries follows from the sunk character of investments in infrastructure. Otherwise, the investor would not fully depend on the users of the infrastructure, as he could also recover his costs by selling the infrastructure to somebody else. This is why the hold-up problem does not emerge in other economic transactions, such as the sale of goods in a shop.

Chicken and egg in broadband

In the public debate on broadband, reference is often being made to a 'chicken and egg'-problem with respect to infrastructure and applications. Infrastructure providers would not roll out broadband networks because of a lack of true broadband content and applications, whereas new broadband content and applications are not developed because of a lack of broadband infrastructure. Whether or not these mechanisms occur, does it refer to a market failure?

Broadband infrastructure and broadband applications can be seen as complementary goods. Without the one, the other would be worthless. Therefore, if one is not produced, no one will buy the other. For private firms, the easiest solution to this problem is to supply both the infrastructure and the applications together. If, however, regulation would not allow such vertical integration, the market can end up in a situation described by a so-called coordination game. In such a game, both players, i.e. the infrastructure provider and the application provider, can choose between investing or not, but cannot credibly commit to this. Two equilibria exist: one in which both invest and one in which both do not invest. Even if both players would actually prefer the first equilibrium, still the second equilibrium may be the final outcome of this game (see, among others, Fudenberg and Tirole, 1991). Hence, a market failure could arise.

The occurrence of the undesirable equilibrium strongly depends on the assumptions regarding the rules of the game. The most important one is the simultaneity of players' actions. If, e.g., the infrastructure provider knows for certain that the application provider will invest if he invest, the possibility to move first would already solve the problem in this game. Since reality does not preclude any player to move first, the undesirable outcome is highly unlikely to emerge. The only reasons why both players still would not invest is either too much uncertainty regarding the payoffs (which is not a market failure), or the hold-up problem mentioned before.

Sometimes this latter phenomenon, i.e. the hold-up problem, is called a chicken-egg problem as well. It is, however, not comparable with a situation in which one player waits for the other to move (and vice versa). As mentioned before, the hold-up problem is caused by the large sunk costs of rolling out a network and the ex ante uncertainty about ex post returns. These could lead to such an unfavourable bargaining position of the network provider vis-à-vis downstream service providers that investments in infrastructure are not undertaken at all. In this perspective, the analogy with the chicken and egg story is not straightforward.

3.4.4 Asymmetric information

Asymmetric information might negatively affect the introduction of new services in telecommunications. Services are typical experience goods, and the utility derived from a new service is highly uncertain. This, in turn, may reduce the incentives to innovate and lead to suboptimal levels of dynamic efficiency. However, for most telecommunication services, rather simple market solutions for the problem of asymmetric information exist, such as free trials for a limited period.

3.5 Regulation and competition policy

3.5.1 Introduction

In order to solve the above (potential) market failures in the market for telecommunication, governments have several policy options to intervene in the industry. In the past, state ownership was a common choice to influence, i.e. to determine, the behavior of network firms. This solution enabled public-owned firms, among others, to set prices at marginal-cost level as public authorities gave lump-sum subsidies to cover fixed costs. Although this option theoretically solves the issue of allocative efficiency, it generally scores less on the issue of productive and dynamic efficiency because of the lack of incentives for management to improve productivity and to increase innovation.

Because of the unsatisfactory performance of the public-owned monopolists in the telecommunication industry, governments started a process of liberalisation and privatisation in the European countries in the 1990s. Simultaneously, economic regulation and competition policy were introduced in order to establish competitive markets and solve competition problems. Economic regulation is directed at designing competitive markets, e.g. by proscribing conditions for network access, while competition policies focuses at preventing and curbing abuses of market power (Worldbank, 2000). Regulation and competition policies are strongly mutually related.[26]

Regulation

Regulation (in the broad sense) has to ensure that network operators do not abuse market power resulting from the natural monopoly of the network. Regulatory measures include both structural measures and behavioral measures. The former affects the legal and ownership structure as well as the vertical and horizontal organisation of the industry, while the latter focuses at changing the incentives of players in the industry. Behavioral measures include access regulation, notably negotiated or regulated third-party access, price regulation (e.g. caps on the prices the dominant firm may demand) and quality regulation.

Consistency in regulation is an important issue. A private firm that plans to invest in a new broadband telecommunication network will take into account that, in case its network becomes an essential facility, it will be subject to policy measures (notably access and price regulation). Too much uncertainty about future regulation will adversely affect welfare if it makes firms refrain from otherwise welfare enhancing investments. Under adaptive expectations, this implies that current regulation should not give rise to uncertainty.

Competition policy

Competition policy is directed at conditions, other than access tariffs, affecting entrance of new players to the local loop, and, more generally, competition within this industry. The need for this policy follows from the options the owner of the network has to hinder competitors, which can be summarised under the heading 3D: deny, delay and detail. An unregulated owner of the local loop could, for instance, impede access to the local loop by referring to shortage of space for co-location at the main distribution frames. Other examples of anti-competitive behavior are discriminatory use or withholding of information, strategic designs of products, bundling,

[26] The need for sector-specific regulation of the telecommunications industry is declining due to the growing competition within this industry. According to several authors, the industry eventually will only be subject to general competition policy (see e.g. De Ru, 2004). The question is, however, in which pace this development is emerging.

predatory pricing and tacit collusion.[27] In the remaining of this report we focus on regulation issues.

3.5.2 Regulation of access

Introduction of competition in a network industry, such as telecommunications, requires adequate regulation of access to network components which cannot easily be duplicated. In the case of a vertically-integrated firm, both parts of this firm, i.e. the network part and the service provision, usually are closely interwoven. As a result, a vertically-integrated firm has strong incentives to hinder downstream competitors (see above under the heading “market power”). Consequently, key issues in the regulation of networks are the accessibility to the network of upstream or downstream commercial firms, the tariffs network firms may demand for the use of the network and the investments by network owners in maintaining and extending the network.

3.5.3 Unbundling

In order to reduce the options for a firm to hinder competition and to increase the power of the regulator to effectively intervene in the market, unbundling is a regulatory measure generally applied in network industries. After all, proper third-party access to network can only be realised if network activities are conducted independently from competitive activities. However, separation can incur significant costs due to economies of scope between network management and service provision. The choice of the degree of unbundling, such as accounting unbundling, legal unbundling or ownership unbundling, is not the same across industries and may also depend on characteristics of the country. “As experience mounts with weaker forms of separation, a movement can be discerned, especially in certain sectors, towards stronger and more effective forms of separation.” (OECD, 2001)

In telecommunication, separation of the local loop from competitive services appears to be problematic. Separation undermines incentives for efficient investment in the local loop, as it is difficult to contractually arrange that the owner of local loop appropriates returns on his investment. Because of the alleged high economies of scope between network management and retail, local loop unbundling is usually carried out in a form of access regulation, such that the incumbent retains ownership and responsibility for maintenance of the lines which are then leased to the rival operator. The OECD (2003b) strongly doubts whether ownership unbundling in telecommunication would strengthen competition and, hence, reduce prices, while it views the costs of full separation significantly high, in particular due to increased problems with

[27] See ERG (2004) for a systematic overview of competition problems and remedies. The past has shown several examples of this kind of practices in the Netherlands resulting in actions by the regulator (see website of the regulator for an overview of disputes: www.opta.nl). In the more recent past, less of such events have happened suggesting that the regulator together with the competition authority (NMA) is improving its effectiveness in dealing with competition restricting behavior in the telecommunication industry.

coordination of investments between network firm and retail firms.[28] Given the growing competition among alternative techniques for telecommunication, i.e. copper lines, cable and wireless techniques, the networks in this industry cease to be bottlenecks, reducing the need for unbundling (De Bijl, 2004).

3.5.4 Access conditions

In determining the access condition, the regulator has to deal with the issue of hold-up, i.e. the risk the investor in network infrastructure faces regarding future access conditions. Therefore, network firms very much need contracts which give them certainty about future access conditions in order to deal with the risk of ex post opportunism of users of the infrastructure.

The determination of access tariffs belongs to the key issues of regulating network industries, as it is related to allocative efficiency as well as dynamic efficiency (Mason et al. 2001, Canoy et al. 2003).[29] Proper regulation of access fees for the infrastructure is needed to give the network firm adequate investment incentives without distorting the market for services. However, the relationship between access tariffs and (infrastructure) competition is not unambiguous because of the existence of two separate dynamics: the impact of access tariffs on entry and the mechanism described by the idea of a ladder of investments (Brunel University, 2001). The former dynamic requires low access prices in order to encourage entry and, hence, competition by entrants. However, if access prices are below average costs, the network firm does not have an incentive to invest in the (new) infrastructure (such as glass fiber).

The second dynamic states that access prices should rise in order to stimulate investments by entrants when they are climbing on the ladder of investments. Eventually, access tariffs will reach a level at which the (potential) entrant will be indifferent between paying the access tariffs for using the local loop of the incumbent and rolling-out its own infrastructure to the end-user. Consequently, the incentive for the incumbent to improve efficiency (and performance) of the local loop follows from the threat that entrants will roll-out alternative infrastructures.

If a network firm is integrated with a downstream firm, i.e. a service provider, regulation is needed to guarantee access of other downstream firms to the infrastructure in order to realise competition in the market for service provision. If other service providers have own networks, regulation has to force interconnection of the several networks because of the existence of network externalities (see above). Interconnection in telecommunication means that, for instance, “a phone call originated in a local loop is carried over the network of other carriers

[28] In a cost-benefit analysis of structural separation in telecommunication, OECD (2003b) concludes that structural separation in this industry is “risky with benefits that seem limited, uncertain, indeed, conjectural, with on the other hand, potentially significant costs including potentially adverse effects on network development. Certainly, there is insufficient evidence that benefits would be convincingly in excess of costs”.

[29] “Any access price affects operator’s (potential) profits, and hence also their incentives to enter the market, to invest in new technologies, to roll out networks, to maintain and upgrade existing networks and so on see ” (Canoy et al., 2003).

both nationally and internationally" (Shy, 2001). Without interconnection, only the largest firm would eventually remain (Aalbers, et al., 2002).

3.5.5 Trade-off between static and dynamic efficiency

Both competition policy and regulation affect the economic efficiency of the market for telecommunications. Economic efficiency can be viewed at from two perspectives: static and dynamic. Static efficiency is maximised under two conditions. First, the sum of consumer and producer surplus should be maximised. This condition is called allocative efficiency, and it is achieved when goods are priced according to their marginal costs.[30] The second condition, labelled productive efficiency, states that production should take place at the lowest possible costs (given all available technologies). If the second condition does not hold, so-called x-inefficiencies exist.

Dynamic efficiency refers to the present value of the future stream of static total welfare. The development of product innovations that increase consumer surplus, or process innovations that lead to smaller production costs, enhance dynamic efficiency. However, maximising dynamic efficiency is not the same as maximising static efficiency in every period, because under some circumstances dynamic efficiency requires conditions that adversely affect static efficiency. If innovation requires large investments, high post-innovation profits are needed to recover the costs of innovation.

Strategic behaviour by firms resulting from their market power generally reduces social welfare due to price distortions. Besides this adverse impact of market power on static efficiency, dynamic efficiency might also be affected by market power. Theoretically, this relationship is, however, not clear. Too little competition could reduce the incentives to innovate, because the 'reward' for an innovating monopolist is generally smaller than the reward for a competitive firm. Loosely speaking: the monopolist is already enjoying monopoly profits[31], whereas a competitive firm has the opportunity to escape from competition by innovating leading to monopoly profits. However, if the innovation is easily imitated, these monopoly profits will merely be temporary. Other firms will simply copy the innovation, making the innovator lose its competitive advantage. When the innovator knows this in advance, it will have much smaller incentives to invest in innovative activities. Therefore, the presence of too many competitors that can easily imitate an innovation reduces the incentives to innovate.

In conclusion, in theory market power may enhance dynamic efficiency, but it may also reduce it. Or, put differently: there could be a trade-off between static and dynamic efficiency, but they can also go hand in hand. Empirical research, however, appears to be less ambiguous. An

[30] Perfect price discrimination, where every consumer pays according to his maximum willingness to pay, also maximises the sum of consumer and producer surplus.

[31] Arrow (1962) has labeled this the replacement effect: the monopolist replaces himself at a slightly higher profit level.

overview by Canton (2002) suggests that in most industries competition is found to be conducive to dynamic efficiency. The synthesis of theory and empirics presented in this paper mentions a number of conditions in an industry that result in a trade-off between static and dynamic efficiency. These conditions are:

- High research and development expenditures: as these costs are largely sunk, post-innovation profits (i.e., low static efficiency) are needed to recover the costs.
- Low marginal costs: if marginal cost are low (relative to fixed costs), average costs are declining over a large range of output. Scale economies result, implying a large market share and high price-cost margins for a firm. These (statically inefficient) prospects are conducive to innovation, as earning back the cost of innovation is relatively easy.
- High technological and commercial uncertainty: again, high post-innovation profits are needed to overcome these uncertainties.
- Network effects: if these are present, being the first to innovate will be highly profitable. The propensity to innovate is therefore high, but after the innovation the winner will obtain a large and stable market share.
- Highly fluctuating market shares: this condition states that it is actually possible to take over the market due to a successful innovation.

Summarising, Canton (2002) states that static inefficiencies due to market power can coincide with dynamic efficiency if the industry is characterised by high costs of research and development, substantial economies of scale and high technological or commercial uncertainty. Put differently: if the sunk costs of innovating are high, excess profits are required in order to undertake the innovative activities. Excess profits, in turn, require market power, which can be found in markets where scale economies and network effects prevail.

How does this apply to the telecommunications industry? As telecommunications is not a typical knowledge-intensive industry (such as pharmaceutics), spending on research and development are not very high. Telecommunication is predominantly capital-intensive, and technological advances in capital are typically developed outside the telecom industry (by manufacturers of telecommunication and network equipment). Still, the costs of *introducing* an innovation, particularly if it concerns the roll out of a new network, are high and largely sunk.

Will a telecom firm be able to recoup the costs of innovation? This depends on the appropriability of profits associated with the innovation: can a firm that introduces some innovation or increase in infrastructure quality appropriate sufficient gain before its competitors are able to imitate and reduce the benefit to unprofitable levels (Bennett et al., 2001)? The costs associated with switching from one infrastructure provider to another are certainly helpful in this respect. These switching costs actually grant some monopoly power to the innovator. If switching costs are smaller than the benefit from switching from the existing infrastructure to the new infrastructure, but larger than the gain from switching from one new infrastructure to another, an innovator will be able to recover the cost related to the innovation or upgrade of its infrastructure.

This reasoning supports the evidence for a trade-off: switching costs, whilst bad for static efficiency, are conducive to investments in more advanced infrastructure that are characterised by high fixed costs.[32] Furthermore, marginal costs are low (i.e., scale economies are substantial), network effects are clearly present and, in particular commercial uncertainty appears to be high as well.[33] Only highly fluctuating market shares are not observed in telecommunications, partly due to switching costs, but also due to the relatively short period of market liberalisation. Nevertheless, scale economies, network effects and switching costs give telecom firms some degree of market power. If a telco is successful, it will, at least for some time, be rewarded by monopoly-like profits. Given the high costs of introducing innovations in infrastructure, these profits are highly conducive to undertake innovative activities in telecommunications. Static and dynamic efficiency hence do not seem to go hand in hand in the telecommunication industry.

Further evidence for the existence of the trade-off between static and dynamic efficiency may come from indicators that reflect the present level of static and dynamic efficiency of the telecom industry. Although static and dynamic efficiency are hard to measure, the following variables can be used for this. For static efficiency, one could e.g. look at demand side substitutability (to what extent is it possible for customers to substitute other services for those in question) and supply side substitutability (to what extent can suppliers switch, or increase, production to supply the relevant products or services), the number of suppliers and the level of switching costs. Dynamic efficiency can be approximated by the number of product and process innovations, a larger set of choices for consumers and improvements in quality and services. If one finds that telecom is statically inefficient but dynamically efficient, or vice versa, this would further support the evidence for a trade-off.

Naturally, the size and significance of the trade-off, as well as the present location on this trade-off, matters a lot for policy. We will come back to this issue in chapter 4, where we discuss the effects of Dutch regulation on the deployment of broadband.

[32] Hausman (1997) shows that neglecting the irreversibility of these investments has led the Federal Communication Commission (FCC) in the US to focus too much on static cost efficiency. As such, the FCC “...has failed to account for the demonstrated large gains in dynamic economic efficiency that arise from new investment.” Hausman (1997, pp. 36).

[33] Most telecom firms have fully depreciated the huge amounts they have paid for UMTS-licenses in only a few years. Apparently they have all greatly overestimated the value of these licenses.

3.5.6 Investment incentives

When assessing effects of regulation on incentives for investments in networks, it is important to distinguish between effects on incumbents' incentives to maintain and upgrade the existing network and effects on entrants' incentives to invest in new networks instead of using the incumbents network (Canoy et al., 2003). Both incentives depend on the current access price, as well as on the expected future access prices. The following example shows this by presenting a stylised setting of a telecom industry where a more advanced network potentially challenges the present, less advanced infrastructure. Given this setting, we evaluate whether the presence of the less advanced network could lead to underinvestment in the new infrastructure.

Does the presence of the current networks 'bias' broadband deployment?

Both the owner of an existing network (the incumbent), as well as a new firm, may invest in a new, more advanced infrastructure. Let us first consider a potential entrant that wants to roll out a new, more advanced network. We will assume that a number of consumers connected to the old network is willing to pay for (and switch to) the new network. Further, we assume that the old network was a natural monopoly.

The presence of an incumbent with a less advanced network may affect the entrant's decision to invest in a new infrastructure in the following way. If it will have rolled out a new network, a number of consumers will still be indifferent between the old and the new network. For this group of consumers, the entrant will be in direct competition with the incumbent. Many scenario's can arise now, but the bottom line is that for some time we will have two firms operating on a segment of the total market where having one supplier would be more efficient.[34] Whether this is good or bad for society as a whole depends on the relative size of the group of other consumers (the ones that are willing to pay for the new network). If the revenues derived from these consumers alone are already large enough to cover the investments, then social welfare will not be adversely affected. If this is not the case, then the answer depends on the size of the reduction in deadweight loss[35] due to the increased competition in the market for indifferent consumers. If the reduction in deadweight loss in the demand for the 'old' network plus the sum of consumer and producer surplus in the market for consumers that are willing to pay for the new network is higher than the total investment cost of the new network, society as a whole will benefit.

This latter assessment is obviously hard to make in practice. However, if we assume that the incumbent is subject to regulation, the reduction in the deadweight loss will be modest. This, in turn, would imply that the producer surplus in this market is low as well.[36] In fact, it may even be zero, depending on the level of the regulated price is. The entering firm will therefore not be

[34] In a sense, we would then have an unnatural duopoly where we should have a natural monopoly, given our assumption.

[35] The deadweight loss can be defined as the loss in welfare terms of consumer surplus and producer surplus in imperfect markets compared to a perfect market.

[36] More technically: the business-stealing effect, an externality imposed by the entrant on the incumbent, will be low in case the incumbent is subject to regulation. See Mankiw and Whinston (1986).

able to attract customers and make much profit in this market segment. Thus, in its decision to enter or not with a new network, it will virtually only consider the revenues it can take from the consumers that are willing to pay for the new network. Only if these are sufficient, the entrant will enter, in which case social welfare is not adversely affected.

Now let us consider the situation from the position of an incumbent firm. If the expected profit of a new network is higher than the profit derived from its existing network, this firm will invest in a new network. As the fixed costs associated with the existing network are sunk, these will not play a role in the decision making process for an incumbent firm.

In this situation, the incentives of the incumbent will be in line with maximising social welfare. The only disturbing factor here could be inadequate access fees. If the incumbent firm is subject to access regulation and, for some reason, receives access fees that generate excessive profits, then it may want to preserve the status quo. This depends on what the firm's expectations are regarding future access regulation. If it expects that this situation can continue to exist when it has rolled out a new network, then the incumbent may be rather indifferent. If, however, the firm expects that the favourable situation will not arise when it rolls out a new network, then the incumbent will want to preserve the current situation. In that case, the level of investments in new broadband infrastructure will be insufficient.

If, on the other hand, access fees are set too low, investments can be too low as well. Again, this depends on the incumbent's expectations. If it expects that access fees for the new infrastructure will be too low as well, it has no incentives to invest.[37]

In conclusion, the physical presence of less advanced networks generally does not lead to inefficient levels of investment in broadband infrastructure. Only inadequate access fees for the existing network could lead to wrong incentives, but this depends on the expectations of potential investors regarding future access fees.

3.5.7 Other policy measures

Besides the above main regulatory measures, governments have several options to improve the market for telecommunications. For example, if consumption externalities result in excess inertia or excess momentum, government could implement policies to resolve these inefficiencies, such as regulation of standards, making consumers less uncertain about the future dominant technique. Positive consumption externalities can be enhanced by subsidising consumers outside densely populated areas. Theoretically, the subsidy should be equal to the contribution of these regions to the total value of telecommunication. One option to deal with market power is reducing switching costs, for instance by means of making the market more transparent.

Besides potential market failures, which are discussed above, equity results can legitimise government intervention. In the debate on broadband, unequal access to broadband across

[37] Note that the same would apply to a potential entrant with similar expectations.

different groups of consumers is often mentioned as a reason for governments to intervene in the deployment of broadband.

3.5.8 Sources of government failure

Not only markets have potential failures, also government policies can show failures. Theoretically, a government policy improves welfare if the impact of a policy measure on market failure exceeds government failures. Government failures can result from information asymmetry or the principal-agent problem (see Aalbers, et al., 2002). In industries where technology is moving fast, governments face large difficulties permanently obtaining all the information needed for taking appropriate decisions. In industries such as railways and electricity, the pace of developments in technologies is significantly slower than in the telecommunications industry. In telecommunications, several innovations continually alter the industry, making this industry more vulnerable to inefficient government measures, such as supporting an inefficient technology or standard.

The principal-agent problem also constitutes a source of government failure. Public servants or public agency potentially have targets different from those defined by politicians. In addition, there is always the risk that lobbyists effectively change policy decisions in a direction deviating from the socially optimal decision.

3.6 Conclusions

From a theoretical point of view, inadequate regulation of network industries and different types of externalities are the most important factors that could lead to inefficient levels of broadband deployment. As regulation influences allocative efficiency as well as investments incentives, inappropriate regulation could adversely affect both static and dynamic efficiency of the broadband market.

Network externalities are a market failure that may lead to excess inertia, meaning that society can be stuck with old and inferior technologies. Benefits that are external to broadband suppliers and consumers constitute another market failure that could lead to inefficient levels of broadband production and consumption.

The significance of these market failures is, however, not so clear in practice. Furthermore, various market responses exist that can deal with these market failures.

Table 3.1 offers an overview of the regulatory and market failures, and the related market responses and policy options that deal with these failures. In the following chapters, we will try to assess whether current regulation sufficiently supports broadband deployment. Further, we investigate to what extent the listed market failures are actually present in the Dutch broadband market. For this latter purpose, table 3.1 also suggests a number of variables that may act as indicators of the listed market failures.

Table 3.1 Potential market failures, market responses and government policies

Market failure	Consequences	Indicators	Market responses	Government policies
Market power and inadequate regulation of the natural monopoly	Allocative inefficiencies (access fee is too high) or inadequate investment incentives (access fee is too low); Hold-up	Vertical organisation, interconnection conditions, method of access pricing, low transparency	n.a.	Improving regulation
Network externalities	Path dependence, inertia, too low level of diffusion of new technologies, inefficient use of existing networks	Incompatibility of networks	Development of standards	Coordinating and stimulating standardisation
		Requirement of other adopters		
		Existence and size of a critical mass	Attracting new customers by pricing below marginal costs	Acting as launching customers, Demand bundling
		Too low investments in networks		
Production externalities	Positive: Too low level of broadband deployment	Information spillovers	Internalisation of spillover rents, e.g. by additional contracts or creating markets	Subsidising production
	Negative: Too high level of broadband deployment			Coordinating digging activities
Consumption externalities	Too low willingness to pay	Relationship between teleworking and traffic (among others)	n.a.	Subsidising consumption
Asymmetric information	Low development of new services	Too few innovations	Free trials of new services	
Politically unwanted equity results	Unequal access to broadband	"Digital divide", access to networks in rural areas compared to other regions	n.a.	Guaranteeing provision in rural areas (Universal Service Obligation) Subsidising consumers in rural areas

4 Competition and broadband deployment

Given present regulation, market power does not impede broadband deployment in the Netherlands. The Dutch regulation of the telecommunication industry gives efficient incentives for technological development such as the deployment of broadband. Therefore, there is no need to change regulation.

4.1 Introduction

4.1.1 Aim of this chapter

This chapter investigates to what extent the present regulatory framework affects the incentives to invest in broadband in the Netherlands. As discussed in chapter 3, market power is often concomitant with network industries. Regulation generally aims to deal with this market power. However, less market power could negatively affect the incentives to invest, because a trade-off may exist between static and dynamic efficiency.

This chapter discusses how the Dutch regulator of the telecom industry (OPTA) has dealt with the possible trade-off between static and dynamic efficiency. In particular, this chapter analyses to what extent the regulation of the telecom industry has affected deployment of broadband in the past and explores the impact of current regulation on future deployment of broadband in the Netherlands.

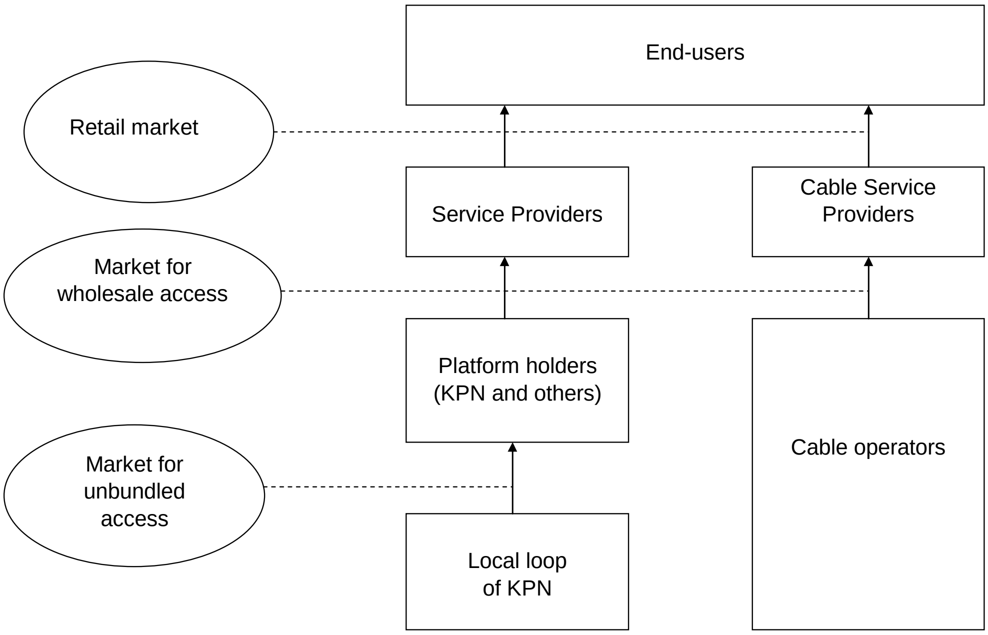
The impact of regulation on dynamic efficiency depends on both the strength and nature of the trade-off between static and dynamic efficiency, as well as on the (starting) position on this trade-off. Therefore, in order to discuss the effects of regulation, our analysis will include an evaluation of the current market situation in the Netherlands as well. But before doing so, we will first clearly define the relevant markets we are examining.

4.1.2 Three markets

Based on European directives, OPTA distinguishes three relevant markets for the provision of broadband through the infrastructure (see figure 4.1). As regulation is based on the notion of relevant markets, we will closely follow OPTA’s delineation of relevant markets throughout our analysis in this chapter. Hence, we will distinguish three different markets with respect to broadband.

The first relevant market is the *market for unbundled access*. More precisely, it refers to the market for unbundled access (including shared access) at the wholesale level to metal networks, i.e. the local loop, in order to provide broadband services (OPTA 2005d). The local loop is the infrastructure from the main distribution frames (MDFs) to the end-users. The supply side of this market consists of metal network owners (usually KPN), whereas so-called DSL-platform holders, such as BBned, Versatel and Tiscali, but also KPN, constitute the demand side.

Figure 4.1 Broadband markets in the Netherlands



Source: OPTA, 2004.

The platform holders are, in turn, suppliers in the second relevant market in broadband. On this market, *wholesale broadband access* is traded, i.e. backbone owners supply bitstream transmission along glass fibre networks to communication service providers. Wholesale broadband access is hence the product that a network owner delivers to a service provider. Besides the DSL-platform holders mentioned above, other (cable) companies such as UPC, Essent and Casema can offer wholesale broadband access as well.

The third relevant market is the *retail market for broadband access*. This market consists of retail markets products such as broadband access and data communication. For instance, internet service providers, such as Zonnet, Wanadoo or XS4ALL offer broadband access to the end-users. In order to get access to these networks, internet service providers pay a fee to the owners of the infrastructures. These service providers may be network owners themselves. For instance, KPN provides several types of communication services along its own networks. Moreover, each cable firm owns its own (regional) network and supplies its internet service along this network.

4.1.3 Dutch regulation of telecommunication in international perspective

Agreeing with recommendations by the European Union, OPTA assesses significant market power as the key concept of the degree of competition. A firm has significant market power if it is able to conduct independently of its competitors, direct customers and end-users.[38] In assessing significant market power, OPTA distinguishes two market dimensions. The first one

[38] OPTA, 2005a, pp. 6-7, and ‘Case nr. 27/76, United Brands against the Commission, Jusispr. 1978, pp. 207’.

is the homogeneity of products, such as networks and broadband services. If products are rather substitutable, they belong to one single market. Otherwise, they belong to different markets. The second dimension is the geographical area where firms compete with each other. In broadband, the market is most often national.

The OPTA takes a functional approach to competition. The regulator directly investigates a number of determinants of competition, including types of abuse of market power by firms.[39] [40] Recently, OPTA analysed the aforementioned three markets and reaffirmed that KPN has a dominant position in the market for unbundled access to the local copper infrastructure, as well as in the market for high quality wholesale broadband access. In these markets, demand substitutability, supply substitutability and the level of potential competition are considered too low to leave these markets unregulated. Therefore, OPTA obliges KPN to give access to its network to competing platform holders and retail providers against regulated prices.

Dutch policies on privatisation of the telecommunication industry and intervention by regulation of the local loop correspond with international trends in policies as well as economic studies. Intervention by regulation aiming at reducing sign market power is supposed to enhance sufficient broadband deployment.

Similar to the Dutch government, most other governments in the European Union started a process of privatisation in the 1990s. Before, state ownership was common and prices were set at marginal costs, whereas public authorities gave lump-sum subsidies to cover fixed costs. This option did solve the issue of allocative efficiency, so static efficiency was high. However, it discouraged dynamic efficiency due to the lack of incentives for management to improve productivity and to increase innovation. More specific, state ownership gives too little incentives for broadband deployment.

Ownership structure KPN

For about a decade, KPN has been quoted on the stock exchange. Under influence of the European Commission aiming for less government influence in the telecom industry, the State has reduced its share in this company. Currently, the Dutch State possesses about 15% of KPN. Besides this share in KPN, the State possesses a golden (symbolic) share giving it veto rights in strategic decisions regarding KPN, such as mergers and acquisitions. Whether a golden share de facto gives the State more influence in the firm is subject to debate. Moreover, according to the European Commission this special treatment of the State cannot be maintained.

[39] See e.g. OPTA, 2005a, 2005b and 2005c.

[40] In contrast to the functional approach, competition can be measured as either the concentration of the market shares of firms or the ratio of selling prices to marginal costs (see e.g. Creusen et al., 2005).

Simultaneously with privatisation, the Netherlands as well as most European countries, introduced regulation in order to curb abuse of market power (Worldbank, 2000). Regulation[41] is aimed to curb significant market power by access pricing and unbundling of the local loop. Actually, the EU made unbundling compulsory (EU, 2000, Regulation (EC, no. 2287/2000 of the European Parliament and the Council on unbundled Access to the Local loop). The curbing of significant market power is considered to give sufficient incentives to invest in broadband. Different countries show comparable movements viz. privatisation and intervention by regulation by means of unbundling and access pricing.

Sweden

The telecommunication industry is privatised, but the Swedish government still owns almost 50% of TeliaSonera. This is the result of the merger (in 2002) of the Swedish incumbent telecommunications operator (Telia) and the Finnish firm Sonera. In addition, local authorities have shares in telecommunication firms. For instance, the municipality of Stockholm owns the network firm Stokab which has invested in a (dark) fibre network in the Stockholm region, consisting of more than 30 towns.[42] Stokab is a wholesaler of bandwidth to over 70 service providers, including public authorities and telecommunication companies. The local loop has been unbundled since 2001 (Wu, 2004).

Canada

Most telecommunication firms are privately owned in Canada (OECD, 2002a). After privatisation, the number of firms increased rapidly making the market fairly competitive and stimulated investments in new technologies, such as broadband (OECD, 2002a). Canada restricts foreign ownership in the telecommunications industry (Wu, 2004) because of the political ambitions “to promote the ownership and control of Canadian carriers by Canadians” (article 7 of the Telecommunications Act of 1993, OECD, 2002a). The Canadian local loop is unbundled (Wu, 2004). The access fee is regulated. Initially, the fee was based on “incremental costs plus a 25% mark-up for the recovery of fixed and common costs” (OECD, 2002a). As the resulting level of the access fee appeared to hinder entrants, the access fee was significantly reduced.

South-Korea

The telecommunication firm, Korea Telecom, is privatised since 2002, after a gradual privatisation during the 1990s. In spite of the privatisation, the government still affects the

[41] Also competition policy was adjusted. However, regulation and competition policy are strongly mutually related. The need for sector-specific regulation of the telecommunications industry is declining due to the growing competition within this industry. According to several authors, the industry eventually will only be subject to general competition policy (see e.g. De Ru, 2004). The question is, however, in which pace this development is emerging.

[42] Source “Stokab, city-owned dark-fibre provider, http://www.point-topic.com/content/operatorSource/ profiles/ Sweden/ Stokab_brief_050719.htm, 19 July 2005.

deployment by Korea Telecom by means of licensing procedures, imposing standards and proscribing the choice of equipment and technologies. Moreover, law restricts foreign ownership of telecommunication firms to 49%.[43] Access to the local loop is unbundled since 2002 (Wu, 2004).

USA

In the United States, investments in fibre-to-the-home (Ftth) networks are not subject to unbundling if they are additional to existing (copper) local loops (OPTA, 2005c). If the Ftth-network replaces a local loop (i.e. a brownfield investment) the owner of that network has to give access to third parties only for enabling transmission of voice (i.e. 64 Kbps) while the remaining capacity of the fibre (above 64 Kbps) is not unbundled. Third-party-access obligations are not imposed when an Ftth-network is realised in a region without any existing local loop (i.e. a greenfield investment).

4.2 The market for unbundled access

4.2.1 Current structure

The market analysis by OPTA concludes that KPN has significant market power in the market for unbundled access. Currently, KPN is the only party that can offer unbundled access to individual local connections. For technical reasons, cable network providers cannot provide easily access to their connections equivalent to KPN.[44] The type of access that cable network providers are currently able to offer compares more to wholesale broadband access rather than to complete unbundled access (OPTA, 2005b). Thus, in practice, unbundled access is currently only possible through the copper networks of KPN. Regulation of access to the local loops owned by KPN is, therefore, required to achieve a competitive market for unbundled access.

Important components of the regulation of this market are the unbundling of the local loop and access regulation. As clarified before, unbundling is aimed at achieving competition on the market for service provision. In the Netherlands and in other countries of the European Union, the local loop has been unbundled for several years now after the European Union made it compulsory (EU, 2000). Unbundling of the local loop (ULL) means that other firms have access to the MDF and to local exchanges within the local loop (see box). ULL enables entrants to offer broadband access (in case of partial unbundling by line sharing) or broadband access as

[43] South-korea is no exception on the restrictions on foreign ownership. Many other Asian countries impose restrictions on foreign ownership. E.g. India, Indonesia, Philippines and Malaysia (Fink et al., 2001).

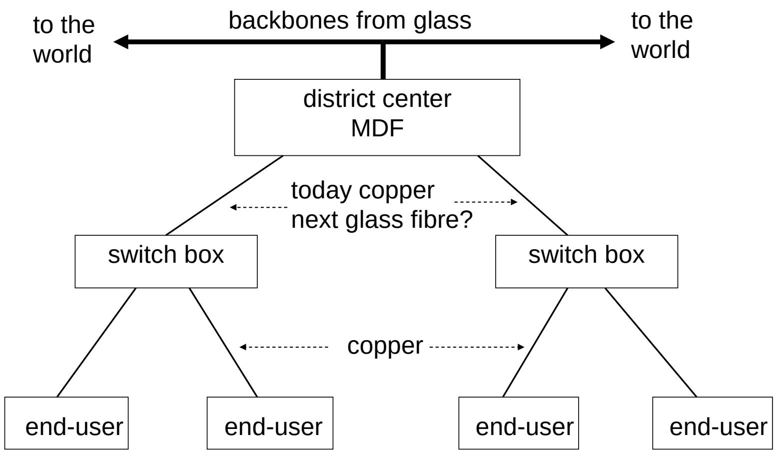
[44] The cable connections to each individual end-users are only spliced just before the connection to the houses, whereas the copper local loop is already spliced in the MDF. Technologically unbundling of the cable would involve high costs.

well as telephone services (in case of full unbundling) without rolling-out a complete infrastructure immediately.[45]

From backbone to end-user

The figure sketches the main characteristics of broadband access via the copper line. The backbones are part of international backbone networks as they are internationally connected. The MDF connects the backbone to the copper local loop. The unbundling of the copper local loop physically happens at the MDF-location. Here, the user of transmission capacity may install its own equipment. Between the MDF-location and the end-users are switch boxes, which split and combine the copper wires at lower distance from the end-users.

From backbone to end-users



The access tariffs (for using the ULL of KPN) are regulated. In the early stages of ULL, OPTA based these tariffs on historical costs including a return on capital. The regulator planned to start with relatively low tariff levels and to raise the levels after a number of years (see e.g. Van Eijk, 1999). The initially low levels should attract new players to the new market while raising the tariffs should give sufficient incentives to both the network owner to invest in its network and to competitors to develop alternative infrastructures.

Under influence of several legal disputes, the method of cost allocation gradually changed. Currently, access tariffs are based on actual costs (also called embedded direct costs). OPTA motivates the choice for this method by the mechanism described earlier, where the (potential) entrant faces a ‘make-or-buy’ decision, which, in turn, motivates the incumbent to improve efficiency (and performance) of the local loop.

Actually, access tariffs have declined since the start of access regulation. For instance, according to a memorandum of the regulator, KPN has proposed to reduce (one-off as well as periodic) 2004/2005 tariffs for access to the main distribution frames and for line sharing by 3 to 15% (OPTA, 2004b). As the access tariffs are cost based, this decrease is due to efficiency

[45] The first step on the ladder of investments is offering Carrier Select services by an entrant without investing in any network component.

improvements in the management of the local loop. It is not unlikely that, given the growing competition within the industry, the access tariffs will be less strongly regulated in the future, giving the owner of the local loop more freedom to determine tariffs (see e.g. de Ru, 2004).

4.2.2 Incentives to invest[46]

The key question now is whether the way the local loop is regulated affects the development of new technologies. Without regulation, this market is bound to be statically inefficient. With no substitutability on both the demand side and the supply side, allocative efficiency will be low due to high access prices and anti-competitive practices (such as delaying collocation and unbundling requests). Furthermore, x-inefficiencies may well exist. Although in theory a monopolist would gain from reducing x-inefficiencies, in practice the lack of competition usually reduces the incentives to maximise productive efficiency.

Without regulation, dynamic efficiency is expected to be high. As the market for unbundled access is a typical natural monopoly, an innovator will be able to fully reap the benefits of a successful innovation. A radical innovation in this market would be the replacement of the local loop by another local loop (increasing the capacity of the existing local loop is an innovation in an other market, namely the market for broadband access).[47] If the new local loop is indeed economically profitable – in the sense that the private revenues will outweigh the private costs – either an entrant or the incumbent will roll out the new network of local loops. Due to the high fixed and sunk costs associated with this, duplication by other suppliers will not arise. Therefore, the first supplier to roll out a new local loop infrastructure will be able to appropriate all rents. Other possible innovations in this market are generally far less radical. Here, one can think of organisational and operational improvements related to the physical unbundling process, network maintenance, as well as billing and account management. But the same principle applies: the (unregulated) innovator can fully reap the benefits of these innovations. Although an incumbent will have weaker incentives to do so, the threat of entry can be sufficient to make an incumbent innovative.

In short, without regulation, the market for unbundled access will be statically inefficient, but dynamically efficient. However, for a number of years the local (copper) loop has been subject to access regulation by OPTA. The key question now is whether the way the local loop is regulated affects the development of alternative infrastructures and other innovations. As mentioned, lower access tariffs, albeit good for static efficiency, generally reduces the appropriability of profits due to innovation.

Initially, OPTA pursued a scheme with rising access prices. At first, access prices were based on historical costs. Then, access prices would gradually rise to the level of actual costs.

[46] Here, we explicitly focus on incentives to invest related with regulation. In chapter 5, we elaborate on the amount of investments in network related to the issue of networkexternalities.

[47] However, if this new loop is not made of metal, but, e.g. fiber, the new infrastructure will not fall under the current definition of the market for unbundled access.

The initially low access prices encouraged firms to enter the market for wholesale broadband access by rolling out their own backbone networks and connecting these networks to local loops rented from KPN. However, these low access prices did not encourage the rolling-out of alternative local loops by other firms, because access tariffs were presumably below the actual average cost. The gradual rise of access prices up to the level of actual costs was meant to overcome this. If a potential entrant would expect that his costs will be lower than the actual costs of KPN, this would encourage him to roll out his own network of local loops. This, in turn, would discipline KPN to lower its actual costs to the lowest possible level.

This latter effect clearly emerged in the market for unbundled access. Access prices have in fact declined, indicating that actual costs have fallen below the level of historical cost.[48] The prevailing method of access pricing, based on actual (average) costs, seems nevertheless dynamically efficient, as it gives both the incumbents and entrants incentives to invest in the local loop. Entrants will only invest in an alternative infrastructure if that is more efficient than using the network of the incumbent. Otherwise, this 'make-or-buy' decision which (potential) entrants face stimulates the incumbent to improve efficiency and performance of its own local loop. Although post-innovation profits will be lower due to regulation, the innovator will at least be able to recover its costs. Consequently, the current regulation of the local loop does not bias the investment decisions of both the incumbent and (potential) entrants.[49] Formally, it does have a negative impact on static efficiency, because the access price is above the level of marginal costs. However, given the high level of fixed costs, marginal cost pricing would probably imply that the incumbent would not be able to recover its fixed costs. Therefore, a price based on average costs seems to be a good compromise between static and dynamic efficiency.

In the future, additional incentives for improving efficiency of the existing local loop may come from competition from other infrastructures, in particular cable but also wireless.[50] As such, regulation might be less needed to balance and/or stimulate static and dynamic efficiency as this changes the relevant market of unbundled access. However, under present market conditions, access tariffs based on actual costs increase static efficiency, but still give entrants as well as the incumbent sufficient incentives to improve the network of local loops.

A remaining question is whether the hold-up problem is adequately dealt with by the current regulation. Strictly speaking, there is no hold-up problem in this specific market, because the metal networks are already there. The hold-up problem can only be relevant for investments in new networks of local loops, which do not fall under the present definition of the market for unbundled access. As local loops other than the metal ones are currently not regulated,

[48] Note that this decline in average costs can be due to incremental innovations, but also to a reduction of x-inefficiencies and to increasing economies of scale.

[49] From this respect, the regulation of OPTA can be called technology neutral (see OPTA, 2005b).

[50] At present, however, these incentives are not very strong, because both cable and wireless are no feasible substitutes in the market for unbundled access (OPTA, 2005b).

investments in passive infrastructure can be held up by uncertainties regarding future market conditions. Naturally, vertical integration of infrastructure provision and the provision of communication services will automatically solve the hold-up problem.

However, one obstacle may remain. This is the uncertainty with regard to future access regulation. As mentioned in chapter 3, a new local loop infrastructure may be regarded as an essential facility after some time, and regulatory uncertainty may negatively affect the investment decision. Certainty about future regulatory conditions and access tariff structures can thus be very important for potential investors now.

4.2.3 Conclusion

Unbundling and access fees regulate the market of access to the copper local loop in order to deal with the significant market power of KPN. The present regulation gives sufficient incentives for broadband deployment. The markets for access to the local loops of cable, glass fibre and wireless connection are not regulated, because currently active firms do not have significant market power, and because of technical reasons.

4.3 The market for wholesale broadband access

4.3.1 Current structure

According to OPTA, the market for wholesale broadband access actually consists of two separate relevant market segments. The distinguishing feature between these two segments is the contention ratio (in Dutch: overboekingsfactor), i.e., the ratio of guaranteed to maximal bandwidth. The level of contention determines which services can be offered at the retail level.[51] In particular, data communication services, mainly used by large companies firms to connect their different offices by means of a closed network, require high levels of overbooking.

OPTA concludes that the relevant market for wholesale broadband access with a contention ratio of 1:20 or higher (high quality) is different from the market with contention rate lower than 1:20 (low quality). Demand substitution between these two markets is low, because retail services that require high contention rates (mainly data communication services) by definition cannot be properly supplied through networks with low contention rates. In practice, this means that cable networks cannot supply data communication networks, because of their low contention rates.

At present, there are several networks of backbones in the Netherlands. Providers are for example, KPN, Versatel, MCI, Telecom Italia (BBNed), Colt Telecom, Surfnet, Global

[51] In general, three retail markets can be distinguished: VoDSL (telephony over DSL), broadband access and datacommunication services.

Crossing, Priority Telecom and Worldscan.[52] Moreover, cable providers also supply transmission along their own backbones. Thanks to unbundled access, virtually all of these wholesale suppliers can offer low quality broadband access to their retailers. Competition in this market segment is hence substantial, mostly due to the large number of providers and the large overcapacity in the backbones.

Contrary to several other European countries, owners of backbones (i.e. the long-distance infrastructure) are not obliged to give access to their infrastructure (what is called bitstream access) in the wholesale market for low quality. Although the regulator initially intended to proscribe bitstream access in order to foster competition, several legal procedures between OPTA and a firm demanding bitstream access (Tiscali) against KPN resulted in the judicial decision that the then prevailing Telecommunication law did not provide a legal base for bitstream unbundling.[53] Consequently, potential competitors in the Netherlands needed to invest in own backbones in order to reach end-users. OPTA views the different treatment of local loop and bitstream as beneficial for the development of facility-based competition.[54]

Different conditions exist, however, in the wholesale market for high quality broadband access. Providing data communication services, the most important retail market for high quality broadband access, requires a local loop network with national coverage. As KPN is the only firm with such a network, and duplication of this network is not economically feasible, KPN has a dominant position in the market for high quality wholesale access. For this reason, KPN has to grant access to its network against reasonable conditions.

4.3.2 Incentives to invest

Without unbundled access to the local loop, each platform holder would need to have its own local loop network in order to offer broadband access. Given that a local loop network is a typical natural monopoly, static efficiency would be low in the wholesale market as well. Similarly, without unbundled access dynamic efficiency would be high, given the favourable appropriability conditions. However, unbundled access regulation exists nowadays. How does this affect static and dynamic efficiency in the market for wholesale internet access?

As mentioned, the unbundling of the local loop combined with the relatively low access tariffs and no unbundling of the higher parts (bitstream) of the network have contributed to investments in alternative backbone infrastructures (OPTA, 2005). ULL and low access tariffs provided potential competitors with a guaranteed option to use the existing local loop against relatively favourable conditions while the latter measure forced those firms to invest in own backbone networks. Consequently, infrastructure competition in higher parts of the network has emerged in the Netherlands. Currently, DSL Platform holders own approximately five different

[52] See www.surfnet.nl and http://www.brabantstad.com/locations-and-infrastructure/ict-infrastructure/Index.html.

[53] Steenbruggen, 2004.

[54] OPTA, 2005a.

backbone infrastructures. Competition has led to strong investments in the backbones, even to such an extent that there is large overcapacity at present.

Capacity utilisation networks

The high current investments to enhance network capacity are not needed to avoid urgent capacity bottlenecks (see for instance, table 4.1 for the capacity utilisation in the backbone networks of KPN). Other providers also have large overcapacity and have sometimes already invested in empty tubes, through which new wires can be drawn cheaply whenever necessary in future.

Table 4.1 Capacity utilisation KPN-networks

	2002	2004
	%	
Traditional backbone	57	67
Glass fibre backbone	45	65
City rings (glass fibre)	20	20

Source: KPN, 2005, Altijd dichtbij, Annual Report 2004, pp.30

The capacity utilisation of the local loops is difficult to measure. The reason is of a technical nature. The copper wires between the end-users and the switch boxes are one-to-one dedicated links. The intensity of the use of each customer determines the capacity utilisation. At present, customers face no problems to get access to the backbones for their interconnections.[55] Therefore, assessed in this way, no bottleneck in the local loop is present. In case of demand for more capacity, the providers can rapidly adjust by investing in (additional) equipment in the switch boxes and eventually to replace the copper wires from the district centres to the switch boxes by glass fibre.[56]

Likewise, data on the capacity utilisation of the cable network is not available. Yet, capacity does not seem to be a constraint in the near future due to the transition from analogue to digital television. Digital television requires less capacity in terms of bandwidth.

Hold-up problem

In theory, the hold-up problem may arise in the wholesale markets. However, since entry barriers are rather low in the downstream retail markets, we can expect that the ex post bargaining power of a single retail service provider will not be that large. It seems unlikely therefore, that asset-specific investments will be held up for this reason. Besides, in case access regulation is absent, vertical integration will solve the problem as well.

[55] We encountered no indications that the worldwide connection through the Amsterdam Internet Exchange might become a bottleneck in the near future.

[56] As essentially being planned by rolling out VDSL.

Low quality access

Over the last ten to fifteen years, several firms have invested rather heavily in new network capacity.[57] As the costs of these investments are, within reasonable boundaries, hardly influenced by the size of the cables, firms choose to roll out backbones with very large (spare) capacities.[58] As a large amount of capacity is not yet utilised, supply is determined by short run marginal costs. Consequently, static efficiency is high at this moment.[59]

Technological developments in communication equipment constantly enhance the capacity of existing networks. For instance, by using different colours of light instead of only one, many more light signals can be transported over the existing glass fibre networks. For the near future, investments in new wholesale capacity will hence not be hindered by large sunk costs. Therefore, as long as the existing (spare) capacity and developments in transportation equipment are sufficient to meet demand, dynamic efficiency will also be high.

This leads us to conclude that now and in the near future, both static and dynamic efficiency are high in the market for low quality wholesale access. Only in the long run, when e.g. a completely new technology will require significant investments, the trade-off between static and dynamic efficiency may alter.

High quality access

As the situation in the wholesale market for high quality broadband access closely resembles current market conditions in the market for unbundled access, we derive the same conclusions here regarding static and dynamic efficiency. Due to current regulation, static efficiency is increased, but sufficient incentives remain for entrants and incumbents to improve the network.

4.3.3 Conclusion

In the market for low-quality wholesale access, a trade-off between static and dynamic efficiency does not exists. Competition has led to considerable investments in glass fibre backbones to such an extent that there is large overcapacity of these networks at present. Consequently, static efficiency is high. Further, the costs of deploying existing spare capacity are rather modest. Hence, investments in new capacity do not require high investments, which is good for dynamic efficiency.

[57] And continue to do so (see OPTA 2005d).

[58] Overoptimistic expectations regarding future demand may also explain this.

[59] One may wonder whether the current situation is sustainable. Some suppliers have made substantial losses. If this continues to be the case, firms may even exit this market. It is, however, unlikely that this will eventually lead to substantial market power for the remaining firms (and hence low static efficiency). After all, given the level of fixed costs relative to demand, this market is not a typical natural monopoly.

The conclusion on the high-quality part of the wholesale access market is similar to the one for the market for unbundled access. Due to current regulation of this market, static efficiency is increased, but sufficient incentives remain for entrants and incumbents to improve the network.

4.4 The market for retail broadband access

Retail broadband access basically consists of two different services: transmission and internet-connectivity. Often one supplier provides both services. Both the cable network and the copper local loops are apt for offering retail broadband access.

4.4.1 Current structure

Firms active on the retail market provide broadband access to end-users. The retail market is not regulated, since firms with significant market power are absent. Although at the regional level cable operators may have a substantial market share, the presence of several national players renders the market power of the regional players insignificant. Other market conditions support sustainable competition as well, as will follow from the discussion below.

The retail market generally consists of a business segment and a consumer segment. The main difference between both segments is related to quality. The business sector demands high quality at high prices, whereas consumers are generally satisfied with a lower quality at cheaper prices. Quality attributes are for instance symmetrical bandwidth, security, higher contention rates and adequate help desks.[60]

The retail segment for business clients is larger than the retail market for private consumers. This follows from table 4.2, which shows the distributions of the (global) turnover across the market segments of some main companies with networks in the Netherlands.

Table 4.2 Distribution turnover of some main network providers, 2004

	Wholesale and local loop	Retail	
		Business sector	Consumers
	%		
KPN	15	45	40
Versatel	21	55	24
MCI	18	57	25
British Telecom	22	46	32

Sources: KPN estimation CPB, Versatel, Annual Report 2004, pp. 82, MCI, Annual Report 2004, pp. F-75, BT, Annual Report 2004, pp.9

OPTA does not regard the business and consumer markets as different relevant markets. As demand substitution between the products provided to the business sector and to consumers is substantial, a hypothetical monopolist on one of these markets could not significantly increase its price without losing too many customers to the other market. In fact, quite a number of

[60] See, e.g. www.kpn.nl., click Zakelijk.

business clients use products that are basically meant for private consumers. Nevertheless, to give the reader a bit more insight in these two markets segment, we will zoom in on both segments separately in this subsection.

4.4.1.1 Business segment

No firm with significant market power exists in the business market segment, as several firms compete to meet the demand of the business sector. Among the suppliers are KPN, Versatel, MCI, British Telecom and Telecom Italia. Competition has led the firms to launch a large variety of differentiated services.

The prices paid by the business sector exceed consumer prices because of the higher quality of the services. Price formation is probably transparent as the services of the suppliers and the corresponding prices can be easily compared by searching the websites of the internet providers.

4.4.1.2 Consumer segment

In the consumer segment, competitive conditions are favourable as well. Firstly, no firms with significant market power are present. In 2003, Chello had the largest market share. But the 10th in ranking (Het Net) still had a substantial market share as well. There is even no dominance if we aggregate the market shares of KPN's daughters Planet Internet, XS4ALL and Het Net. Its total market share is then slightly larger than 20%.

Secondly, incumbent service providers are facing new entrants. During 2001− 2003, Tiscali and Het Net entered the fast growing market, while the market share of the leader Chello dropped significantly.[61]

Thirdly, almost everyone who is willing to pay for Internet access, can have it. A strong indication that current supply matches demand is the fact that people can choose from a large variety of subscriptions. Hence, everyone can choose the price quality combination that fits best. Moreover, consumers are satisfied with their Internet service providers.[62] If people do not use internet, it is due to other reasons than an insufficient operating broadband market.[63]

Finally, running a regression on subscription rates, the results seemingly support the statement that the market of internet providers functions appropriately (see appendix A and box for more details). Prices are strongly related to quality. Figure 4.2 depicts the relation between the monthly subscription price and the downstream speed per second of the 86 Internet subscriptions VU Amsterdam, May 13th, 2005.[64] The figure shows that consumers are willing to pay for more downstream speed. However, consumers pay less for every extra bits per second, the more they use Internet. Put differently, the relation is non-linear. As further discussed in the box, other determinants are important as well and explains observed price

[61] Ministry of Economic Affairs, 2004d.

[62] Consumentenbond, 2005

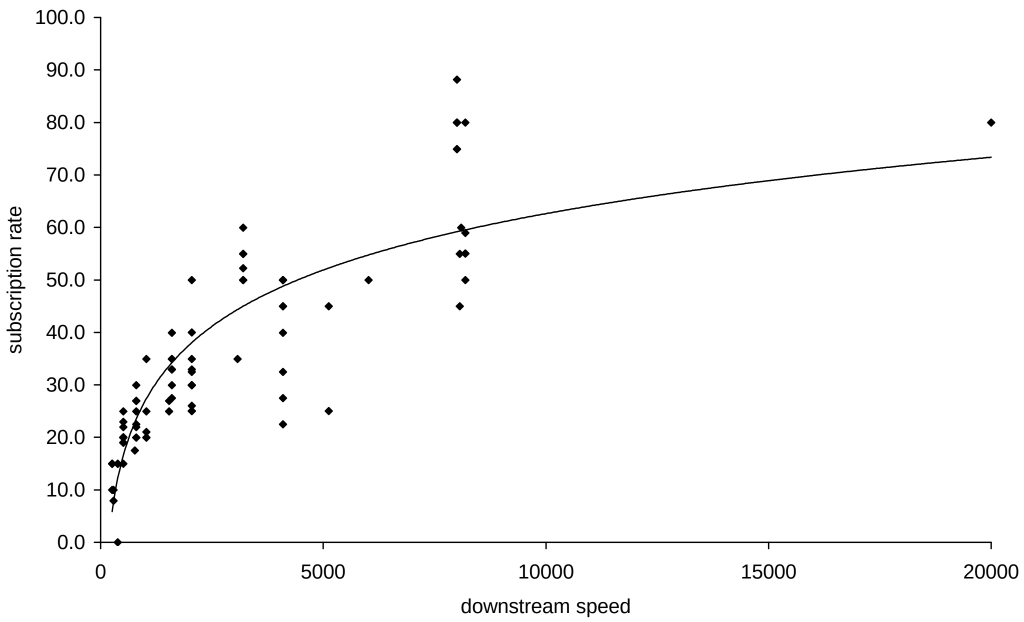
[63] Statistics Netherlands, 2003. Staat 5.1.1, pp. 79.

[64] This analysis resembles the analysis by OPTA, 2005b, pp. 154-157.

differences to a large extent. For instance, the consumer also wants to pay for unlimited use of Internet, because if there are download limits, the subscription rate is lower.

Probably, price differences not attributed to quality related determinants can only exist for a very short time. There are appealing indications for Internet service providers rapidly responding to each other's changes in subscription rates. For example, many providers have special offers. These responses led to a sharp decline of the subscription rates (per bit per second) during 2004-2005. On average, we found a drop in the monthly subscription rates per bit per second of 58% of all available subscriptions types during the period 2004-2005 (see appendix B).

Figure 4.2 Monthly subscription rate and downstream speed at Amsterdam, May 13th 2005



Switching costs not substantial barrier

Switching costs may be a barrier for end-users to switch between service providers and/or different technologies. These costs reduce the choices of consumers to meet their needs in the most efficient way. If switching costs are large, so are the barriers to entry, especially in a saturated market. Consequently, if switching costs are high and consumers are locked in than these costs lead to lower substitutability, less competition and, hence, less welfare.

Switching costs with respect to broadband include the duration of contracts, the term of notice and, the costs of buying a new modem. Further, they also consist of searching costs to find another ISP and potential lack of transferability of email addresses.

Explanation monthly subscription rates at Amsterdam, May, 13th, 2005

The 86 monthly subscription rates in euros are explained by the determinants listed in the table with regression analysis.

Impact monthly subscription rates		Regression coefficient	T-ratio
Significant impact			
Downstream speed	Bits per second/1000	6.90	6.00
Squared		– 0.20	3.40
Download limit	1000 Mb	0.63	2.17
Costs modem	Euros	– 0.15	1.84
No significant impact			
Upstream speed	Bits per second/1000	5.25	0.27
Squared		1.10	0.07
Once-off connection costs	Euros	– 0.06	0.64
Provider owns network	Yes=1, No=0	0.60	0.27
Explained variation in rates (100*R^2)	%	80	

Quality related determinants

Consumers are willing to pay for a higher subscription rate for three facilities. Firstly, consumers pay for more downstream speed, albeit at a declining extra rate (the negative sign of the squared downstream speed). Secondly, prices for unlimited downloading are higher. If there are download limits, the subscription rate is lower. Thirdly, they are willing to pay for a 'free' modem. For if the consumer must pay for a modem, he would have to pay a lower subscription rate. It shows that these facilities account for almost 80% in the variation of the 86 subscription rates. The following facilities do not have a significant impact: the upstream speed, once-off connection costs and whether or not the Internet service provider supplies its services on its own network. The upstream speed hardly determines the subscription rate. Apparently, the upstream speed is not a bottleneck for consumers, otherwise the providers could charge a price for it.

Market distortion related determinants

As regards possible market distortions, we find two results. Firstly, the subscription rate is not significantly affected by whether or not the provider owns the network. This result can be interpreted as circumstantial evidence that providers, which transfer via their own network, cannot abuse their market power. Secondly, corrected for the quality determined determinants, XS4ALL and the network op KPN contribute to a higher subscription rate. In contrast, the price of Speedlinq and along the networks of Tiscali and Wannado give a lower rate. It is far too early to interpret these outcomes as market imperfections. Omitted quality determinants and just statistical chance may determine these results. For technical details, see appendix A.

With regard to the Dutch case, the overall impression is that the switching costs are not a strong impediment for end-users to switch.

First, OPTA monitors elements of switching costs to enhance competition and freedom of choice of customers. In that respect, in 2004, it ordered KPN to reduce the switching time to other DSL-providers. Second, the switching costs seem to be modest. Presently, the size of the overall switching costs depends to some extent on whether it is a change between ISP's or between cable and copper due to need for other modems. Sometimes additional costs occur due to the need for a new modem. However, frequently modems are free of charge. Next, a switch is mostly not a time consuming activity, as standard forms of denouncement are freely available on the internet. Moreover, consumers can compare offers of ISP on websites collecting this type of information. Finally, in general, the duration of broadband contracts is one year with a silent granting of an undetermined period or again for one year. The term of notice varies between 1 to 3 months.

A number of figures support the impression of relative low switching costs. The number of clients that switch from one service provider to another is an indicator to what extent switching costs are substantial. The recent OPTA-report (2005b) states that if broadband prices of cable would rise with 10 percent than approximately 24% of all people using cable would switch to DSL and 62% would not change. On the other hand, if broadband prices of DSL would increase with 10 percent than only 15% of all people using DSL would switch, 80% will stay. The differences in results are mainly related to the (perception of better) reliability, faster connection and better services of DSL service providers. Additionally, Dialogic (2005) illustrates that many of the respondents of their survey changed to other connections over time.

Nevertheless, some impediments may still reduce the switching possibilities of end-users. The main problem we encounter is the lack of transferability of email addresses. If an end-user switches to another ISP, its previous email address will be deactivated. In contrast to DSL-users, end-users of cable cannot change between cable providers, as the latter are regional providers.

Recently, the Dutch government has shed its light on the future of electronic communication.[65] Freedom of choice for customers is essential. On issues like settlement of consumer complaints, transparency of invoices and quality of websites comparing broadband products ought to be regulated by the market parties. However, if that fails, the government warns the market parties by intervening and strengthening of regulation. In that respect, the Minister of Economic Affairs recently stated that in 2006 internet providers are not allowed to tacitly renew a contract. In that case, the contract turns into an indeterminate period of time and term of notice is only one month.

Lack of transparency

We find no evidence that consumers lack information (i.e. asymmetric information) on a large scale. Consumers seem to be satisfied and well informed regarding existing products and therefore their consumption decisions are likely to be optimal. Consumers choose deliberately and voluntarily and they are alert on changes in technology options (see chapter 5).

The market for internet services is transparent due to the following additional reasons. Firstly, at least four websites provide, free of charge, the assortment of subscriptions available for each

[65] See Ministry of Economic Affairs, 2005a and 2005b.

postal code.[66] This improves transparency as the customer can sort out the subscriptions ranked according to their quality (speed in bits per second), monthly price, once-off connection charges and the supplier of the network. Secondly, the residuals in figure 4.2 are rather small and further analysis (see results in the previous box) shows that the price differences between the Internet subscription rates can largely (i.e. 80%) be explained by facilities.

Consumers satisfied

Presently, consumers are satisfied with the opportunities of Internet. This is the outcome of a recent enquiry among 2600 people of the Dutch consumer pressure group 'Consumentenbond'.[67] The consumers appreciate the speed of Internet, its reliability and its user-friendliness. A minority of the enquired people complain about the support and after sales-service of the Internet service providers. One can find anecdotal evidence of complaints on the Internet (see e.g. http://www.chelloo.com/forum). Consequently, the market responses of service providers have mainly been oriented to improving the services of their call centre and/or helpdesk. There might be a slight difference in the satisfaction between users of the copper local loop and that of the cable. The difference is linked to the different types of technology as will be further discussed in chapter 5. KPN reports a broadband customer satisfaction rate of 78% at the end of 2004, a ratio that increased since 2002.[68] Unfortunately, the cable sector does not publish data on household satisfaction.

4.4.2 Incentives to invest

In absence of regulation, in particular the unbundling of the local loop, the retail market for broadband access would be statically inefficient. The retail market for high quality would, in that case, even be monopolised, as KPN is the only wholesale supplier. KPN would set its wholesale access prices so high that potential entrants to the retail market would not be able to compete with KPN's (or a subsidiary) retail business. KPN would then also be the only supplier of high quality retail broadband access, leading to a statically inefficient market.

In the low quality segment of the retail market, cable companies also offer retail broadband access. If upstream regulation was absent, we would hence have two independent suppliers of retail broadband access in most regions. This, however, does not mean that static efficiency would be high. In particular, KPN would still have substantial market power. The reason for this is that end users perceive the quality of internet access through cable inferior to internet through DSL networks (see OPTA 2005b). Although this does not give KPN monopoly power, still we can expect that prices would be substantially higher than marginal costs. Hence, static efficiency would be low in a retail market without regulation in the upstream market.

[66] www.2surf.nl; http://www.breedbandwinkel.nl/, www.Internetten.nl, www.adsl.nl.

[67] Consumentenbond, 2005.

[68] KPN, 2005, pp. 13.

However, as explained earlier, due to unbundling regulation the market for low quality wholesale broadband access has become quite competitive.[69] This, combined with the low entry barriers in retail broadband access, has led to high levels of static efficiency in the retail market. Dozens of independent providers are active now, offering many different types of competing subscriptions. At present end-users can choose from a large variety of transmission speeds, transmission qualities and alternative means of telephony (see box).

Differentiation monthly subscriptions at Amsterdam, May 13th, 2005

Today a citizen of Amsterdam can choose between a large assortments of subscriptions to pick out the subscription, which best fits his needs. In fact, 16 Internet service providers along 6 networks provide 85 subscriptions types. The table illustrates the ranges in prices and facilities. Of course, generally, the consumer must pay more for more Internet facilities as explained previously.

Characteristics subscriptions

	Range	Comment
Monthly subscription rates	0– 88 euro	Average 36 euro
Costs first year	0 – 1058 euro	Average 428 euro
Downstream speed	256 – 20,000 kilobits/second	
Upstream speed	64 – 1,024 kilobits/second	
Download limit	250 MB – unlimited	
Once-off connection costs	0 – 74,95 euro	All free, except 2
Purchase modem	0 – 80,92 euro	All free, except 3

Source: www.2surf,nl, postal code 1011 ER 1.

Do these fierce competition levels negatively affect dynamic efficiency? The answer is no, because the costs of introducing new retail services is rather low (compared to demand). It mainly involves new services related to internet-connectivity. Both these activities do not require monopoly profits. Furthermore, investments are not typically asset-specific, and demand side concentration is very low. Therefore, the hold-up problem is virtually absent in the retail market.

Recent innovation: triple play

A recent example of a new service, or rather a new package of services, is triple play. This is the supply of telephony, television and internet in one basket. In order to supply triple play, firms are investing in the digitalisation of voice, video and internet. Triple play can be supplied along copper and cable local loops. It will probably lead to a further rise in competition in the short run, as the cable firms are attacked on their significant market power in radio and television distribution (see box). However, in the longer run, it is imaginable that a firm with

[69] This process was obviously stimulated by the fact that cable networks have become apt for communication services rather than just for the transmission of radio and television.

significant market power will emerge. Therefore, monitoring is needed in order to respond fast if this would happen.

Regulation radio and television distribution

The market of radio and television distribution is regulated by OPTA (OPTA, 2005e). The reason is that the firms which transmit radio and television signals to the households have significant market power. 90% percent of the population receives the broadcasting signals by cable. There are 28 cable providers of which UPC, Essent, Casema and Multikabel are the largest (see www.vecai.nl) Each firm has a local monopoly on radio and television distribution. The remaining 10% receive the signals by dish antennas (Ministry of Economic Affairs, 2004d, table 3.50). The broadband market does not include the market of radio and television distribution. Therefore, this regulation is not dealt with in the main text.
The cable firms also provide internet connection and telephony. As regards these activities, they are discussed in the main text.

4.4.3 Conclusion

Predominantly due to regulation in the upstream wholesale market, the market for retail broadband access is statically and dynamically efficient.

4.5 Conclusions

In this chapter, we assessed the impact of competition and regulation on the deployment of broadband. The key issue of regulation of access to a network is dealing with the trade-off between static efficiency and dynamic efficiency. Favourable conditions for access to the network contribute to allocative efficiency and productive efficiency, but can negatively affect incentives for investments in upgrading of existing infrastructures and developing new ones. Governments in the different countries, such as South Korea, Canada, Sweden and the Netherlands, were faced with similar policy decisions. All privatised the formerly state-owned incumbent telecommunications firms. Only Sweden still shows a rather strong state share in this industry. Moreover, South Korea as well as Canada imposed restrictions on foreign ownership. Many countries introduced unbundling of the existing local loop, but some countries, such as the United States, have given exemptions to investments in alternative infrastructures.

In the Netherlands, regulation of the telecommunication industry is designed with the aim to enhance competition between alternative infrastructures without affecting the technology choice of both incumbents and entrants. Based on European directives, OPTA distinguishes three relevant markets within the provision of broadband through the copper infrastructure: the market for unbundled access, the market for wholesale broadband access and the retail market. The market for unbundled access and a part of the market for wholesale access, i.e. the high-quality market, are regulated. The impact of regulation on the deployment of broadband depends on how the key issue of regulation, i.e. dealing with both static and dynamic efficiency, is solved. Here we summarise the conclusions for each of these markets:

- In two markets, i.e. the market for unbundled access to the local loop and the market for high quality wholesale access, a trade-off exists between static efficiency and dynamic efficiency. This trade-off is due to the presence of the high fixed costs of the infrastructure. Tariffs for access to the local loop reflect (average) actual costs of the existing copper infrastructure, giving entrants incentives to make efficient make-or-buy decisions. In addition, the threat of infrastructure competition in the local loop, as well as the service-based competition between providers using different infrastructures, i.e. copper and cable, are incentives for the incumbent to increase efficiency. Consequently, the current regulation of the local loop does not bias the investment decisions of both incumbents and (potential) entrants making use of the copper local loop. Formally, it does have a negative impact on static efficiency, because the access price is above the level of marginal costs. However, given the high level of fixed costs, marginal cost pricing would probably imply that the incumbent would not be able to recover its fixed costs. Therefore, a price based on average costs seems to be a good compromise between static and dynamic efficiency.
- A similar conclusion holds for the high-quality part of the wholesale access market. This market closely resembles current market conditions in the market for unbundled access. Due to current regulation of this market, static efficiency is increased, but sufficient incentives remain for entrants and incumbents to improve the network.
- In the market for low-quality wholesale access, a trade-off between static and dynamic efficiency does not exists. Competition has led to considerable investments in glass fibre backbones to such an extent that there is large overcapacity of these networks at present. Consequently, static efficiency is high. Further, the costs of deploying existing spare capacity are rather modest. Hence, investments in new capacity do not require high investments, which is good for dynamic efficiency.
- In the last market, i.e. the retail market, a positive relationship exists between the level of competition (static efficiency) and innovation (dynamic efficiency). This market appears to be both statically and dynamically efficient.

Our overall conclusion is that Dutch regulation of the telecommunication industry gives efficient incentives for technological development such as the deployment of broadband. Continuous monitoring by OPTA remains requisite in order to respond rapidly with regulation and supervision if firms with significant market power in broadband markets would emerge. Finally, regulation should not give rise too uncertainty, as this may negatively affect investments decisions (see chapter 6).

5 Other market failures in the Netherlands

No market failures are found with regard to network externalities and consumption externalities that need additional or other policy measures. Production externalities may arise, but these are already being tackled by R&D-subsidies. Here as well no policy adjustments are necessary to enhance broadband deployment. With respect to equity, we do not find evidence for a geographical digital divide in the Netherlands. Elderly and low-income groups are underrepresented in broadband access. In the course of time, this social digital divide will decline. Moreover, broadband is not seen as universal service obligation.

5.1 Introduction

This chapter discusses whether there is evidence for other market failures besides market power with regard to broadband in the Netherlands. Below, we will successively discuss network -, production - and consumption externalities. Additionally, we also analyse if indications are present for a geographical or social digital divide in the Netherlands. For each topic, we also take an international perspective focussing on arguments put forward in the international literature. Subsequently, we end with an assessment whether or not changes in Dutch current policy are required.

We will not explicitly deal with the potential market failure of asymmetric information. As we already mentioned in chapter 3, asymmetric information might particularly be a problem with the introduction of new services. After all, services are experience goods, and the utility derived from a new service is highly uncertain. However, current market strategies, such as free trials for a limited period, are generally sufficient to overcome this problem. Hence, in practice, this market failure hardly exists.

5.2 Network externalities

5.2.1 Present situation in the Netherlands

Network effects result from the phenomenon that a user’s benefits from being connected to a network can depend on the number and the kind of other people using similar or compatible products. Demand for such a service may only take-off when a critical mass has been achieved. Network externalities are cause for public concern when they cannot be materialised because networks fail to interconnect. After all, fragmentation of networks effectively leads to a set of smaller networks with smaller aggregate network effects. Secondly, there may be cause for public concern when a critical mass cannot be reached, so that network or service provision is not viable.

Hereafter, we elaborate on the following indicators related to network externalities: compatibility of networks, investments, and interdependency between users.

Compatibility and interconnectivity of networks present

In the Netherlands, positive network effects are materialised due to compatible and interconnected networks. The (national) networks are technically compatible, as they all use standard protocols guaranteeing interoperability between data and networks. Important standards are the Internet Protocol, Frame Relay, Asynchronous Transfer Mode and the Open Systems Interconnection.

These standardisation developments towards (international) protocols are market responses to cope with the potential market failure of network externalities, as discussed in chapter 3. In general, each network provider has incentives to develop and to comply with these standards. Therefore, the market generally tends to provide compatibility whenever it is socially optimal (see Shy, 2001). A network provider that opts for being not compatible with other networks will not get sufficient customers. Customers will strongly prefer compatible connections with other networks in order to communicate with people in other networks.

Nowadays, numerous commercial ISPs offer internet access through many backbones and private networks. These networks are interconnected either at an Internet Exchange Point or through private interconnections between two or more networks.[70] Regarding the Netherlands, via the Amsterdam Internet exchange (Ams-IX), for instance, ISPs can interconnect and exchange (worldwide) Internet traffic with each other.

According to OECD (2002b), at present, market parties (including ISPs) have sufficient incentives to interconnect their networks, including the provision of access to global Internet backbones. The current arrangements for Internet traffic exchange give the right incentives for developing backbone markets. It is internationally recommended that two providers involved in establishing interconnection reach a mutual agreement, taking into account the possible need for compensation for elements such as traffic flow, number of routes and the cost of international transmission.

Whether or not ISPs will ultimately charge each other depends on their net gain from interconnection. Settlements of agreements will include transaction costs, such as negotiation costs and accounting of traffic flows. These transaction costs may be higher than the individual gain by one ISP from charging the other. Hence, if the value of the networks between two ISPs does not differ substantially, it will be more attractive to peer without charge.

[70] An Internet Exchange Point creates economies of scale for ISPs and generates an attractive point for global backbone networks to connect with due to traffic aggregations.

In practice at the international level, financial compensation agreements exist in which large networks reap the benefits from bringing more customers in into the network. At the local, Dutch level, we see that peering agreements between (local) ISPs often do not include an exchange of money in the Netherlands since many ISPs are more or less equally sized in practice.[71]

In conclusion, network providers and ISPs have sufficient incentives to comply with international standards and interconnect their networks. Therefore, with respect to network externalities, no market failure exists.

High investments to enhance network capacity

Different interested parties express their concern that companies are reluctant to invest in broadband due to financial uncertainties (e.g., long term repay) and financial constraints. Financial success ultimately depends on the number of customers. If companies fear that network externalities will lead to excess inertia (i.e., customers will stick with the dominant technology), they will not invest in new broadband technologies or networks.

We did not find significant evidence of negative network externalities with respect to this issue. The (network) providers appear not to abstain from investing. Presently, many telecommunication firms invest in wires, equipment for switch points and modems for customers (see also box). These investments are high, despite e.g. current overcapacity in the local loop. Hence, the next few years, bottlenecks in network capacity will probably be absent. These propositions are further explained below.

The investments in network facilities were high during the period 1995-2002 as table 5.1 reveals. The share of investments in networks is about a quarter of the investments in ICT. Apparently, this share is rather constant over time. Despite considerably lower prices of equipment, we do not notice a significant relative drop in network investments up to 2002.

Table 5.1 Investments in network facilities

	1995	2001	2002
	Millions of euros		
Network facilities	1638	4570	3395
Total ICT investments	6684	15327	13448
Total investments business sector	61347	92873	92572

Source: Statistics Netherlands, 2005, De digitale economie 2004, staat 3.2.1.

[71] Note that such an agreement implies that, at the margin, a new subscriber to network A will not lead to a higher compensation received by network provider A. Consequently, a part of the positive network externality imposed by the new subscriber is not internalised. However, if the number of subscribers to network A continuous to grow, this network will eventually adjust its peering agreements such that it will receive extra compensation and, hence, internalise the externality.

Enhancing and improving broadband

Presently, worldwide several channels are followed to improve and enhance broadband with respect to speed and capacity. The first one is technological progress in telecommunication equipment. New generations of modems and routers enable to transmit an increasingly number of bits per second along the existing wires of copper and coax cable. Secondly, better compression techniques also enhance broadband capacity. Better software algorithms are leading to further compression of content. The third channel to enhance the capacity of broadband is by developing new alternative technologies as satellite and energy power lines (EPL). EPL uses the existing power grid infrastructure to provide high-speed, broadband Internet access to homes and businesses. It is a new innovation based upon existing Power-Line Communications technology allowing a speed of 100 Mbps around 2010.[a]

Here, we elaborate a bit more on the first channel. It can be stated that the technology of the network itself is presently not a main issue for improvements in broadband. The broadening of broadband to end-users will likely continue among all kind of technologies. For instant, next generations of copper lines include VDSL which identifies a speed of 50-55 Mbps.[b] VDSL transmits high-speed data over short reaches of twisted-pair copper telephone lines, with a range of speeds depending on actual line length. Also, improvements are made in the cable technology to extend the access speed.[c]

[a] Platform Nederland Breed, 2004.

[b] The maximum downstream capacity under consideration is between 51 and 55 Mbps over lines up to 300 m in length

[c] See, for instance, press release of Jupiter Telecommunications Co of June 22, 2005. This company plans to provide high-speed Internet services using both the fiber-optic cable network and coaxial cable.

No official data for the Netherlands is available for the years since 2002. However, additional information of companies suggests that investments by the telecommunication industry have remained high during the past few years. Table 5.2 illustrates this proposition for some main companies with their backbones in the Netherlands at the company level. Although these companies do not publish official figures for the Netherlands, for the main Dutch players KPN and Versatel we could make reliable estimates of their investments in the Netherlands.

Table 5.2 Investments by companies with networks in the Netherlands

	2002	2003	2004
	Millions		
Company			
KPN	EUR 1,137	EUR 1,421	EUR 1,698
Versatel	EUR 69	EUR 89	EUR 135
MCI	$ 1,040	$ 756	$ 982
Telecom Italia	EUR 3,251	EUR 4,894	EUR 5,335
British Telecom	₤ 3,908	₤ 2,445	₤ 2,672
Colt Telecom	₤ 412	₤ 141	₤ 129
Of which in The Netherlands			
KPN	EUR 800	EUR 1,040	EUR 1,190
Versatel	EUR 35	EUR 40	EUR 60

Sources: Company: Annual Reports of the companies; The Netherlands: KPN, 2005, Altijd dichtbij, Annual Review 2004. Company: pp. 118 and 144; share NL 2003=73%, 2004=70%. CPB assumes 2002=70%. Versatel: CPB estimate share the Netherlands in fixed assets times company investments (Annual Report, pp. 83). MCI: No figures available for the Netherlands.

Unfortunately, the Dutch cable providers do not publish data on their investments in their network. It is reasonable to assume that those providers also invest in broadband developments to maintain their market position. Currently, cable providers are quickly loosing market shares to DSL providers. Although the number of end-users using cable still increases, the number of end-users using DSL-techniques surpassed the former in the period 2001-2004.

At present, all providers stress the importance of broadband and the need to invest in it. For example, like many of its competitors, KPN intends to upgrade its network to ADSL2+ very soon, and to extend its digital television network to countrywide coverage. In addition, KPN will invest in more broadband-services like VoIP, mobile television and Video-on-Demand.[72] Since the summer of 2005, Versatel offers a speed of 20 Mbps including entertainment on demand in the form of soccer. Cable suppliers as UPC, Essent and Casema invest in technologies to switch from analogous television to digital television, which improves the quality of television and results in more broadband capacity due to compressing techniques of digital television.

All in all, these developments do not support concerns that telecom companies are reluctant to invest[73] in broadband. Apparently, companies seem to expect a sufficient rate of return on their investments. They seem not to fear that network externalities are strong enough to make customers stick with smallband technologies.

Higher relative costs of glass fibre in the active local loop

The active local loop is the combination of the wires of the local loop and the connected equipment in the switch boxes at home. The (investment) costs per transmitted bit per second of the active glass fibre local loop are at present higher than both the costs of the local loops of copper and coax cable due to the following. First, there are large economies of scale regarding the production of the modems, routers and software for the DSL-technique. Demand for this equipment is large as most parts to the end-users in the world are still connected with copper and cable local loops. World leaders in the production are Cisco, Lucent and Microsoft. Compared with this demand, the demand for glass fibre equipment is small. In consequence, an active glass fibre local loop presently appears to be insufficiently attractive from a commercial perspective on a large scale. Second, for the deployment of glass fibre one needs to dig and rollout new wires to the end-users. This is a relatively costly operation in existing residential areas. In new residential areas, the rollout of glass fibre is more attractive. Moreover, due to technological progress and increasing demand, glass fibre (equipment) may become more economical in future.

No excess inertia

End-users appear to be alert on changes in technological opportunities. Statements whether or not the level of total consumption is below the optimal level leading to insufficient use of economies of scale are hard to make. The figures in table 5.3 illustrates the swift move from the ‘old fashioned’ analogous and ISDN technologies to ADSL, cable and wireless technologies.

[72] KPN, 2005, pp. 5.

[73] Here, market failures on the capital market may have an impact. However, we have no indications that telecom companies experience financial constraints.

These results suggest that excess inertia among households is absent, probably due to market transparency and relatively low switching costs (see section 4.4).

Table 5.3 **Distribution households by technology of Internet connection**

	2000	2002	2004
	%		
Copper	89	82	70
Analogous modem	71	60	37
Digital ISDN	18	18	14
Digital ADSL	0	4	19
Cable	11	20	30
Wireless (WAP)	0	2	3

Sources: 2000: SCP, 2004, Table 5.6.
2002-2004: http://www.cbs.nl/nl/publicaties/artikelen/algemeen/webmagazine/artikelen/2005/1644k.htm

Consumers do not demand symmetric broadband

Today, consumers choose deliberately for asymmetric broadband. This preference for asymmetric broadband is not surprising, as for most of the current activities a high download speed is more important than a high upload speed. Empirics point to the following. Consumers most often use broadband respectively for e-mail, to search for specific information and for downloading software and music (see table 5.4).

Table 5.4 **Use of Internet by households**

	2002	2004
Internet activities	% share of users	
Searching for specific information	81	85
E-mailing	78	82
Just surfing	35	40
Electronic shopping	23	32
Chatten	19	26
Downloading free software[a]	25	30
Downloading free music[a]	17	20
Downloading free games[a]	8	9

Source: CBS, 2005-04-25, http://www.cbs.nl/nl/publicaties/artikelen/algemeen/webmagazine/artikelen/2005/1644k.htm (people > 12 years old)
[a] CBS, Statline 2005-08-26.

These activities require more downstream than upstream speed. Therefore, asymmetric DSL (i.e. ADSL) is popular. In its latest reports on broadband and use, Dialogic (2005) supports this conclusion. Upstream activities such as upload of movies, music or photos are still in their infancy and appear to be not related to the upstream capacity. For this reason, network externalities are probably not so important. For most activities that are currently being used, the number of other consumers that also have a fast connection is irrelevant. Hence, the utility for one consumer of a broadband connection does not depend on the number of other consumers with a broadband connection for most of the current activities.

An additional empirical finding is that most of the consumers are willing to pay for downstream speed and not for upstream speed. This is a result of the analysis of price formation of Internet as discussed in section 4.4. Moreover, consumers can choose from a variety of subscriptions with a range of speed, as shown by section 4.4 as well. Therefore, consumers that prefer more bandwidth speed can choose that kind of subscription if they are willing to pay higher prices. Consumers with extreme wishes of upstream speed can fulfil their preferences by moving to the business segment. Prices in the business segment are, however, much higher than the subscription rates on the consumer market. Amongst other, more services (e.g. safety and 24 hours of helpdesk services) means higher prices.

5.2.2 International evidence

An OECD-paper alludes to the existence of network externalities by asserting that "widespread and affordable access can contribute to productivity and growth through applications that promote efficiency, network effects and positive externalities, with benefits for business, the public sector and consumers".[74] However, no further elaboration or justification of this statement is provided. The paper gives a list of principles, how the supply and use of broadband can be encouraged to create a critical mass.[75]

A report by the *Wissenschaftliches Institut für Kommunikationsdienste* (WIK) looks into justifications for *universal service obligations* (USO) for telecommunication in general, and broadband in particular.[76] It argues that network externalities can be a valid motivation for USO in order to achieve the most efficient outcome. With respect to Internet services, the only network externalities that WIK finds, relate to e-mail services. E-mail externalities are largely similar to positive network externalities for telephony and pertain to connectivity rather than usage. Nevertheless, it is argued that no subsidies are required to correct any resulting problems.

With respect to plain e-mail, it seems safe to maintain that any network externalities are sufficiently enabled by the current Internet infrastructure. Messages with large attachments (such as large documents, audio files, photographs), however, reasonably require transmission speeds beyond that of dial-up Internet. Cable Internet and DSL provide such speeds, allowing for new network externalities to be realised. Hence, each generation of Internet infrastructure can open a door to a new kind of communication services, which will experience network externalities just as plain e-mail does. If those externalities fail to be established, this does not

[74] OECD, 2003a.

[75] Later, these principles were adopted in OECD, 2004c.

[76] WIK, 2000. At more length, this report has discussed motives for public involvement with broadband in relation to equity.

seem to stem from a lack of interconnection or standardisation, since all traffic is transmitted over the Internet using international communication protocols. Rather, a critical mass using a new generation of infrastructure could be needed for a new communication service such as high-quality video-conferencing to become viable.

As indicated in chapter 2, a way to achieve such a critical mass is for a government to bundle demand in public institutions or to act as a launching customer. This seems to be one of the secrets of Korea's success in broadband deployment (see box). In a similar vein, Japan bundled public demand to boost broadband deployment, particularly in rural regions. Since 1998, the Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunication has been helping local government to connect schools, libraries, city halls etc. through public intranets. Central government pays for one-third up to half of these investments.

Broadband in South Korea

As was shown in chapter 2, Korea has by far the largest broadband penetration in the world. By mid 2003, 70% of Korean households had a broadband connection, while 62.7% of businesses used DSL and 21.9% used a leased line.[a] What contributed to the high availability rate is the country's population density, which makes the rollout of DSL relatively cheap. Including satellite, broadband is available to 98% of towns and country regions.
Between 1999 and 2002, government action was laid down in the 'Cyber Korea 21'-plan.[a] The primary role for government was to encourage competition in the broadband Internet market. Local access competition is believed to be a crucial element explaining the Korean success. At an earlier stage, however, the government funded the development of backbone networks in return for use by the public sector. By 2002, the investment had been 'repaid' by public sector usage. In addition, low interest loans were available for parties that wanted to build broadband infrastructure. However, the financial markets provided even cheaper money.

[a] OECD, 2004b, pp. 30-32.

5.2.3 Need for policy change?

In the Netherlands, positive network effects are materialised due to compatible and interconnected networks. Network providers and ISPs have sufficient incentives to comply with international standards and interconnect their networks. Therefore, with respect to network externalities, no market failure exists. Hence, no additional government measures are required. Moreover, standardisation and compatibility are international issues. Although there is no explicit policy that focuses on other network externalities, both the national and international analysis provide no arguments for having one.

We encountered no clear evidence that a USO can be justified economically in terms of *network externalities* that occur by connecting those regions. The market itself responds with marketing strategies to attain a critical mass. Furthermore, for most of the current activities by internet users, network externalities do not play a large role anyway. The utility derived from these activities does not depend on the number of other users with a (broadband) connection.

5.3 Production externalities

5.3.1 Present situation in the Netherlands

Broadband can generate (external) economic benefits in several ways. For this reason, firms will invest in broadband to enlarge their profitability. However, not all economic effects are external.[77] Private parties internalise a considerable part of the positive effects. Moreover, firms and the market itself can prevent potential market failures by creating institutions or new markets. Examples are cooperation between firms and the origin of the consultancy market for exchanging knowledge. In these cases, government intervention is not necessary to generate positive economic effects.

However, some parts of the economic benefits of broadband are external. Production externalities arise if activities of producers generate benefits or costs that cannot be taken into account by the producer. First, research and development (R&D) activities by telecom firms themselves could result in new knowledge. If this new knowledge cannot be kept private to the innovating telco, others will benefit. Second, broadband could stimulate knowledge spillovers from all kind of industries and universities to other parts of the economy. For instance, it is likely that broadband has positive spillover effects due to better access to external know how. This means that for a given level of knowledge creation, more knowledge may spill over to external parties due to a more advanced communication network.

Broadband may have, therefore, contributed to a widening of the gap between private and social returns.[78] Note, however, that more transmission capacity alone is probably not sufficient to enhance the spillover process. Complementary elements, such as search engines, data procession, and human capital etcetera are needed as well in order to generate more spillovers. For instance, human capital largely enables the accumulation and absorption capacity of knowledge.

The (empirical) literature identifying mechanisms transmitting production externalities is sparse and remains underdeveloped (see box). In 2002, Rand Europe identified the advantages of broadband for the Netherlands. For instance, they concluded that it could provide a major incentive for the growth of ICT in SME’s, traditional industries, and in the innovative efforts of clusters and information networks. In that respect, we refer to positive findings from ICT-investments on productivity for the Netherlands (see, e.g. Van der Wiel, 2001, and Van der Wiel and Van Leeuwen, 2003). Quantitative evidence on the size of external production effects of broadband is lacking for the Netherlands.

[77] Appendix C elaborates on the difference between economic benefits and production externalities in more detail.

[78] Nevertheless, it is questionable what more advanced broadband speed would add to these effects. Present ADSL and cable network have sufficient capacity for the exchange of information in the form of e-mail, e-books and articles. Only for the exchange of knowledge carriers such as large video files, large databases, and high-resolution imaging, the current infrastructure might form a bottleneck.

Hard to find empirical evidence

It is not suprising that empirical evidence of external effects/spillover effects of broadband for an economy is lacking. A number of reasons complicates such type of analysis.

First, it is probably still too early for such an analysis, because broadband is rather new. The effects are hard to deter. Another complication is the lack of detailed data. In general, statistical offices do not discern investments in broadband. So, it is statistically almost impossible to disentangle the broadband impact from other determinants of productivity gains. Let alone the difficulty to measure spillover effects separately. Moreover, from an economical perspective, this separation is problematic as well. At large, broadband seems to be an enabler and complementary to other important production factors. In that respect, all kind of intelligent software helping people absorbing, processing and creating new knowledge is probably more important. As discussed, presently, software improvements in transmission are main issues in the technological development. Moreover, knowledge spillovers via broadband are likely to be limited to codified knowledge like blueprints. Finally, knowledge spillovers (including tacit knowledge) probably disseminate all over the world through other channels as well: for instance, researchers visiting international workshops and conferences.

There is some indirect evidence based on the effects of R&D on productivity. Many studies came up with significant impact of foreign R&D on Dutch productivity (see e.g. Coe and Helpman (1995), Jacobs et al. (2000)). It seems to be reasonable that broadband applications will increase the impact of foreign research on Dutch productivity.

5.3.2 Digging effects

Digging for the rollout of new wires such as glass fibre gives rise to negative production externalities, particularly in highly populated areas as in the Netherlands. For the Netherlands, no studies are available that quantify the external effects of digging activities for rolling out broadband. Therefore, we elaborate on this issue in qualitative terms.

Breaking up the streets generates external effects in terms of lower revenues of shop-owners, higher risks for people to get hurt entering shops or their houses, and environmental issues like nuisance. Moreover, negative production externalities arise due to interference between other types of network, such as gas, water, sewage and electricity. For instance, the contractor that deploys broadband wires does not fully take into account all welfare economic costs. For example, it includes the costs of a breakdown in electricity supply wires, which disturb electricity supply in a district for a few hours. Generally, individual firms have insufficient incentives to minimise these externalities or to coordinate digging activities.

5.3.3 International evidence

A fast growing literature exists that looks into the economic effects of broadband. However, we did not come across studies that explicitly find evidence for production externalities. For instance, the OECD postulated productivity growth and positive externalities, but without further justification.[79]

Dialogic recently performed an international quick scan.[80] Out of a list of 21 studies, 18 report a positive relationship between broadband and economic performance. The availability of broadband infrastructure is claimed to stimulate productivity growth, give a country a

[79] OECD, 2003b, pp. 2.

[80] Dialogic, 2005.

competitive advantage in the global market and to improve a country's attractiveness for companies and investment. However, Dialogic states that many studies are methodologically deficient. Particularly, it is hard to isolate the effects of broadband from those of dial-up Internet and even harder to isolate the effect of what they call 'real' broadband (such as optic fibre) from mid-band (such as ADSL or cable). In general, Dialogic finds a trade-off between audacity and thoroughness: studies that hesitate to make assumptions that are to some extent disputable fail to reach hard quantitative conclusions.

5.3.4 Need for policy change?

There is consistent evidence for a positive relationship between broadband and economic performance. However, a large part of the economic benefits can be internalised by market parties. What remains are the external effects. These concern (1) the knowledge spillovers of R&D activities by firms active in broadband development and (2) stronger spillover effects of existing knowledge creating activities.

Although these externalities may justify government intervention, they do not justify government stimulation of broadband deployment. After all, it is the knowledge creating activities, like R&D, that generate the positive externalities. As such, broadband subsidies are less effective and efficient than R&D-subsidies. The latter are directly seized upon the issue at stake. R&D-subsidies stimulate knowledge creation as firms themselves may decide how to spend this money.

International issue

Due to telecommunication and mobility of people, knowlegde spillovers do not stop at the borders of a country. As such, the Netherlands take advantage of knowledge produced elsewhere in the world and vice versa. Hence, the problem of subsidising knowledge spillovers is an international issue based on the subsidiarity principle. According to this principle, powers are transferred to an international level if there are substantiated arguments in the form of external effects or economies of scale that this offers advantages over a national approach.

In conclusion, there is no reason to adjust today's government policy by implementing broadband subsidies. R&D-subsidies appear to be more effective to internalise the benefits of knowledge creation. If the R&D-subsidies are considered insufficient, then they can be raised.

Digging

The national policy discussion highlights fragmentation and the costs of multiplicative digging for local loops. In both cases, however, the current policy of coordination to reduce the externalities is effective and efficient according to research of Dialogic and SEO Economic Research (Dialogic/SEO, 2004). Telecom companies themselves lack the incentives to coordinate digging activities and the installation of ducts and cables because they cannot internalise the benefits whereas the costs are for the coordinating party. To circumvent the lack of a market, local government can coordinate this issue taking into account all externalities. Coordination may also be considered at the national level if more than one municipality is involved.

The Telecommunication Act obliges municipalities to coordinate digging activities in the public ground. For instance, they can coordinate digging activities of different telecom companies in limiting the number of breaking up streets. On the other hand, municipalities have a tolerate duty to accept digging activities of telecom companies.[81]

5.4 Consumption externalities

5.4.1 Present situation in the Netherlands

Consumption externalities are related to consumers and arise if activities of consumers generate costs or benefits for others that are not taken into account by the consumption decisions.

Positive externalities of telework

Telework is potentially an example of a positive consumption externality. It is indisputable that broadband is an important application for teleworking. A study of Dialogic (2005) refers several times to the pros of broadband for teleworking. As discussed in section 2.2, the Netherlands ranks first in an international perspective when it comes to home-based teleworking. According to Statistics Netherlands, the amount of teleworkers entails 3% of the working population in 2002. Unfortunately, no time series are available. Yet, based on different (international) reports from market research companies, it is reasonable to assume that in the Netherlands the share of teleworkers has increased over time stimulated by internet facilities.

What are potential benefits of this type of working? In general, teleworking may contribute to time and cost savings for both employees and employers. Employees can make a better match between work and private activities. If they can have a good connection from their home to their office facilities, or if teleconferencing becomes a good substitute for physical meetings, they will need to travel less for their businesses. As a result, they have more leisure time as they travel less between home and work. On average, this probably saves about half an hour per week for each teleworker. Secondly, telework saves on the costs of passenger transport. An average teleworker travels about 40 kilometres per week less between home and work. However, it should be noted that part of these savings are compensated by more leisure-traffic, as the extra leisure time is partly spend on traffic to shops and to meet friends. Thirdly,

[81] Presently, the government is reconsidering adjustments of the new Telecommunication Act with regard to digging issues. These adjustments are not assessed in this report.

teleworkers adjust their hours of travelling to avoid traffic jams. In doing so, they help to diminish waiting times of others in traffic jams.[82]

Likewise, teleworking may result in advantages for employers. For instance, it diminishes the need for office and parking space. It also might help to reduce the consequences absence of employees because it more easily permits the latter to optimise the balance between work and private. As a result, productivity may be improved.

Most of these aforementioned benefits are not external except for the case of less road congestion. Apparently, the use of (more) broadband by teleworkers might generate a positive consumption externality in the form of less road congestion.[83] Road users and, from an environmental point of view, society at large will benefit from this but will not pay the broadband user for it. It can be argued that if both the external costs and benefits were correctly incorporated, there would apparently be greater demand for teleworking.

To our knowledge, no study for the Netherlands is available that have tried to quantify the size of this type of positive consumption externality. The size depends on the extent to which a much higher transmission capacity of the communication infrastructure will induce more teleworking. One may wonder whether current facilities such as ADSL are not already sufficient for e.g. teleworking. In that respect, two factors should be taken into account. First, it should be noted that teleworking including its potential externalities already existed in the Netherlands before broadband really took off. Furthermore, other factors, such as the attitude of employers to teleworking, may be much more important than high-speed data connections.

Yet, there is another externality of telework not referred to: a reduction in social benefits and taxes. More people might enter the labour market due to the opportunities of having access to Internet. The reason is that travelling (e.g. disabled people) and travel time (e.g. housewives) is a barrier to enter the labour market. This barrier is negatively related to working time since travel costs are largely fixed. Teleworking reduces travel costs, and consequently makes it easier for part time workers to enter the labour market. For the economy at large, this is an external benefit because it reduces the tax burden of employees and employers, because more people become employed.[84]

Negative externalities from congestion

It can be argued that the individual use of Internet increases quadratically with the capacity of the network, and decreases with the disutility of delay (see Shy, 2001). A negative consumption externality arises if a high consumption level of one user negatively affects the speed or quality

[82] Potentially, telework is an incentive to move at a further distance from the office.
[83] See MuConsult, 2003, section 2.
[84] See Besseling et al., 2005.

of the telecommunication services available to the others. Hence, congestion may negatively affect the use of broadband.

The extent of congestion is limited in the Netherlands. It is absent on the backbones, due to the large overcapacity and probably limited on the local loops. In case of normal use, the copper local loops also have sufficiently capacity partly due to their technical nature. Each end-user has its own wire to the common switch box. In consequence, there is no interference with other users on the last mile after the switch box. Only in the switch box itself may arise a mutual dependency, if many users decide to surf at the same time at high speed. In practice, this does not occur regularly due to a combination of the capacity of the switch box and the rule of large numbers (it is unlikely that all users of a switchboard require a large degree of capacity at the same time). Moreover, end-users may overcome this problem of congestion by simply paying for a higher contention rate (i.e. the ratio of guaranteed to maximal bandwidth). This contention rate determines the minimum speed if all other end-users use there connection at the maximum. Moreover, if the other end-users are sharing the same network providers, the network provider internalises this externality. Lower contention rates lead to lower demand.

Customers using cable networks may possibly be to some extent mutually dependent. The connections along cable differ with the one-to-one dedicated technology of the copper networks. Nevertheless, if dependency exists, its size is small and likely decreasing over time as cable network owners are constantly improving the quality of their network (see also section 5.2 investments) driven by the current competitive pressure. Moreover, suppliers of content (e.g., websites) may improve and optimise their services by enhancing their server capacity to overcome congestion problems in terms of ‘server too busy’. Additionally, from a welfare-economic point of view, these externalities are not a severe problem, because an unsatisfied customer can easily switch to other Internet service providers on the copper local loop.

5.4.2 International evidence

The international literature on consumption externalities is rather sparse and mainly oriented to the relationship between broadband and a reduction of road congestion because of telecommuting. It does not provide additional information to the review on national arguments.

5.4.3 Need for policy change?

Before embarking on the need for a policy change, it is important to take into account the following. Although the size of the effect of broadband on telework and labour supply is unknown, we guesstimate that economic actors themselves can internalise most of the benefits (i.e. direct effect). Hence, a small part is probably external and that may be a reason for policy makers to consider intervention.

With respect to reducing road congestion, other policy measures are more effective than broadband subsidies, as the latter are not directly seized upon the target that generate the market failure. Government may, for instance, consider pay-as-you-drive policies (e.g. road pricing) to reduce congestions.[85] Similarly, it is questionable whether subsidies for specific end-users are a better option to increase labour supply. Government already stimulates people to attend the labour market via a number of channels (e.g. adult education and social security taxes).

5.5 Politically unwanted equity results

5.5.1 Present situation in the Netherlands

The objectives of broadband policy need not to be purely economic. Government can intervene to change the market outcome based on motives like justice, security, and removing inequalities between different income groups, and differences in the use of particular services. Here, we focus on the inequalities argument in terms of geographical and social digital divide.

It is debatable whether the existence of a geographical or social divide should be linked to connectivity in terms of availability of networks or in terms of availability of (universal) services. At least, the former is a necessary condition for the latter to be transmitted. Moreover, these kind of services are mostly obtainable via existing distribution channels as well. For instance, elderly taxpayers can resolve tax issues either via the Internet website – if they are connected – or he/she can go directly to the counter of the tax office. Here, we define geographical and social divide in terms of the availability of networks, because data is easier obtainable.

Geographical digital divide

Do people or firms in rural areas in the Netherlands have less access to broadband networks than those in other regions? This question is important for at least the following two reasons. The first reason is that consumers without access will lag in current welfare as they cannot use the benefits of broadband. Secondly, the long run prospects of productivity gains in unconnected areas are less optimal. The employees in these regions get fewer incentives to acquire up-to-date broadband competences to apply in their work, as they cannot build up experience at home. Moreover, the firms where they work cannot profit from the (external) production effects.

We did not find evidence for a substantial geographical digital divide in the Netherlands. A major reason for the absence of a regional digital divide in the Netherlands is the availability of at least two networks that are able to provide broadband access. Almost everyone has access to DSL. In fact, KPN covered already 99% of the Netherlands in 2004.[86] Likewise, cable networks are available to approximately 90% of all Dutch households.[87] Even in remote areas, most

[85] See Besseling et al., 2005, for a discussion of pros and cons of several different types of road pricing.
[86] Source: KPN, 2005, pp. 19. The high coverage is supported by figures of 2002 provided by http://www1.oli.tudelft.nl/adsl/, quoted in Statistics Netherlands, 2003, pp. 57.
[87] http://www.vecai.nl/portal/alias__Rainbow/lang__nl-NL/tabID__3330/DesktopDefault.aspx.

people can usually choose from a variety of about thirty Internet subscriptions (see box).[88] The only difference between the big cities and the remote areas is that citizens in the big cities even have more choice, not only in number of providers, also in the assortment per provider.
In addition, no evidence of geographical price discrimination comes forward from a comparison between the subscriptions (rates) which are supplied in Amsterdam compared to small villages as Metslawier and Zuiddorpe (see also section 4.4). The prices and facilities of all service providers were equal in the three places on May 13th, 2005. OPTA (2005d) also concludes that there appears to be no price differences in DSL across regions in the Netherlands.

Degree of consumer choice between Internet subscriptions, 2005

Consumers can choose between roughly 80 Internet subscriptions in densely populated areas and between approximately 30 in remote areas. The table mentions the number of subscriptions a consumer can choose from, in the largest cities and in some randomly selected remote areas.

Choice in Internet subscriptions by region

	Postal code	Number of available subscriptions
Amsterdam	1011 ER	85
Rotterdam	3012 NC	85
The Hague	2585 JR	83
Remote areas		
Luttelgeest (NO Polder)	8315 AH	33
Garsthuizen (Groningen)	9923 PC	33
Metslawier (Friesland)	9123 JZ	34
Valthermond (Drenthe)	7876 GA	29
Reutem (Overijssel)	7668 TC	29
Vragender (Gelderland)	7134 RD	29
Zuiddorpe (Zeeuws Vlaanderen)	4574 NP	29

Source: http://www.2surf.nl/ date: May 4th 2005.

Another contributing element in the absence of a geographical divide is that the average connection costs to broadband like copper lines and cable are low, because the Dutch population density belongs to the highest of the world.

Social digital divide

Today, a social digital divide is to some extent apparent in the Netherlands. This divide is linked to the labour market. In the course of time, however, this type of divide will largely disappear due to a cohort effect.

Table 5.5 reveals the split in 2003. Almost all young, married and highly educated people have a PC at home, and almost all of them are connected to the Internet. In contrast, the majority of people older than 65 years does not have a PC at its disposal and hence does not

[88] Naturally, exceptions do exist but the people involved are a very small group.

have Internet. In addition, people with the lowest income levels are also relatively less connected to the Internet. For both groups, the main reason to remain e-illiterate is that they feel no need to use Internet. The price is hardly a bottleneck for an Internet subscription.[89] Consequently, the fact that these kind of people do not use Internet, suggests other preferences.

Table 5.5 Penetration of Internet by social groups, 2003

	PC at home %	Internet connection %
Total population	80	68
Social groups		
Young, married and highly educated	95	85
Housekeeping/housewives	68	55
Lowest income quartile	NA	39
Only basic education	NA	34
Older than 65 years	33	24

Source: SCP, 2004, PC at home: Table 5.3, Internet connection: Table 5.4.

The social digital divide is mainly related to labour market issues. Educated (working) people almost certainly use Internet at home.[90] In contrast, the lowest skilled workers have a larger probability to be e-illiterate as their work requests less use of Internet.[91]

5.5.2 International evidence

A common concern in many countries is that people in rural or sparsely populated areas will be unable to access the benefits of broadband in education, health and government services. The quick scan of Dialogic (2005) underlines the (worldwide) issue of the roll out of infrastructure in sparse populated regions.[92] Although the relation between population density and investment in broadband infrastructure seems to be widely acknowledged, differences relating to other variables such as income and ethnicity are disputed.[93]

Starting from the observed geographical digital divide, it is repeatedly suggested that broadband Internet provision (or in older literature, dial-up internet provision) should fall under the framework of USO. The argument is that in order to prevent social exclusion and unequal opportunities, broadband should be available in all regions at an ‘affordable’ price. Government should intervene and subsidise or cross-subsidise regions where private parties are reluctant to

[89] Statistics Netherlands, 2003,

[90] Note that a mutual strengthening effect of Internet experience might occur between work and private purposes. What you learn at your work, you can apply privately, and what you learn privately, you can apply at your work. These reinforcing activities may lead to higher productivity.

[91] The people with only basic education hardly work with monitors (only 13% in 2000). Source: Statistics Netherlands, 2003, graph 4.3.3.

[92] Dialogic, 2005, pp. 22.

[93] Grubesic, 2002, and Prieger, 2003.

build infrastructure and provide services. In the EU, similar regulations exist for ordinary telephony services, electricity supply, postal services etc.[94]

Currently, both the OECD and the European Commission conclude that the criteria for USO are not met.[95]

OECD

In 2003, the OECD published a report on this issue.[96] It concludes that at that stage, there is no convincing case for USO for broadband. Broadband is largely a means of faster web browsing, downloading, etc. and as such it is presumed to provide no new *essential* services that could cause social exclusion for the unconnected. Moreover, the report argues that the perceived digital divide is no different from other technology divides, and is rather symptomatic of much deeper social and economic gaps. Yet there could be a time when penetration levels would reach a threshold where it becomes crucial for participation in society. Therefore, the report suggests that periodic reviews of the scope of USO be made.

The report also adopts an economic (cost-benefit-analysis) perspective on the desirability of universal service. From that point of view, it argues that subsidisation programmes could discourage private investment and slow down adoption in (overcharged) urban regions. Also, the costs of provision in rural areas are generally high, while the benefits are highly uncertain.

In 2004, an overview of rural broadband development in OECD countries strengthened these conclusions.[97] Rapidly increasing private entry in the provision of broadband in rural regions – often using various wireless technologies – is reported across the OECD. Even the provision of DSL or wireless in communities of only a dozen subscribers is becoming economically viable. Contrary to expectation, rural prices are sometimes even lower than in urban areas, and performance can be superior.

European commission

In 2000, a report by WIK for the European Commission aimed to justify a re-examination of USO in telecommunications.[98] It argues that there are three basic justifications for a USO: economic efficiency, the provision of a merit good, and redistribution. Redistribution, the report argues, is best achieved through income support, and it is dropped as valid motivation for USO. Subsequently, market failures, and particularly externalities are seen as the principal reason for imposing USO. Social exclusion, electronic citizenship, and electronic democracy are subsequently prompted and discarded as alternative non-economic arguments for Internet USO.

[94] Footnote EU document and Poort et al., 2005.
[95] See for a theoretical model of the effects of a USO for broadband: Foros et al., 2003. For a systematic analysis of the economic effects of USOs, see: Poort, et al., 2005.
[96] OECD, 2003a.
[97] OECD, 2004b.
[98] WIK, 2000.

Likewise, arguments supporting the mandatory rollout of broadband (as opposed to lower speeds) are deemed insufficiently convincing, for reasons that are similar to the ones given in the OECD-report, namely distortion of the competitive process, and costs outweighing the benefits. Just like the OECD-report, WIK suggests to monitor the developments in future. If external benefits might arise, government policy could be reconsidered.

Such reconsideration took place in May 2005, with a similar outcome. Based on the observation that only a small, albeit rapidly growing proportion of the EU population makes use of residential broadband, despite the availability to, the European Commission concludes the criteria for a USO are not met. After all, this would require the service to be “necessary for normal participation in society, such that lack of access implies social exclusion” (European Commission, 2005b, pp. 9).

In July 2005, the Digital Divide Forum reported on the state of affairs concerning a digital divide with respect to broadband (European Commission, 2005b). By January 2005, broadband was available to 90% of the EU-15 urban population compared to 62% of the rural population. However, this disparity seems to be mostly a time lag, as rural coverage increased by 40% in 2004, while take-up in those areas more than doubled.

Hence, the report calls for caution not to inhibit market incentives and innovation, nor to distort competition. In addition, it states that: “*the difference between coverage (88% in EU15/EEA) and take-up (10% in EU15/EEA) and the lower propensity to use broadband in rural areas suggests the importance of stimulating use through Inclusion policies that go beyond the territorial access issues”* (European Commission, 2005b; pp.4).

Nevertheless, at least 4.7 million broadband would-be users are said to be excluded by commercial rollout in 2013 in the EU25. This may justify public intervention, in order to “*give a new meaning to living in remote areas”* and make rural areas more attractive for business people, families with young children, etc. (*ibid.* pp. 20). Authorities could intervene by using Structural Funds, public private partnerships, and exchange of best practices. Attention should be paid for these initiatives to minimise distortions of the competitive process, leave room for local decision-making based on local circumstances, and integrate access policies with stimulating skills and digital literacy.

Country experience

Notwithstanding the positive observations about the provision of broadband infrastructure in rural regions, and the advice against imposing a USO at this stage, several countries have taken action in this direction. Korea, for instance, announced an almost-universal service obligation for broadband with transmission speeds that exceeds most common DLS and cable services on offer. Sweden has also enacted universal access to broadband and allocated financial support to achieve this (see box). In the United States, there are also several Federal and State programmes supporting rural broadband development. The largest is the Federal Rural Broadband Access

Loan and Loan Guarantee Programme. In this programme, US$ 1,4 billion in loans is available for rural initiatives (in communities up to 20.000 people). At state level, there is a variety of programmes, ranging from grants, tax credits and low interest loans to rights of way regulation. Many target rural areas specifically.

In addition, both the FCC in the United States and the European Commission are promoting broadband over the electricity grid – Power line communication – as a means to enhance the availability of broadband, particularly in rural and sparsely populated regions. They aim to do this by removing regulatory barriers that this technology experiences.[99]

Universal services for broadband infrastructure in Sweden and Korea

In 2000, the Swedish government presented the Bill 'An information society for all', stating that within a few years all households and businesses would have access to broadband. The primary role would be for the market, while it was up to the government to make sure the entire country would be covered and to maintain competitive neutrality. The government allocated US$ 1 billion for financial support and for building a backbone to every municipality. Regional networks in rural areas that were unlikely to be serviced commercially could also be funded from public resources. Municipalities are required to fund at least 5% of the project cost and to choose an independent operator, while government funding covers 33-89%. To our knowledge, municipalities are not allowed to own the network.

In 2002, Korea declared that broadband Internet would become a universal service. The main goal is for 90% of Koreans to have access to a connection of 20 Mbps by 2007. Already in 2003, 20 Mbps VDSL service was offered in some densely populated regions. For rural areas the standard is set at 1-8 Mbps. In 2004, the government announced a US$ 60 million investment to expand broadband access in rural areas with more than 50 households. Apart from universal service provision, the Korean government has gradually shifted its attention to developing e-government applications, and training users (see ITU, 2003, pp. 4).

5.5.3 Need for policy change?

To summarise, there are no clear redistribution arguments for a USO to connect rural underserved regions or other social exclusions. Neither the OECD nor the European Commission advocates a USO for broadband infrastructure as yet. The EC emphasises the following. As far as a digital divide would exist, intervention should not distort the competitive process, leave room for local decision making based on local circumstances, and integrate access policies with stimulating skills and digital literacy.

Geographical digital divide

As both in urban and in rural areas coverage in the Netherlands is close to 100% of all households, this means that there is no digital divide as defined by the European Commission. Almost everyone has potential access to broadband networks and the linked services. This is a partly consequence of the high density of the Dutch population, and the historical availability of two networks.

[99] Commission Recommendation of 6 April 2005 on broadband electronic communications through powerlines (2005/292/EC) and 'Plugging in, at last', The Economist, 2-12-2004.

In conclusion, there appears to be no reason for Dutch policy makers to develop a regional policy. The aforementioned EC policy options have no direct relevance for the Netherlands due to the high coverage. Moreover, as other emerging technologies like satellite and power lines might become more attractive in the future, it is questionable whether the geographical digital divide will still be an issue with respect to broadband. These technologies might be able to close the gap in the future if those remote regions become financially attractive.

Social digital divide

Elderly and low-income groups currently lag behind in the use of broadband. Neglecting preferences for the time being and the issue of broadband being a USO, if policy makers find it important that such people should be able to use broadband and know more about the internet, targeted training programmes and possibly subsidising computer ownership for specific groups or availability of broadband in public places such as libraries could be options to be further explored.[100]

In this respect, the government should beforehand consider the following. First, cross-subsidies may give dead-weight-losses of various kinds, generally leading to a decrease in social welfare. In addition, this digital divide seems to be less reason for concern since it will decline in the course of time. The rate of illiteracy of elderly will diminish as the next generations elderly (i.e. the baby boomers) will be more and more experienced computer users. Low-income groups will probably have to use more Internet on their job as it is likely to be integrated in all kind of work activities. Finally, both employees and employers have an interest in using broadband as both parties can benefit from it: higher productivity and higher wages.

5.6 Conclusions

The main findings of this chapter can be summarised as follows:

- In the Netherlands, positive network effects appear to be materialised due to compatible networks. The (national) networks are technically compatible as they all use standard protocols. Network providers and ISPs have sufficient incentives to comply with international standards and interconnect their networks. Therefore, with respect to network externalities, no market failure exists. Hence, no additional government measures are required. Moreover, standardisation and compatibility are international issues.
- Although empirical evidence is lacking, it is likely that broadband produces positive production externalities. These concern (1) the knowledge spillovers of R&D activities by firms active in broadband development and (2) stronger spillover effects of existing knowledge creating activities. Although these externalities may justify government intervention, they do not justify

[100] Another aspect on this issue is the need of care for elderly. Digital delivery of care is an interesting option. This issue is, however, related to the government as producer of public services and therefore further discussed in chapter 6.5.

government stimulation of broadband deployment. After all, it is the knowledge creating activities, like R&D, that generate the positive externalities. The government already takes account of these externalities in the form of R&D-subsidies as the WBSO.

- Negative external production effects of digging are present as private parties face insufficient incentives to minimise these effects. This coordination problem is already taken care off by public authorities.
- Broadband may stimulate telework and in doing so may generate consumption externalities. For instance, broadband may stimulate to work at home. Externalities might occur due to less road congestion and perhaps even increase labour supply as broadband might stimulate more people to participate on the labour market. A higher labour supply implicates lower overall social premiums and taxes. For both examples, alternative policies (e.g. road pricing and labour market policies) are more effective. Furthermore, other factors, such as the attitude of employers to teleworking, may be much more important than high-speed data connections.
- On the issue of equity, we come up with two findings. There is no serious geographical digital divide in the Netherlands. Most households have access to either DSL or cable. To some extent, a social digital divide occurs and this finding is linked to labour market issues. Elderly people and low-income groups have relatively less Internet connections. In the course of time, this digital divide will diminish as next generations will be more and more experienced computer users. Moreover, neither the OECD nor the European Commission advocates a universal service obligation for broadband infrastructure.

6 Concluding remarks

Using the conclusions formulated in the former chapters, this chapter assesses current government policy, both on the national level and the local level. On both levels, policy measures can hardly be based on the presence of market failures. On the contrary, many policy measures face the risk of incurring serious government failures, e.g. by making an inefficient technology choice. Governments have, however, a major task in permanently monitoring competition on broadband markets, as technological and economic developments may give rise to new dominant positions.

6.1 Introduction

The key questions of this report were whether current market failures hamper current deployment of broadband and which policy options efficiently deal with those market failures. The main lesson of our analysis is that market failures are limited and mainly related to market power on the copper local loop and production externalities. Regulation by OPTA and R&D-subsidies, respectively, seem to address both market failures adequately. Hence, in principle, there is no need for additional policy measures. On the contrary: other policy measures easily result in government failures. As this conclusion is based on the analysis of the current broadband markets, we have to determine its sustainability by paying attention to possible future market failures (section 6.2). Having formulated a conclusion on both current and future market failures, we will be able to assess current government policies, both on the national level (section 6.3) and on the local level (section 6.4). Finally, we look into the role of public authorities as economic agents using broadband (section 6.5).

6.2 Future market failures

6.2.1 Introduction

Economic policy that is optimal to address current market failures does not need to be optimal if future market failures would be known in advance. Anticipation of future market failures may lead to a change in current policy intending to enlarge future welfare. To grasp the issue of future market failures, future visions on developments on the supply-side (i.e. technological developments), the demand-side (i.e. preferences of consumers), and the market structure should be taken into account first.

6.2.2 Future trends in supply, demand and market structure

Although it is difficult to make reliable forecasts for the technological opportunities and demand for broadband (services), it is reasonable to assume that broadband penetration and the use of broadband services will further increase in future. Technological improvements – such as higher access speed, better routers and further compression techniques of content – seem not to be exhausted yet. In that respect, it is assumable that the costs of supplying broadband will decline and quality will be further increased. As a result, the adoption of broadband access will further rise. Although it is not exactly clear what consumers' demand will look like in the future, it is for sure that the bandwidth of broadband will enlarge, since end-users will demand more speed demanding features like videoconferencing, safety and gaming. It suggests a continuation of current trends. Moreover, if demand for applications is beyond a critical mass, it is to be expected that growth in demand tends to stimulate further growth (i.e. a bandwagon effect). Complementary products will make all services more attractive.

The ongoing growth of the broadband market will likely coincide with changes in the market structure. Digitalisation of communication technology strongly reduces the boundaries between different infrastructures increasing the competition in the industry. In response, firms are engaging in an international process of vertical and horizontal integration in order to realise economies of scope and scale as well as to increase market shares. As a result, telecom companies, cable companies and firms from the software industry, using different infrastructures, increasingly compete in the provision of networks, services as well as content (such as TV, internet and phone).

The key question in this respect is whether this process will end in new dominant market positions. For instance, will there be one prevailing technology? In the Netherlands, the current situation is that copper lines and cable are the most important technologies. It is expected that for the short term, this situation will not change dramatically. The geographical conditions in combination with the connection costs are in favour for these technologies compared to other technologies like satellite, Wifi, and glass fibre. The current situation, however, might change in the longer term, although it is also possible that different technologies will co-exist on the market.

As stated, it is expected that the significant market power of KPN on the unbundled local loop will continue in the short run. OPTA already adequately deals with this problem and monitors developments. In this regard, it is important to monitor the consequences of vertically-integrated telecom firms. These types of firms may have incentives to hinder downstream competitors. As argued as well, broadband enables knowledge spillovers today and it will do so in the future. These production externalities are, however, already being tackled by R&D-subsidies. No significant evidence is available that other market failures will occur in the near future.

6.2.3 Consequences for policy: continuing monitoring of the industry[101]

Market failures that are present today are already dealt with. It is most likely that current market structures and current economic policy also give sufficient incentives to invest in broadband. Changes in this policy are only needed if changes in market failures become evident. Although

[101] Here, we disregard equity issues as driving force for policy makers to change broadband policies.

unforeseen developments may occur, we conjecture that such failures will emerge gradually, if at all. Moreover, if some type of market failure become apparent, for instance, after 10 years, it is very difficult to oversee the consequences for current policy and hence to set up robust policy today.

In addition, broadband policy is no free lunch. Firstly, subsidies would have to be financed by taxes which distort the economy. Next, government may not outperform the market if intervention involves choosing or preferring certain technology options. Finally, the allocation of subsidies requires manpower. Government policy, therefore, may involve considerable costs. The reasoning that "it may not help, but it won't hurt either" cannot defend government action. This conclusion applies both at the national level and the local level. Further, policy measures can hardly be founded on the presence of market failures according to this report.

We conclude that the most efficient policy is to permanently monitor the broadband markets in order to determine whether additional ex ante (i.e. regulatory) measures are needed or ex post (competition) measures will need to be taken. Continuous monitoring is required in order to be able to respond rapidly with regulation and supervision if firms with significant market power in broadband markets would emerge. It is possible that one dominant broadband technology will emerge in the future resulting in a natural monopoly network. In that case, regulation has to ensure that market power is not abused. However, the option for regulation should not give rise to uncertainty, as this may negatively affect current investment decisions. Certainty about future regulatory conditions and access tariff structures can be very important for potential investors now.

6.3 Broadband policy of the central government

6.3.1 Policy aims and instruments

Referring to the ICM-report (2004), the Dutch government states that market parties hold primary responsibility for investments in further development of the new generation of broadband-type infrastructures and development of accompanying services. It also argues that if the public interest is challenged as result of a lack of competition or if some commercially unprofitable areas are excluded, then public authorities in cooperation with private parties could consider stimulating broadband initiatives. Generally, this ICM-report identifies three aims for (semi) public authorities encouraging the rollout of broadband infrastructure, i.e. 1) internalising external effects for firms and consumers, 2) improving effectiveness and quality of semi public authorities, and 3) strengthening the economic position of cities or regions.

In order to reach these targets, the government distinguishes three types of policy measures:

- Coordination in digging

- Strengthening demand by subsidising end-users
- Demand bundling to create a critical mass

In implementing these measures, the (local) authorities should prevent distortion of markets. It is seen as undesirable if public money is used to compete with private parties without a thorough justification in terms of externalities. In this respect, the government formulated a number of requirements to prevent market distortion, such as transparent tendering, neutrality on technology choice and non-discriminating access rules.[102]

6.3.2 Assessment

The first measure, *coordination of digging activities*, is already discussed elsewhere in this report. The government has an explicit role in coordinating digging activities as market parties fail in efficiently dealing with this issue.

The second one, *subsidising end-users*, has only a welfare-economic basis if either market failures or equity issues prevail. Then, governments might consider supporting end-users to use some kind of infrastructure or services. Chapter 5 concluded that there is to some extent an equity issue with respect to elderly and low-income groups. To overcome a potential social digital divide, strengthening demand by subsidising elderly might be a remedial action to be considered. On the other hand, the EC does not classify broadband as universal service. In addition, it is expected that the number of 'have not' will decline over time. Moreover, before embarking on specific subsidies, it should be considered whether other measures achieve this objective more efficiently.

The final domain to promote the use of broadband is *demand bundling* of private and/or public parties to create a critical mass and generate network effects. Usually, market parties themselves try to generate sufficient demand by using marketing strategies. If, however, market responses do not take place and hence, the network effects are not explored at large, then demand bundling can be an interesting route for government to deploy the markets for broadband. Public authorities can bundle their own demand or demand of other economic agents to create economies of scale in the supply of broadband.

Bundling the demand of firms, however, might be counterproductive and, hence, inefficient as it may obstruct market initiatives, for instance, reducing the service supply to other firms. In that case, a serious government failure emerges. Such a failure also emerges if the government chooses an inefficient technology and, hence, distorts the market by backing the wrong horse. Before doing so, a cost-benefit analysis seems advisable. A less risky option is to operate more passively. Government could stimulate the business sector to find innovative solutions through open tendering (i.e. launching customer). Another option is to encourage experimentation (in the semi-public services) to gather more information than the market would gather on its own.

[102] Other requirements are: prevention of conflict of interests between public authorities, guaranteeing free choice by customers, only charging real use of broadband services, no conflicts with European State Aid-rules, and prevent cartels.

Although both options can be an interesting contribution to stimulate the development of broadband, the main aim of the government as economic agent should still be the production of public services in effective and efficient ways (see section 6.5).

6.4 Broadband policies of local public authorities

6.4.1 Policy aims and policies

Given the regulation of parts of the broadband market and other policy options to cope with production externalities, it is interesting to observe that some local authorities (including building societies) in the Netherlands still consider local initiatives to (financially) stimulate the deployment of broadband. Examples of these local initiatives are the municipalities of Appingedam, Amsterdam, Deventer and Eindhoven.

In 2004, the municipality of Appingedam decided to rollout and to explore a glass fibre network itself. In addition, the central city Amsterdam has specific plans to support the construction of a fibre-optic access network. The city has advanced plans to participate in an initiative to rollout fibre to approximately 40,000 dwellings, as incumbent operators are viewed to be too reluctant to deploy glass fibre in the near future.

The Kenniswijk Initiative in Eindhoven was aimed at developing a broadband infrastructure, with the intention of stimulating broadband facilities and services for consumers. Initiated by the Ministry of Economic Affairs, consumers taking part in this project received a subsidy. This experiment started in 2000 and ended in October 2005.

The municipal authority of Deventer started ‘DevEnter Breed’ at the end of 2004 in order to increase the use of broadband by small and medium sized enterprises, schools, health care institutions and municipal services. DevEnter Breed is attainable in a strictly defined geographical area consisting of the city and its near surroundings, private individuals like households are excluded. Deventer has negotiated a 5-year contract with infrastructure providers KPN and Essent in order to rollout glass fibre to end-users and to install a virtual market place where these end-users can buy and sell products. Firms are free to participate. If they decide to participate then they can choose between KPN and Essent at subscription prices which are set to a maximum. Both KPN and Essent may provide services on each others network. The investments of the municipality of Deventer in this project are negligible. Of course, the project is not without cost. The costs for Deventer mainly consisted of labour costs on negotiation, the hours spent to form and adjust ideas to new broadband opportunities, searching costs to find launching customers among Deventer’s enterprises, and the subsidy (i.e. 1500 euros) for the first hundred clients. The next few years, some expenses will be made on the supervision of the contract.

6.4.2 Assessment

An important issue in the assessment is whether these initiatives of municipalities distort the broadband market. In general, the European Commission considers investments of municipalities in new broadband networks as state aid if these networks compete with existing broadband networks (article 87 (1) EC). In the case of Appingedam, the court of Groningen ordered the municipality to stop its activities immediately. The court stated that the municipality might restart if the EC considers the activities of Appingedam not as state aid. Additionally, Amsterdam has explicitly asked the EC to look at its case as, in the view of this municipality, the project confirms with the market economy investor principle, i.e. it does not distort the market.

Recently, the EC published an article on state aid rules and public funding of broadband.[103] This article expresses present views of the EC based on findings of several projects involving support to broadband development in underserved areas. Nevertheless, the EC unequivocally states that these views might evolve over time, as more information becomes available. According to the latest views, public authorities might invest in broadband infrastructure on the same market conditions as for private investors. In that case, there is no state aid. Another option to consider government intervention not to be classified as state aid is, when a government would decide to build the infrastructure that is made available to all operators on non-discriminatory terms and limited to basic civil works and *unserved areas*.

In the case of both Appingedam and Amsterdam, the answer of the EC whether or not these cases are seen as state aid is not yet known.[104] Additionally to the EC-views, it is important to state that 'market initiatives' of local authorities can create a conflict of interest as local authorities are also acting as regulator for private parties.

Another issue is the effectiveness of local broadband policies. According to a recent study of Wallsten (2005) that assesses a number of policies, most state-level policies in the United States are ineffective. Although the analysis is not without problems and contains weaknesses, it concludes that programs targeted at underserved areas do not boost broadband penetration. These types of programs may even reduce it by giving an artificial advantage to one type of provider over another. Additionally, tax incentives appear to have no effect. In contrast, access to public rights-of-way by broadband providers turns out to be strongly correlated with penetration.

To gain overall knowledge of broadband and the potential role of government, a larger number of empirical studies assessing broadband impacts for the Netherlands would be most welcome. The Dutch government could stress the importance of such research. Profound analysis of

[103] See EC, 2005c.

[104] To our knowledge, both municipality initiatives are neither based on a profound analysis of market failures, nor on any type of cost-benefit analysis.

experiments and various pilots such as Deventer model and Kenniswijk can provide empirical information to make conjectures about costs and benefits (see box).

Local benefits versus national welfare gains

Assessments of local experiments are important to gain knowledge. These assessments, however, should also take into account the gains for the Dutch economy as a whole. Even if the experiment of Deventer may turn out to be successful to the municipality of Deventer at large, it should be emphasised that extrapolation to the Netherlands as a whole, probably gives more costs. The reason is that the cost of glass fibre deployment in Deventer is relatively low due to the fixed area and the high density of small and medium firms and local institutions. If the area is further extended, costs will increase. Moreover, the overall costs will be higher if households as end-users are included as well.

6.5 Public authorities as users of broadband

6.5.1 E-government activities

Hitherto, we mainly focussed on the role of government as policy maker. The government is, however, also an economic agent as well. It produces (semi) public services such as education, health care and national security.[105] Telecommunication including broadband can contribute to increase efficiency of the production process of government organisations.

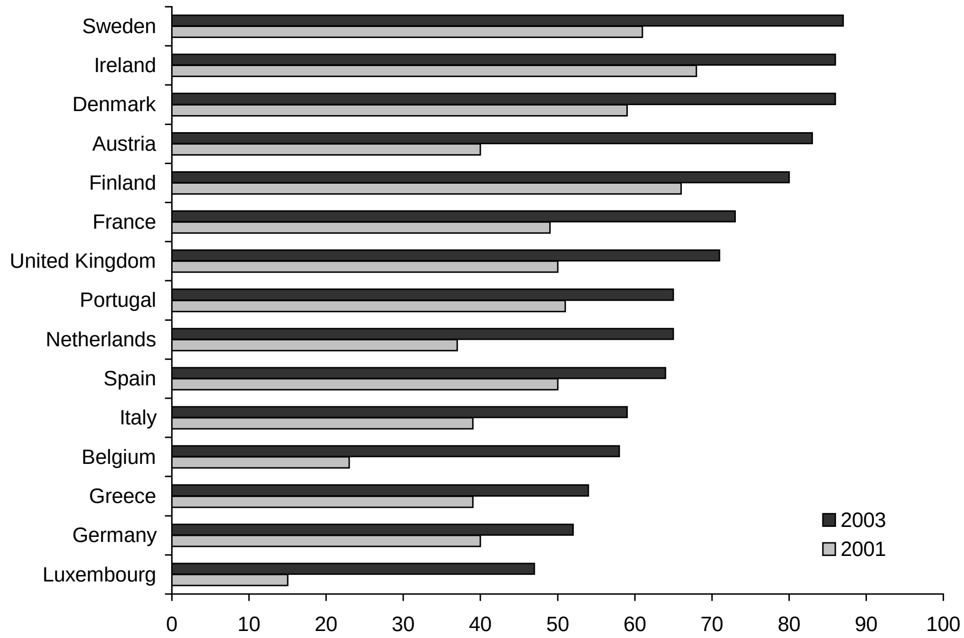
The Dutch government's policy to invest in ICT and broadband to supply better and cheaper public services can therefore be an effective and efficient way to increase economic welfare. Examples of its investments are 'electronic government', 'ICT in semi-public sectors' and 'e-democracy'. It is beyond doubt that society will benefit from these developments, as using up to date technologies can improve the production of these public services.[106] Moreover, authorities may think of offering existing services or even new services through broadband (i.e. websites of municipalities, tax declaration, remote consultation in health care and graduate education). The ideal result is that those services can be produced with fewer inputs.

Looking at the available data, the performance of the Dutch government in using telecommunication is modest compared to other countries (see figure 6.1). Particularly on e-government services, the Netherlands scores less than many other countries. Accenture (2005) annually calculates an e-government score for a number of countries. This score is based on a host of underlying indicators relating to the service maturity and the customer service maturity. Among 22 countries studied for the 2005 score, the Netherlands takes a joint tenth position. This position has been rather stable over the last few years (11th in 2002; 13th in 2003; 9th in 2004). Canada, the United States and Singapore consistently occupy the first three positions. An alternative assessment of e-government looks at the 'online sophistication of basic public services available on the internet'. Figure 6.1 gives the scores for 2001 and 2003. In this period,

[105] These services have in common that they are difficult or even impossible to produce by private parties, because the market does not exist or fails to account for its externalities.
[106] Provided that the costs do not exceed the additional surplus due to broadband.

the Dutch score improved from a 13th to an 8th position in the EU-15. The availability of Dutch online government services was still below the EU-average, despite substantial improvements.

Figure 6.1 **Share of online government services (in %), 2001 and 2003**



Source: Statistics Netherlands, 2005: The EU-15's New Economy. A statistical portrait.

6.5.2 Assessment

Generally, a hospital or university can improve its performance by using (more) broadband. However, in practice, it turns out that it is difficult to implement new telecommunications technologies to improve the supply of public services. Difficulties that are referred to are, inter alia, fragmentation, lack of economies of scale and lack of transparency (Verrips, 2005). Next, it is stated that not all the benefits and costs are accounted for by the ‘decision-maker’. Problems also include a mismatch between demand (government) and supply (private parties) in terms of what is exactly needed to improve the production process of public services.

These problems largely come down to coordination problems hindering implementation of new processes or products.[107] For instance, coordination problems arise if involved (semi-public) parties of the production chain do not cooperate, nobody of them is taking the lead or a lack of institutions exists. In general, these problems can be largely solved if the government itself ensures and stimulates the interaction between different parties including exchange of best practices.

Moreover, part of the problems are also related to the lack of (sufficient) competition in (semi-) public services, and hence the principal-agent problem. Public servants or public agencies may have different targets from those defined by politicians resulting in less cost-

[107] In that respect, these kinds of problems are occasionally refered to as system failures.

conscious. In these cases, introducing some kind of competition element, such as yard-stick competition, may be a better policy than providing additional budgets to invest in ICT and broadband.

Concluding, although telecommunication techniques may contribute to the performance of (semi) public authorities, the introduction of these techniques appears to be hindered by inefficient coordination between demand and supply as well as the lack of competitive incentives. Improving these factors will raise the penetration of broadband in government organisations.

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Appendix A Prices of the Internet market

Question

To analyse the prices of the Internet we pose the following question: Does the consumer market of Internet operate sufficiently in Amsterdam today? In order to give an answer, we split this question in the following questions:

- What are the impacts of the determinants on the Internet subscriptions prices in Amsterdam, May 13th, 2005?
- Which part of the differences in monthly subscription rates can be determined by quality related determinants? Which part can be explained by determinants of possible market imperfection and which part cannot be explained at all by the available variables?

We assume that the consumer market for Internet operates well in Amsterdam in May 2005, if the determinants of quality significantly explain the subscription rates, the determinants of possible market distortions do not have a significant impact, and the unexplained part is small.

Method

Regression analysis

The regression analysis aims to explain the monthly subscription prices of Internet (in euros) that are available at Amsterdam, May 13th, 2005, by the determinants listed in table A.1. The table shows which determinants we classify as linked to quality or possible market distortions. For each determinant, the table shows the unit of measurement and their potential impact if the hypothesis is true that the market operates well.

Hypotheses signs coefficients

- If the downstream and upstream speeds are faster, the consumer wants to pay for it and the subscription rate is higher. We also assume that the price rises less per extra bit per second. Therefore, we analyse the impact of linear and quadratic speeds on the price.
- If there is a maximal download limit during a month, the consumer will pay less for this monthly subscription rate compared a rate with no limits. Consequently, the higher the download limit, the more a customer wants to pay.
- If the consumer must pay for the (over-off) connection costs, he will pay less for his monthly subscription rate than a consumer who gets his connection for free.
- If the provider charges a modem, the monthly subscription rate will be lower compared with a provider who does not charge a modem.

- If the (connection) costs in the first year are higher, the monthly subscription rate will be lower to compensate for these high connection costs.
- We hypothesise that there is perfect competition. Then the price is given to each provider and network owner. Then their names (=dummies) have no significant impact on the price. If a dummy does have a positive significant impact, it signals that the provider or network owner has to some extent market power.

Residuals

We interpret the total absolute size of the residuals as indicators of the degree of market transparency and adjustment costs. The reason is that there are no residuals if the consumers are fully informed and there are no switching costs.

Table A.1 Determinants Internet subscription rates

Hypothesis: market operates well	Unit of measurement	Hypothesis impact on subscription rate
Quality related		
Downstream Speed	Bits per second	+
Upstream Speed	Bits per second	+
Download limit	No, fair use, limit	+
Once-only connection costs	Euros	–
Modem	Euros	–
Possible market imperfections		
Is the provider the network owner?	Yes = 1, No = 0	0
Name provider	Name specific dummies	0
Network owner	Owner specific dummies	0

Data

- The figures were downloaded from http://www.2surf.nl/, May 13th, 2005. The postal code is 1011 ER, house number 1. This postal code belongs to an address in Amsterdam.
- There are 86 subscription rates, which are explained by 30 determinants, of which 16 providers (=dummies), and 6 networkowners (=dummies).

Results

We carried out the regressions in the following three steps.

Step 1: Price given for providers and owners networks

Table A.2, column variant 1, lists the regression results if all variables are included. It appears that the hypotheses of the impact of the downstream speed, download limit, the purchase of a modem are not rejected, as the signs are according to the hypotheses and statistically significant. The negative sign of the squared downstream speed indicates that the rise of the subscription rate decreases with the size of the downstream speed. The upstream speed has no significant impact on the subscription rate, although the signs are as expected. It indicates that the customers attach little value to the upload speed. The once-only connection costs also have the expected sign, but is not significant. The price is not affected by the fact that the provider is the network owner. From this point of view, the market is not disturbed by the ownership of the network by the Internet service provider. The fit is rather well, as 80% of the variation is explained by these determinants. This result confirms the hypothesis that the market is rather transparent.

Table A.2, column variant 2, presents the results if the non-significant variables of variant 1 are omitted. It turns out that the signs of the significant variables are hardly affected.[108] This also holds for the fit. The explanation of the variation of the subscription rates is lower by only 1% to 79%.

Table A.2 Estimated coefficients explanation subscription rates

	Variant 1	Variant 2
Quality related		
Downstream speed linear	6.90 (6.00)	7.90 (11.47)
Downstream speed squared	– 0.20 (3.41)	– 0.24 (5.28)
Upstream speed linear	5.25 (0.27)	-
Upstream speed squared	1.10 (0.07)	-
Download limit [a]	0.63 (2.17)	0.65 (2.47)
Once-only connection costs	– 0.06 (0.64)	– 0.07 (0.79)
Modem	– 0.15 (1.84)	– 0.16 (2.06)
Possible market imperfections		
Providers owns network (yes=1, no=0)	0.60 (0.27)	-
R^2	0.80	0.79

Between brackets t-ratios
[a] stated: Fair = 3000 Mb, no limit =10,000 Mb (all limits divided by 1000.

Step 2: Market power? Successive dummies

In order to find out if providers or network owners have more or less market power than on average, we carry out regressions with dummies for each provider and network owner. In principle, we could make one regression, which includes all dummies together. However, we do not do that, because it would imply that only 86 prices are explained with 30 determinants. Therefore we take another approach. We carry out a regression for each provider and network owner (dummy) separately combined with all determinants of variant 2 in table A.2. The results are copied in table A.3, column step 1.

We add successively 22 (=16 providers + 6 network owners) dummies to the standard equation and run 22 regressions. Column step 2 presents the results. We do not mention the estimated

[108] Hence, the omitted variables are not correlated with the remaining variables.

coefficients of the quality determinants of table A.3, step 1, because these are different for each equation. Here, we only focus on the impact of the dummies. The fit differs between the regressions. We present the lowest and the highest R^2 of the 22 regressions.

It turns out that the subscription rates of XS4ALL and Freeler are significantly higher (if corrected for the quality-determinants), and that the rate of Speedlinq is significantly lower. Moreover, the price is higher if the network of KPN is used, and lower if the information is transferred along the networks of Wanadoo and Tiscali. There are many interpretations. It is unclear if the impacts of these dummies are related to omitted quality aspects (such as reputation, better service in call-centres etc.) or to abuse of market power. The estimation results do not reveal the real cause.

Step 3: significant determinants only

In order to find the best explanation we combine the findings of steps 1 and 2. We explain the monthly subscription rates by the significant determinants of step 2. The result is shown in column step 3. It turns out that the download limit and Freeler do not have a significant impact anymore. More importantly, almost all variation (90%) in the subscription rates can be explained by these variables.

Table A.3 Explanation subscription rates

	Only quality related Step 1	Without restrictions Step 2	Only significant Step 3
Quality related			
Downstream speed linear	7.90 (11.47)	Not shown	8.36 (16.01)
Downstream speed squared	– 0.24 (5.28)	Not shown	– 0.27 (7.69)
Download limit	0.65 (2.47)	Not shown	– 0.01 (0.05)
Once-only connection costs	– 0.07 (0.79)	Not shown	– 0.17 (2.44)
Purchase modem	– 0.16 (2.06)	Not shown	– 0.16 (2.82)
Possible market imperfections			
Name provider			
Wanadoo		– 3.86 (0.96)	
XS4ALL		12.03 (2.60)	6.98 (1.89)
Tiscali		– 0.39 (0.10)	
12Move		0.56 (0.08)	
Fibreworld		1.92 (0.44)	
Het Net		– 1.59 (0.33)	
Planet		6.14 (1.35)	
Chello		3.10 (0.96)	
Speedlinq		– 9.43 (2.94)	– 7.95 (3.12)
Compuserve		– 0.64 (0.19)	
Quicknet		– 2.51 (0.57)	
KPN		3.05 (0.63)	
Freeler		12.13 (2.40)	2.10 (0.50)
Concepts ICT		1.58 (0.23)	
Leaseweb		– 5.69 (1.39)	
Versatel		– 4.82 (0.80)	
Network owner			
Wanadoo		– 23.80 (3.86)	– 22.17 (4.42)
KPN		10.30 (5.23)	4.81 (2.37)
Tiscali		– 8.05 (3.41)	– 5.93 (2.90)
BBNed		– 2.33 (1.03)	
UPC		3.10 (0.95)	
Versatel		-4.82 (0.87)	
Fit: R^2	0.79	Minimum 0.70 Maximum 0.84	0.90

Between brackets: t-ratios

Appendix B Prices and speed in 2004 and 2005

The price of Internet subscriptions has fallen sharply between 2004 and 2005. Table B.1 shows the prices (monthly subscription rate) and the transmission speed per second. It turns out that the (unweighted) average price per kbps declined with 58% between 2004 and 2005. The prices per kbps of almost all providers fell. This decline was due to much more bits per second, while the subscription rate remained the same.

Table B.1 Prices of subscription, 2004-2005

	Prices		Speed	
	2004	2005	2004	2005
	Euro		Kbps	
Athome budget	17,95	17,95	64	256
Het Net Instap Surfen	19,95	19,95	384	800
Wanadoo Cable Broadband Easy	19,95	19,95	256	850
Zon/Versatel Breedband Family	29,00	29,95	768	1024
Multikabel Family	29,00	29,00	768	768
Athome basis	29,95	29,95	312	768
Chello light	32,95	32,95	1024	2048
Planet Internet ADSL Standard	34,90	34,90	1024	1600
Tiscali Family	39,95	39,95	2048	4096
Freeler Comfort	49,95	49,95	2048	3200
XS4ALL Basic	59,95	59,95	2048	3200
Concepts ICT ADSL Wide Open	64,95	64,95	2048	8192
Demon DSL Express 2048 - 8192	65,00	65,00	2048	8192
XS4ALL Fast	79,95	79,95	4096	8000
Chello Plus	79,95	79,95	4608	8000

Source http://www.webwinkel.nl/ (May 2005).

Appendix C Economic benefits versus external effects

Broadband and productivity gains

Broadband is a source for productivity growth through improvements in production processes, reductions in transaction costs and innovations, such as service applications. In general, it can affect the economy, and, more specifically, labour productivity through three channels (see, e.g. Van der Wiel, 2001):

- Production of broadband equipment;
- Use of broadband as an input in the production process of firms;
- Spillover effects of broadband.

First, the domestic production of broadband network and software applications can contribute directly to labour productivity growth. Technological progress is going very fast in this field resulting in one-liners as better, quicker and cheaper. The production of these types of products can, therefore, generate productivity growth in the producing sector itself, leading to falling prices of broadband equipment. As a result, the demand for these products increases, pushing up labour productivity to rapid growth rates at the macro level.

Second, a country or firm can also profit indirectly from broadband networks and equipment in the production process by capital deepening. Driven by price substitution, firms themselves can raise their productivity by the adoption and use of broadband through investments in broadband. More and better broadband per worker contributes to higher productivity if the (marginal) productivity of this type of investment is larger than the average productivity of the firms. Both effects, however, fade away over time and the effect of broadband investments on labour productivity growth will disappear. What is left is a level effect on productivity in the long term.

But there is a third channel, that is that broadband also may have the potential to generate higher enduring labour productivity growth due to externalities and spill over effects. As discussed in section 3.4, broadband may provide positive network effects among firms. An investment in communication equipment, such as e-mail, may have a positive impact not only for the investor, but also for all other users. These network externalities are larger as the level of standardisation rises. Broadband may also contribute to creation of new goods among both producers and customers due to spillover effects of knowledge. The latter is related to the endogenous growth theory, that technology progress is based on accumulated knowledge and not manna from heaven, as the exogenous growth theory assumes.

Empirical findings for channel 1 and channel 2, are most of the time to a large extent robust. For instance The Allen Consulting Group (2003) and CEBR (2003) came up with impressive results. However, empirical evidence for spillover effects are absent (see also Dialogic, 2005).

Economic benefits versus externalities

Even though these aforementioned studies provide fairly consistent evidence for a positive relationship between broadband and economic performance, the underlying studies do not refer and answer the question whether these are truly *externalities*, and why the market would fail to produce these benefits. Economic benefits and externalities are not the same. As a matter of fact, this report is only interested in externalities, as these are related to market failures.

Chapter 3 revealed that there are arguments that private parties can often internalise the benefits of these production effects. In that case, from a welfare economic point of view no problem exists. In practice, most economic benefits in terms of productivity gains may be internalised by changes in prices.[109] This is not the case if knowledge spillovers are at stake, implicating that the social returns exceeds private returns. For instance, particular information gathered by firms with access to the Internet may be open to all (non-excludable) and downloading may not deplete the information (non-rivalrous). Firms that generate this information cannot appropriate all rents, because other firms can benefit from this information in terms of (free) knowledge and new products. Hence firms are reluctant to invest in Research & Development (R&D) themselves as long as they cannot fully internalise the benefits.

[109] Even though in some cases such as health care, the link between the party that benefits from broadband and the party that pays for it can be very weak or complex (see chapter 6).