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The impacts of network effects and multi-service provision on consumer switching costs in the Swedish telecommunications market

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THE IMPACTS OF NETWORK EFFECTS AND MULTI-SERVICE PROVISION ON CONSUMER SWITCHING COSTS IN THE SWEDISH TELECOMMUNICATIONS MARKET

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ABSTRACT

The Swedish telecommunications market has been liberalised since 1990s. Liberalisation gave an opportunity to several new entrants to enter to the market. Consumers also gained benefits from more telecom providers and services to choose from, and lower telecom prices. The Swedish telecom market is now more competitive than it was in the pre-liberalisation period. However, the telecom market is somewhat different from other markets. Network effects and high consumer switching costs are main features and crucial issues for competition in this market. Incumbent operators tend to use some induced network effects strategies, such as tariff-mediated network effects, local network effects, and multi-service provision to raise switching costs of consumers and gain more competitive advantages.

The thesis aims to investigate the impacts of two main strategies of telecom providers, network effects and multi-service provision, on consumer switching costs. The impacts of tariff-mediated network effects and local network effects have been examined in the Swedish mobile communications market. The findings suggest that tariff-mediated network effects can lock-in existing mobile subscribers to larger mobile operators. Interestingly, tariff-mediated network effects could not be used by larger mobile operators to gain new mobile subscribers during the period of study. However, larger mobile operators can potentially utilize tariff-mediated network effects to increase their market share in later stages. In addition, the results show that local network effects can create switching barriers, particularly for customers of larger mobile operators since they receive lower monthly bills than customers of smaller operators. Hence, they are less likely to switch to smaller operators.

Furthermore, most of telecom providers in Sweden are multi-service provision providers. They provide various broadband access technologies and several telecom services. The empirical results reveal that mobile broadband (MB) is a substitution service to fixed broadband (FB). Broadband providers can encourage their customers to migrate from MB to FB technology within the same carrier. This suggests that multi-service provision in broadband Internet access can raise consumer switching costs. Additionally, the results also show that multi-service providers can utilize their economies of scope together with a discount to create switching costs for their customers, since consumers tend to buy more telecom services from them. This indicates that the current consumers of these providers are locked in. Search costs and the uncertain costs may also encourage consumers to use the service from the service provider of which they already have experience. Therefore, multi-service providers who have a dominant position in a specific telecom service could utilize their position to encourage their existing customers to buy more services.

The thesis provides policy recommendations to reduce consumer switching costs and enhance the level of competition in the telecom market. A bill-and-keep interconnection scheme is proposed to reduce and prevent the potential impacts of tariff-mediated network effects. A bill-and-keep can also hinder incumbents from setting a high termination charge to raise the off-net prices of their rivals. Additionally, revised broadband market definitions should be instituted since there is evidence of substitution between MB and FB. The market for bundle services also needs to be explicitly defined. Precise market definitions will lead to more accurate market analysis.

Keywords: switching costs, termination-based price discrimination, calling clubs, tariff-mediated network effects, local network effects, broadband Internet, multiple-service, Sweden.

APPENDED PAPERS

This thesis is based on the work in the following papers.

Paper I Srinuan, P., Bohlin, E., and Madden, G. (2012). The determinants of mobile subscriber retention in Sweden. *Applied Economics Letters*, 19 (5), pp. 453 - 457

Paper II Srinuan, P. (2011). Termination-based price discrimination and mobile subscriber attraction in Sweden. An earlier version was published in *IEEE explore*, 9th Conference on Telecommunications Internet and Media Techno Economics (CTTE). Under review for publication in Nordic and Baltic Journal of Information and Communication Technologies.

Paper III Srinuan, P. and Bohlin, E. (2011). Paying less with local network effects? An empirical analysis of the Swedish mobile communications market. Presented at International Telecommunications Society (ITS), Asia-Pacific Regional conference, 2011, in Taipei, June 26 – 29, 2011.

Paper IV Srinuan P., Srinuan C., and Bohlin E. (2012). Fixed and mobile broadband substitution in Sweden. *Telecommunications Policy*, 36 (3), pp. 237 – 251. Special issue on Services, regulation and the changing structure of mobile telecommunication markets, Henten, A., Tadayoni, R., and Whalley, J. (Eds.).

Paper V Srinuan P., Srinuan C., and Bohlin E. (2011). An empirical analysis of multiple services and choices of consumer in the Swedish telecommunications market. Presented at International Telecommunications Society (ITS), European regional, 2011, in Budapest, September 18 – 21. Under review for publication in a special issue of *Telecommunications Policy.*

ADDITIONAL PAPERS

The following papers were also written during the PhD study, and some of them have parts that are relevant to the thesis.

Srinuan, P. and Bohlin, E. (2009). Mobile number portability: Evaluating the Swedish mobile communications market. Presented at the conference on the economics of ICT, TelecomParis Tech, 2009, in Paris, France, June 18 – 19.

Srinuan, C., Rohman, I.K., Srinuan.P. and Bohlin, E. (2010). Digital divide in ASEAN countries: Explaining the gap. In P. Gugler and J. Chaisse, (Eds.), *Competitiveness of ASEAN Countries: Corporate and Regulatory Drivers, New Horizons in International Business*, London: Edward Elgar, 153-172.

Srinuan, C., Srinuan P. and Bohlin, E. (2011). Entry relaxation and an independent regulator: Performance impact on the mobile industry in Asia. In D. Jarvis, M. Ramesh, X. Wu and E. Araral (Eds.), *Infrastructure Regulation: What Works, Why, and How do we Know it? Lessons from Asia and Beyond*, Singapore: World Scientific Publishing, 83-108.

Srinuan, P., Annafari, M.T., and Bohlin, E. (2011). An analysis of switching behavior in the Thai cellular market. *Info*, 13(4), 61 – 74.

Srinuan, C., Srinuan, P. and Bohlin, E. (2012). An analysis of mobile Internet access in Thailand: Implications for bridging the digital divide. *Telematics and Informatics*, *29*(3), 254-262.

Srinuan, C., Srinuan, P., and Bohlin, E. (2012). Exploring Mobile Pricing Strategies and Innovations in Thai Mobile Communication Market, in *Proceedings of the Regional International Telecommunication Society (ITS) Conference*, Delhi, India, 22-24 February.

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Pratompong Srinuan

May, 2012

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LIST OF ABBREVIATIONS

2G	Second generation of mobile technology
3G	Third generation of mobile technology
4G	Fourth generation of mobile technology
CDMA	Code division multiple access
DSL	Digital subscriber line
EU	European Union
EC	European Commission
FB	Fixed broadband
FTTH	Fibre to the home
GSM	Global system for mobile communications
HSPA	High speed packet access
IPTV	Internet protocol television
ITU	International Telecommunication Union
KKV	Konkurrensverket, the Swedish competition authority
LLU	Local loop unbundling
LTE	Long term evolution
MB	Mobile broadband
MNP	Mobile number portability
OECD	Organisation for Economic Co-operation and Development
PTS	Post-och telestyrelsen, the Swedish telecom authority
SMP	Significant market power
SNPAC	Swedish Number Portability Administrative Center AB
UMTS	Universal Mobile Telecommunications System

1. INTRODUCTION

"Regulation is presumed to be designed to avoid (potential) market failures, usually because of firms' market power, the consequence of which leads to a decrease in economic welfare. However, the cost of regulation may outweigh any effects policy makers have on the firm due to administrative costs, regulatory capture and other effects that have been addressed by others. . . .Thus, those distorting effects are equally as bad, or worse than, the market failure regulators hoped to ameliorate."

(Alleman & Rappoport, 2005)

1.1 Background

Telecommunications markets in many countries have been liberalized since the 1990s. Liberalization processes include licensing, establishment of telecom regulator, and market entry regulations. Licensing schemes, as well as, market entry regulations (e.g. interconnection and local loop unbundling) have been established to facilitate market competition. In addition, telecom regulatory authorities have been formed to reduce the conflicts of a government acting as both owner and regulator, meanwhile telecom state-owned companies have also been privatized (Bohlin, 1993) and private companies have been issued licenses to provide telecom services. As a result, several entrants have entered the markets. Market entry regulations also provide an opportunity to new entrants to either connect their own networks to the networks of incumbents, or lease these networks. Therefore, the telecom market is currently more competitive, and telecom tariffs, particularly for mobile service, have declined significantly in developed countries, when compared to the pre-liberalization period.

Though liberalization has taken place, the telecom market remains somewhat different from other markets. Incumbent operators seem to have competitive advantages over new entrants. The telecom market shares important features as network industries. The main features consist of significant economies of scale in production, network effects, the need for compatibility and standards, and complementarities in demand and switching costs for consumers (Shy, 2001). Therefore, these features tend to favour incumbents and very often make competition, particularly entry, less competitive (Farrell & Klemperer, 2007).

Network effects and switching costs are crucial factors for competition in a telecom market. It is obvious that network effects exist in this market (e.g. Katz & Shapiro, 1985; Shy, 2001; Farrell & Klemperer, 2007). The decisions of consumers in subscribing to telephony service depend on how many other people are also on the network (both mobile and fixed telephone networks). Then, telephone networks must be interconnected and the interconnection must be a compulsory condition in order to enhance the benefits of network effects. Otherwise, consumers would prefer to subscribe to the larger network rather than the smaller one, so as to be able to call a larger number of people. Therefore, larger networks will become even bigger and more attractive to future consumers, compared to smaller networks.

Consumer switching costs are also important in this market. Changing from one telecom operator to another can potentially result in a less favourable situation for customers. Mobile subscribers can be confronted with high switching costs, and, in particular, with transaction costs. For example, they need to provide information about their new telephone number to their social network. Consequently, it is possible that certain customers will remain with their existing operator, even though they are not satisfied with it.

In the mobile communications market, even though several mobile operators participate in the market and some necessary regulations, such as number portability and mandatory interconnection, have been

introduced due to the liberalization efforts of the 1990s, competition in mobile communications services remains limited. Only three or four major mobile network operators take most of market shares in a country (OECD, 2009, p. 59). This is of course due to technical barriers to entry – the scarcity of a spectrum or limited number of spectrum licenses. Furthermore, incumbent operators can utilize the main features of network industries by introducing strategic instruments that will raise switching costs and enhance the benefits of network effects to bind consumers to their networks (Valletti & Cave, 1998). These strategic instruments include:

- SIM-card locking
- Termination-based price discrimination
- Multiple-standards
- Differential coverage, and roaming
- Calling clubs

Mobile operators, for instance, introduce termination-based price discrimination to compete for subscribers. They set different per minute prices for different calls. Calls made within the same network (on-net) are cheaper than calls made via rival networks (off-net). On/off-net price differentiation will make on- and off-net calls incompatible, even though there is full interconnection (Grajek, 2010). This will prompt new customers to favour the larger mobile operators since most of their calls will make within the larger mobile operator (if new customers expect to have a balanced calling pattern). At the same time, it will limit incentive to switch mobile operator for consumers of larger mobile operator. In other words, this will lead to higher switching costs for these consumers, and will limit competition in the mobile communications market.

In addition, telecom operators in several European countries, including Sweden, have multi-service provision. The operators can produce a number of complementary services and deliver them through the fixed network. Complementary services include fixed telephony, broadband Internet access, and pay TV. In Sweden, most of fixed telecom providers provide mobile telephony, as well as mobile broadband. Telecom operators recently put these services into a basket and sell it at a single price (known as a “bundled package”) and prices of bundles are generally cheaper (since telecom operators offer a discount) than buying them separately. This may indicate that telecom operators utilize special features in telecom market, such as compatibility and economies of scope, together with bundled strategy to attract customers, to create switching costs and maintain their market position.

Telecom operators in Sweden not only provide various complementary services, but they also offer multi-service with broadband Internet access or substitution services in broadband Internet access in the market. They supply various broadband Internet technologies, both fixed broadband (FB) such as DSL, cable modem, fibre, and mobile broadband (MB). Importantly, comparable speed and prices of MB are crucial factors for significant growth in MB adoption. Some consumers consider using MB as their main broadband Internet access, instead of FB. Telecom operators may encourage their customers to migrate from FB to MB services within the same operators. Migration from FB to MB provides an opportunity for telecom operators to avoid FB regulations. At the same time, operators will not lose their customer base. As a result, multi-service provision in broadband Internet access by telecom operators will create consumer switching cost through their economies of scope.

It is more likely that multi-service telecom providers could utilize strategic instruments in mobile telephony market and economies of scope to raise consumer switching costs. Hence, it is crucial to examine the impacts of, in particular, termination-based price discrimination and calling clubs on consumer switching costs in mobile communications service. Also, it is important to scrutinize the impacts of multi-service provision on switching costs from the perspective of the telecom regulator's point of view.

1.2 Purpose and research questions

This dissertation aims to investigate the impacts of network effects, driven by termination-based price discrimination and calling clubs, and multi-service provision on consumer switching costs, in the Swedish telecommunications market. The main research question is:

"What are the impacts of network effects and multi-service provision on consumer switching costs in the Swedish telecommunications market?"

To answer this question, two sub-research questions are formulated. The first sub-research question investigates the possible impacts of termination-based price discrimination and calling clubs (through tariff-mediated network effects and local network effects, respectively) on consumer switching costs. Three studies are performed and investigated these impacts in the Swedish mobile communications market. The last sub-research question investigates the possible impacts of multi-service provision on consumer switching costs, both relating to broadband Internet access and other complimentary telecom services. Two studies conducted use the Swedish telecom market as case study (see Figure 1). All of the studies employ quantitative methods as the main method of analyses. However, different statistical methods are applied in order to answer different research questions in each paper. The sub-research questions are developed as following:

RQ1: What is the impact of termination-based price discrimination and calling clubs on consumer switching costs?

In the Swedish mobile telephony market, mobile operators can utilize several strategic instruments (e.g. termination-based price discrimination, SIM-card locking, and calling clubs) without any restriction. It is crucial to examine the impacts of termination-based price discrimination on consumer switching costs through subscriber retention and subscribers' decision. As mentioned, termination-based price discrimination can potentially yield more benefit to the larger operators than to the smaller ones. This will impact on switching decisions of mobile subscribers as well as initial decisions to select mobile operators. In addition, the decision of a consumer to subscribe to a specific mobile operator could be influenced by his/her social network or calling clubs. In other words, a consumer may take his/her calling clubs into account when subscribing to a mobile operator. This is known as a local network effect. Then, it is also important to investigate the impact of calling clubs on subscribers' decisions, as well as consumer switching costs caused by termination-based price discrimination.

RQ2: What is the impact of multi-service provision on consumer switching costs?

As mentioned, several telecom network operators in Sweden are multi-service providers in retail markets. They mostly offer complementary services, such as various options for broadband Internet connections. In addition, they own both fixed and mobile network infrastructure. They may utilize their resources and capabilities to raise consumer switching costs. Therefore, the last two studies are conducted to show the impacts of bundling and the existence of FB and MB substitution on consumer switching costs.

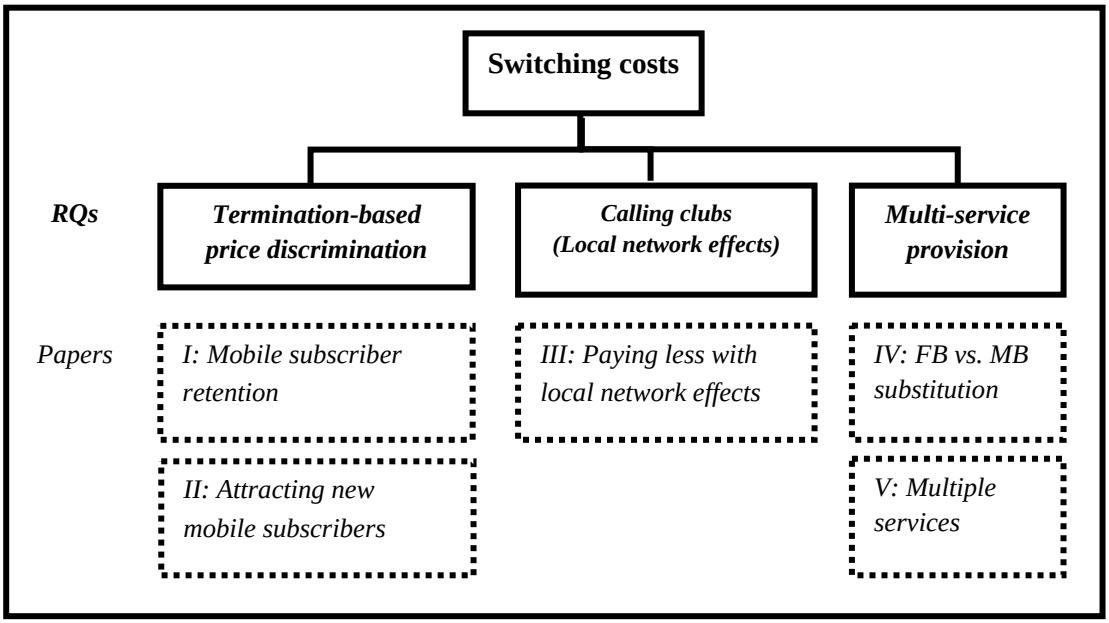

Figure 1The main components of the thesis

Source: Author

These two research questions are based on economic theory, which will be explained in Chapter 3. Similarly, the discussion on how RQ1 and RQ2 contribute to the main research question and also the reasons behind the five studies are described in Chapter 4. A simplified overview is given in Figure 1.

1.3 Scope and delimitation

The thesis focus is limited to study on the impacts of network effects and multi-service providers on switching costs in the Swedish telecommunications market. The thesis investigates mobile telephony, broadband, and multiple services markets. However, there are several strategies that telecom operators can apply to create consumer switching costs. The strategies include hand-set subsidies and long-term contracts in mobile telephony, and executive rights and long-term contracts in providing broadband services in apartment buildings. Future research can take these issues into considerations. The different examinations have different purposes, and the periods of study in the different appended papers can vary.

1.4 Structure of the thesis

The thesis is organized as follows. An industry overview is given in Chapter 2. Chapter 3 provides a review of the relevant literature and theoretical frameworks. Methodology is presented in Chapter 4. Summaries of the appended papers are given in Chapter 5. The analysis and discussion are provided in Chapter 6. The thesis ends with comments on future research in Chapter 7.

1.5 Applied terminology and definitions

Bundling	Telecom operators put more than one service into a package, which they sell at a single price. The prices of bundling packages are usually cheaper than buying the additional services separately.
Calling clubs	Based the phenomenon that individuals do not place their calls randomly across networks, but have a bias toward repeated

	calling other members of their calling clubs (their friends) (Gabrielsen & Vagstad, 2008).
Local network effects	Local network effects refer to benefits that make a smaller group of adopters more valuable than an entire population of adopters. Calling club and termination-based price discrimination can be considered as sources of local network effects.
Mobile communications market	The market includes the provision of voice, SMS and data communications services.
Mobile number portability	Gives an opportunity to mobile subscribers to retain their mobile telephone number while changing mobile operator.
Multi-service provision	The ability of telecom operators who can offer several complementary services (i.e. fixed telephony, mobile telephony, broadband Internet, and pay TV services). They can also provide several broadband Internet access technologies (i.e. DSL, cable, fibre, and mobile broadband).
Network effects	Subscribers gain more benefit from an additional subscriber joining a network. For example, both mobile and fixed subscribers receive higher benefits if there is an additional mobile or fixed subscriber joining the communications services network.
Switching costs	Switching costs are all costs associated with switching from one provider to another. These costs occur even when the services are functionally identical, and can be measured in both monetary and psychological terms (Klemperer, 1995; Chen & Hitt, 2007).
Tariff-mediated network effects	This term, defined by Laffont et al. (1998), means that under price discrimination, consumers are charged different prices according to whether the call terminates on the same network or a rival network. Thus, positive (or negative) network effects exist if the access price embodies a markup (discount) relative to marginal cost. Intuitively, a network discriminates against or in favour of the rival network depending on where it finds it cheaper to terminate calls.
Termination-based price discrimination	Retail tariffs are applied at different rates for different calls. Calls made within the same mobile operator network are cheaper than calls made via rival mobile operator networks.

2. AN OVERVIEW OF COMPETITION IN THE SWEDISH TELECOMMUNICATIONS MARKET

This chapter is divided into three sections according the telecom services that have been investigated in the thesis. The first section provides the progress of development in competition on the Swedish mobile communications market. In addition, it discusses how mobile operators utilize some of strategic instruments to compete and raise consumer switching costs. This section also explains how the Swedish telecom regulator responds to those strategic instruments in order to reduce consumer switching costs in mobile communication market. The development in broadband Internet in Sweden is discussed in the following section, which contains information about broadband penetration, shares of broadband Internet technologies, and major market players and their market shares. Moreover, competitive strategies are also discussed in this section. The last section supplies the explanations of the current state of bundled services. That section contains the bundled penetration in Sweden and discusses how major telecom operators utilize their existing position and bundles to gain market recognition.

2.1 Competition in mobile communications services

This section explains the progress of competition in mobile communications market in Sweden, including the historical background of telecommunication liberalization and market structure. The development of mobile regulations is also discussed. The section ends with an explanation of mobile operators' strategies, subscriber lock-in, and subscribers' retention decisions and their determinants.

2.1.1 Liberalization forces and market structure in the Swedish mobile communications market

The telephone was first introduced in Sweden in 1877 with free competition and several firms, both private and state-owned companies starting to provide switched telephone calls (Bohlin, 1993). This indicates that there was rather intense competition between telephone players (Thorngren, 1990) and there was at first no legal monopoly in telecommunications services, including mobile communications services. Anyone could set up a network to provide services in competition with the dominant state-owned operator, Televerket (Gruber, 2005, p. 84).

In the initial stage of providing mobile services, there were two mobile operators, Televerket and Comviq (whose current name is Tele2). The latter being a private company and entered into the market in 1981 (Thorngren, 1990). Comviq faced many difficulties in competing with Televerket since Televerket had complete control of the regulatory aspects pertaining to competition, including spectrum allocation and interconnection. For example, Televerket several times rejected Comviq's applications for frequencies to supply digital mobile communications services (Lindmark, 1995, p.70). This created a conflict of interest as Televerket was both an operator and a regulator, and was using its dominant position and the role of rule-maker to distort its competitor's ability to compete. Then, the process of liberalization began with a parliamentary decision in the early 1990s in order to resolve this conflict and provide a level playing field for all telecommunications service providers (Bohlin, 1993).

In 1992, an independent regulatory body, the PTS, was finally entrusted with the responsibility for all telecommunications regulations, including spectrum allocation (Gruber, 2005, p. 86). The first Telecommunications Act was introduced in the following year. The aim of the Telecommunications Act was to establish the conditions for an open telecommunications market. The Act also contained special provisions such as an interconnection and numbering plan. Moreover, this Act entitled the regulator to issue licenses that contain special conditions and can set special rules for all operators

(KKV, 1997, p. 12). In addition, Televerket was transformed into a state commercial enterprise – Telia AB – in the same year. Telia, in fact, wanted to be a limited liability company in order to 'compete on the international markets for the profitable large customers' (Hultkrantz, 2002). Telia wanted to conduct ventures in mobile services and mobile data services, and construct fixed telecom network in other European countries (Bohlin, 1993).

Moreover, a third mobile operator, Europolitan (later known as Vodafone, and now Telenor), obtained GSM licenses from the telecom regulator in 1992. This enabled Sweden to become the only country in the world with three competing GSM networks in the 900 MHz range, right from the start (Gruber, 2005, p.86). Nevertheless, the Swedish telecom regulator made efforts to open the mobile communications market with new mobile communications technology.

In December 2000, the PTS decided to issue four new licenses for the provision of network capacity for mobile communications services, based on UMTS technology. These licenses were allocated to Europolitan (now Telenor), Hi3G, Orange and Tele2 (PTS, 2001). Unfortunately, Orange later returned its license because of financial difficulties. Meanwhile, Telia cooperated with Tele2 in the combined company, SUL AB, where they shared the 3G license of Tele2[1] (PTS, 2006). Thus, there are currently four mobile network operators, Telia, Tele2, Telenor, and Hi3G. Three of these operators can offer 2G and 3G mobile communications services, while the new entrant, Hi3G, can only provide 3G services.

The Swedish telecom regulator not only launched mobile licenses to new network providers, but also provided opportunities to small firms who were interested in becoming mobile communications service providers, in order to increase the level of competition in mobile market. On March 1999, the PTS submitted a proposal imposing an 'obligation to provide network capacity' to the Government through amendments to the Telecommunications Act. The proposal was amended and embodied in Section 23a of the Telecommunications Act. This provision entered into force on 1 May 2000 (PTS, 2001). It allows service providers and mobile virtual network operators to lease the capacity of mobile network operators. The main aim is to encourage small enterprises who cannot afford the spectrum license to enter the market and also to raise the level of competition in this market. In addition, to ensure that mobile subscribers of any operator can be connected at any time and area, PTS proposed national roaming regulation[2] at the end of December 1999 (PTS, 2001). Roaming allows subscribers to use another network when the 'home' network is not available (Hultkrantz, 2002).

Thus, there are currently four mobile network operators[3] and a number of virtual mobile operators in the Swedish mobile market. However, most of the mobile subscribers belong to four of these mobile network operators (see Figure 2).

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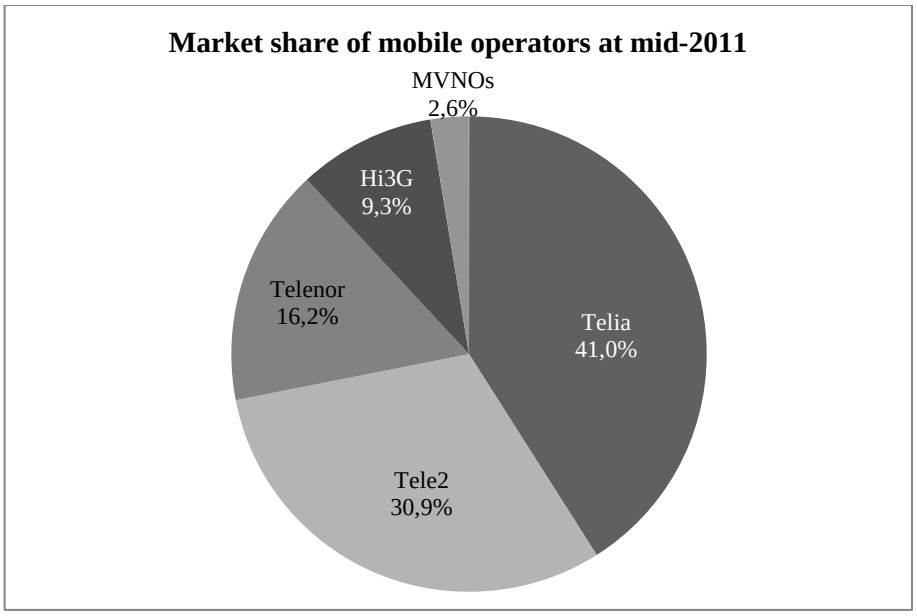
1 Europolitan and Hi3G also formed a joint company to develop a UMTS network.

[2] It was embodied in an amendment to the Telecommunications Act as Section 23b and entered into force on 1 July 2000 (PTS, 2001).

[3] (1) Telia, (2) Tele2 or Comviq in the past, (3) Telenor and (4) Hi3G or Tre as marketing brand.



Source: PTS (2011)

Figure 2 Market share of mobile operators at mid- 2011

2.1.2 Mobile communications regulations

In this sub-section, all mobile communications regulations are discussed as ex-ante regulations. These regulations, dealing with interconnection and mobile number portability, were implemented by the telecom regulator. This sub-section also explains the reasons for introducing these regulations, as well as the current status of the regulations.

(1) Interconnection regulation and cost-based orientation

A key factor to stimulate competition in the telecom industry, including mobile telecommunication, is interconnection. The Swedish Telecommunications Act of 1993 states clearly that "telecom licensees who publicly operate telecom services have an obligation to include interconnection among their networks". This means that all operators that are in the Swedish telecommunications market are currently supposed to conduct interconnections with each other. In this way, all subscribers can reach each other irrespective of which operator's network the subscriber is connected to (PTS, 2003).

Since mobile communication is two-way, mobile operators need both to have calls from other mobile networks terminate on their own network, and to terminate calls from their own network on other networks. Hence, the operators usually pay and charge so-called termination charges.

In the initial stage of regulation, the Swedish telecom regulator used asymmetric regulation due to the 1997 European Interconnection Directive and the Telecom Act, which focus on controlling only mobile operators who have a significant market power position (SMP). The regulator sets several obligations for SMP operators in order to ensure that the mobile market is open for new entrants. There are some necessary requirements such as non-discrimination, transparency, and accounting separation. The most important obligation is to set cost-oriented SMP interconnection charges to make sure that incumbents cannot set high interconnection charges to squeeze rivals' retail prices. This allows new entrants to survive in the market.

Telia was the only mobile operator with significant power in the interconnection market. Therefore, the telecom regulator requested the submission of a calculation basis from Telia in order to review

whether the undertaking's interconnection charges were cost-oriented (PTS, 2003). The cost-oriented model at that time was a conventional rate-of-return regulation based on historical fully distributed costs (Hultkrantz, 2002). For example, the first review of the interconnection charge resulted in the telecom regulator, in May 1999, deciding that Telia should reduce its interconnection charges by approximately 20 per cent, from 2.75 kronor per minute daytime and 1.60 kronor per minute, and at other times, to an average price of 1.89 kronor per minute (PTS, 2001). After Telia's reduction, Tele2 and Vodafone (Europolitan) also reduced their interconnection charges by 20 per cent, although the demand to reduce charges only applied to Telia. Subsequently, all operators reduced their prices in relation to the customers by approximately 20 per cent. This led to cheaper mobile telephony for the consumer (PTS, 2001)[4].

The Swedish telecom regulator also designated Tele2 and Vodafone to be significant market power operators in February 2002, even though the market shares of these operators were lower than 25 per cent, 18.6 and 13.4 per cent, respectively (Hultkrantz, 2002). However, the County Administrative Court has provisionally suspended this decision. Thus, these two companies were not yet obliged to have cost-oriented interconnection charges, but were compelled to charge fair market prices (PTS, 2003).

The new European regulatory framework for electronic communication was adopted in 2002. Under the new framework, all operators are subject to price controls; however, only the early-established operators have an obligation to apply cost-oriented tariffs according to long-run incremental cost (LRIC). Others have an obligation to apply a fair and reasonable tariff. The PTS did not include specified tariffs in its SMP decisions. Therefore, the actual levels to be applied are left for the regulatory authority to decide (PTS, 2006).

Hence, Sweden has changed wholesale and emergent retail regulation. Symmetric regulation has been implemented to replace asymmetric regulation in the Swedish mobile market. This means that every mobile operator has to be regulated in an equal manner. Even though symmetric regulation is applied, it does not mean that symmetric prices are set.

(2) Mobile number portability and mobile communications tariff information disclosure

One of the major obstacles to competition in the mobile communications market is the lock-in of customers' telephone numbers (Gruber, 2005, p. 62). In the past, any mobile subscriber changing mobile communications services supplier also had to change his or her mobile telephone number. Mobile number portability (MNP) was established in order to overcome this obstacle.

MNP means that mobile customers can move from one to another mobile operator while retaining the same mobile telephone number. MNP was introduced in Sweden on 1 September 2001. There are two primary objectives of MNP. The first is to reduce consumer switching costs, in particular for business subscribers which potentially lose revenues if they change their mobile telephone number. The second objective is to achieve increased competition in price and quality of mobile services among mobile network operators and service providers (PTS, 2003). However, there are indications that only five percent of mobile customers take advantage of mobile number portability while they change their mobile operator (SNPAC, 2008).

[4] See more detail on the reviews of interconnection charges from PTS (2001).

A mobile operator usually provides a varied kind of price plan. It becomes a burden to the mobile subscribers to compare prices among mobile operators. The Swedish telecom regulator and the consumer agency realized the importance of search costs, one type of switching costs, for the mobile user. Consequently, a price information website (www.telepriskollen.se) was established in June 2005. This provides the tariff information for all telecommunications services. In particular, this website gives consumers price information for telecommunications service of every telecommunications operator. Subscribers can make personal calculation according to their own habits and needs. In addition, Telepriskollen also includes facts about lock-in and cancellation periods, as well as other important conditions (PTS, 2005). Enabling telecom users to easily compare the prices and conditions of services offered by each telecom operator will result in an increasing level of competition in the telecommunications services market.

2.1.3 Strategies and competitive advantage of mobile operators in relation to subscribers' switching costs

This sub-section explains the mobile operators' price and non-price strategies related to subscribers' switching costs and the competitive advantage of mobile operators. In addition, the subscriber retention decisions and the determinants of retention will be explained.

(1) SIM locking, handset subsidies, and long lock-in periods

Mobile operators have different means of locking in and increasing switching costs for different types of mobile subscribers. Mobile network operators in Sweden use SIM locking for their pre-paid users. SIM locking in the Swedish context is utilized with subsidized mobile telephones. This means that a mobile subscriber purchases a pre-paid card with a subsidized mobile telephone. This telephone cannot be combined with a subscription with any other operator for a certain time period, often 12 months. The telephone continues to be 'operator-locked' even after this period. In order to unlock the mobile telephone, the customer is forced to pay an unlocking fee (PTS, 2001). This creates high switching costs for the pre-paid mobile subscribers who may wish to switch to other operators.

Post-paid subscribers receive a different offer from mobile operators, which is a handset subsidy. This means that a mobile subscriber gets a discount for buying a new handset. The handset is sold at a substantial discount as part of a subscription contract for a lengthy term (often 24 months). In Sweden, mobile operators do not simply give free mobile terminals to their new customers. They apply a monthly payment basis to a customer instead of full-amount payment when a customer wants to subscribe to their network. The mobile customer must agree to a certain subscription period in order to get such a discount. Even though the handset subsidy gives benefits to the mobile subscribers, due to substantial discounts, mobile subscribers have to pay for a longer time using the same mobile operator.

These mobile operator strategies create a long lock-in period to mobile subscribers as well as high consumer switching costs. Nevertheless, mobile operators in Sweden offer these strategies to attract new customers and also retain their own customers without any restriction from the telecom regulator.

(2) Subscribers' retention and the determinants

The price and non-price strategies of mobile operators are not the only way to induce mobile subscribers to remain with their current mobile operators. The mobile operators' characteristics also play an important role in retaining the existing mobile subscribers.

Since 2002, the Swedish telecom regulator has conducted an annual survey of individual use of telecom services, including mobile communications services. According to the 2007 survey, customers who had changed mobile operators in the prior six months constituted 10%, with the remainder (90%) having had no experience of changing their service providers in the same period of time.

The major reasons for continuing to use the current mobile operator are mixed between operators' strategies and characteristics. The operator's characteristics appear to be most important in the decision to remain with the current mobile operator. These include brand image, network coverage, and transparency of billing. However, the operators' strategies, such as low on-net prices and handset subsidies, are also important to the subscribers' retention decision. A further reason for remaining with the current operator is the recommendations of friends and acquaintances (see Table 1).

According to the survey, the most important factor is the first-mover advantage. The mobile operators who established themselves in the market early on are often favourably perceived by subscribers. These operators can also improve the quality of services, i.e. network coverage and customer services over time. Hence, it is worth taking into account the operator characteristics when studying the subscriber's retention decision.

Table 1 Reasons for using the current mobile operators in 2007

Reasons	(%)
Brand image	89
Network coverage	74
Readable and comprehensible phone bill	50
Low rates for on-net calls	42
Well-functioning customer service	42
Recommended by friends or acquaintances	28
Low prices in general	27
Offer flat rates	25
Same call price to all mobile operators	16
Handset subsidy	14

Source: PTS (2008)

(3) Termination-based price discrimination and mobile operators' competitive advantage

The common retail prices for mobile voice communications service in most countries, including Sweden, consist of (1) subscription fees, (2) connection fees, and (3) air charges.

The subscription fee mostly applies to post-paid subscriptions. A fee is typically charged on a monthly basis for access to the mobile network. The charge may in some cases include a certain number of free minutes of airtime. Subscription charges are typically a component of a two-part tariff scheme together with calling charges, whereby a high (low) subscription charge is coupled with a low (high) calling charge.

Connection fees are used with various definitions[5]. In the Swedish context, a connection fee means a fee charged each time a mobile subscriber makes each call. The different mobile operators charge different connection fees (see Table 2).

Air charges are usually based on a per-minute charge. The mobile operators in Sweden usually price calling charges based on the time of day, or peak and off-peak periods. The peak charges are usually more expensive than off-peak rates.

Recently, calling charges based on termination of calls, or termination-based price discrimination, came into wide use by mobile operators in Sweden. The mobile operator fixes the tariffs for calls that terminate on a competing operator's network (off-net calls) at a higher rate than the tariffs for calls that terminate on its own network (on-net calls).

This price discrimination scheme was introduced in Sweden before Hi3G, the new entrant network provider, entered the market. Nevertheless, when Hi3G entered, it used this price discrimination more heavily than the others did. Its strategy involved charging zero per-minute prices for on-net calls and 5 SEK for off-net calls. This proved successful since Hi3G developed a high growth rate of mobile customers[6]. Without a prohibition of termination-based price discrimination, all of the mobile operators have offered similar kinds of termination-based price plans for both post- and pre-paid customers since 2004. Table 1 shows an example of termination-based price discrimination in Sweden at the end of 2003 and 2008.

Table 2 On-net and off-net prices of each mobile operator in 2003 and 2008 (SEK)

	2003					2008					
Operator	connection fee	per minute on-net		per minute off - net		connection fee		per minute on-net		per minute off-net	
		min	max	min	max	min	max	min	max	min	max
Post-paid											
Hi3G	0	0	0	2.5	2.5	0	0.69	0	0.69	0.69	0.69
Tele2	0.4	0.99	5.5	2.5	5.5	0	0.69	0	0.39	0	0.69
Telenor	0.4	3.63	4.95	3.63	4.95	0.79	0.79	0.59	0.59	0.59	0.59
Telia	0.4	2.95	3.5	2.95	5.4	0	0.79	0	0.69	0.39	0.69
Pre-paid											
Hi3G	-	-	-	-	-	0.69	0.69	0.69	1.99	0.69	1.99
Tele2	0.4	5.5	5.5	5.5	5.5	0.69	0.99	0	1.99	0.19	2.49
Telenor	0.5	5.75	5.75	5.75	5.75	0	0.79	0	1.99	0	1.99
Telia	0.4	6	6	6	6	0.5	0.69	0	4.9	0.69	4.9

Source: PTS Statistic Portal

Although Hi3G used termination-based price discrimination heavily and showed a high rate of mobile customer growth in its initial stages, the company still suffers from this discrimination now that all of the mobile operators provide similar price plans. Hi3G customers averaged 61 percent outgoing calls in off-net traffic between 2003 and 2008, while Telia's customers made only 23 percent off-net calls in the same period, as shown in Table 2. This suggests that larger networks can benefit more from

[5] A connection fee can mean an up-front fee that is usually charged for connecting new subscribers to the network (Gruber, 2005, p. 195).

[6] At the end of 2003, Hi3G had 18,056 subscribers, and six months later it had about 111,166 subscribers.

utilizing their network for price discrimination. Without any intervention from the regulator, this can create a potential problem for small operators. As a result, smaller operators may have a deficit access charge and lose profits.

Table 3 Off-net calls percentage for each mobile operator from 2003 to 2008 (%)

Operator	2003	2004	2005	2006	2007	2008
Telia	23.73	16.99	25.63	23.73	25.26	26.21
Tele2	44.54	46.02	18.84	24.35	25.37	24.94
Telenor	49.81	53.85	55.20	57.69	52.21	52.29
Hi3G	65.97	56.85	58.80	63.06	60.99	62.30

Source: PTS Statistic Portal

Hence, termination-based price discrimination offerings by incumbents or larger mobile operators provide a competitive advantage for themselves. Lower prices with larger numbers of subscribers could attract new mobile subscribers as well as retain existing ones.

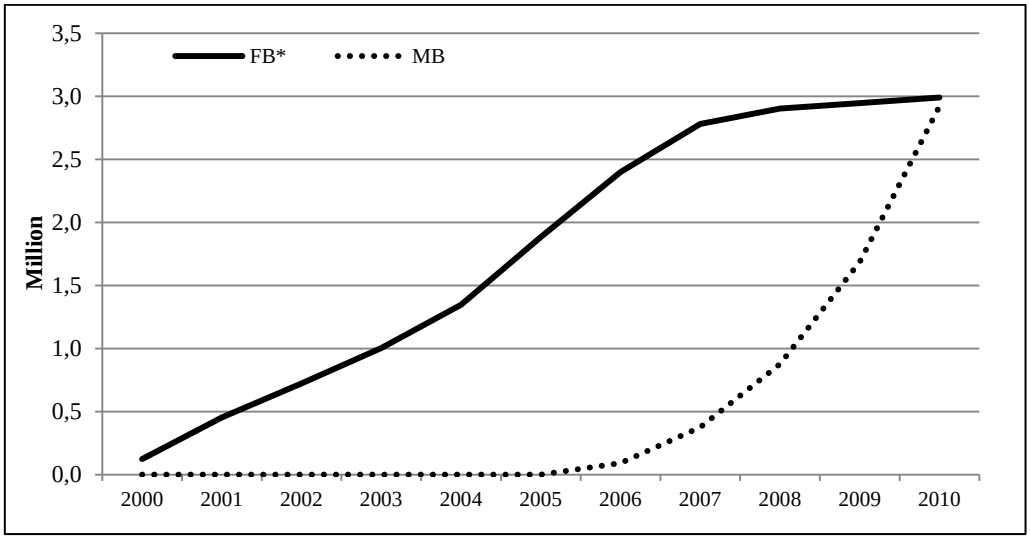
2.2 Development and competition on broadband Internet in Sweden

Sweden has one of the highest percentages of household Internet access penetration, with 86% of the households, compared with 65% for the EU-27 countries. Moreover, 79% of household Internet connections in Sweden use broadband connection and 15% dial-up connection (Eurostat, 2009). High broadband Internet penetration results from a well-developed broadband infrastructure and market regulations.

Several broadband strategies have been implemented since 1999 in order to build broadband network availability throughout Sweden. *An information society for all* was the first broadband strategy in Sweden, and was implemented in 1999. This national broadband strategy aimed to ensure that every household in Sweden had access to the Internet. Two main strategies were proposed. The first was to open up the network of Telia, an incumbent telecom operator, by implementing local loop unbundling (LLU). LLU allows new entrants to use the incumbent's network to provide broadband services to end-users. Another strategy was to provide government funding to foster broadband infrastructure development in 2000-2005 (Eskelinen, Frank, & Hirvonen, 2008). This strategy included the development of FB infrastructure (cable and fibre access) through government funding. Funding was allocated to construct three different levels of broadband infrastructure including backbone networks, regional networks and local networks in the municipalities' areas (Cullen International, 2002). These network infrastructures were built as a competing national backbone to the incumbent's network. Several local communities, as well as private providers, offered their residents and businesses broadband services through municipal fibre networks as a market alternative (Shim, Lee & Yun, 2006). Several broadband strategies and government policies have been implemented in 2000 – 2009. For example, the PTS launched the *Proposal for Swedish Broadband Strategy 2007 – 2010* in February 2007. Its aim was to assure the entire Swedish population of Internet infrastructure allowing at least 2 Mbps downstream capacity, by 2010. The government continued public support for the rollout of broadband infrastructure. One of the conditions for this was that broadband networks funded by central government support would be open to other service providers during the lifetime of the networks (PTS, 2007b).

The national broadband strategies resulted in a well-established broadband infrastructure, especially fixed infrastructure, available for Internet broadband use, with 99% of households having access to DSL connection throughout Sweden. The coverage of the cable and fibre infrastructures is 32% and 33% of the populated areas, respectively (PTS, 2010a). The speed of fixed broadband connection is in the range of 2-100 Mbit/s. More than 30% of households have a broadband connection with a speed exceeding 21 Mbit/s (PTS, 2010b).

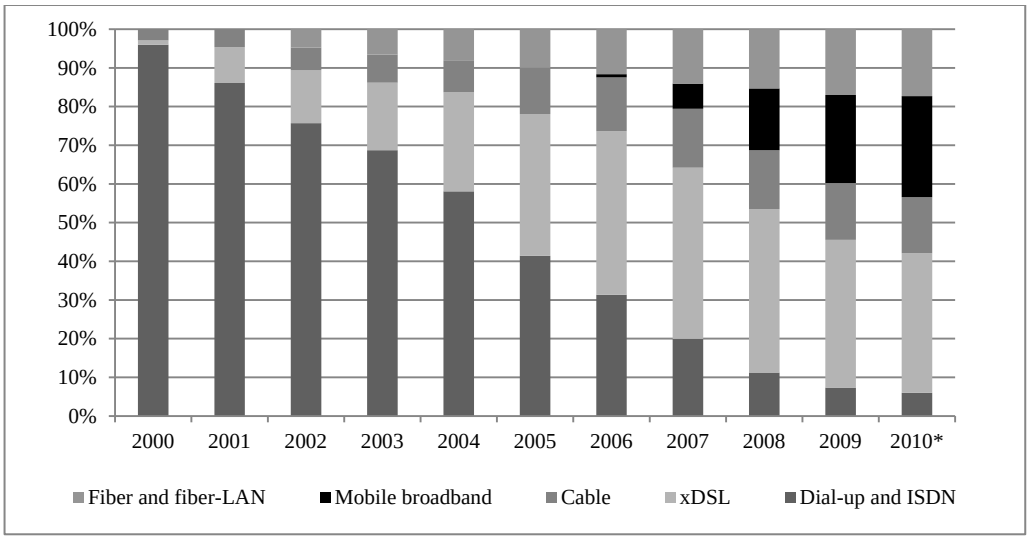
The Swedish government and telecom regulatory authority also pay attention to MB development. In 2007, the *Proposal for Swedish broadband strategy* was proposed by the telecom regulator. One of key strategies in this proposal was to encourage mobile network providers to upgrade their Universal Mobile Telecommunications System (UMTS) to High Speed Package Access (HSPA)[7] in order to promote broadband access by means of wireless service. HSPA had 99% coverage of the populated area of Sweden by mid-2010. This upgrade could raise transmission rates both downstream and upstream. The MB subscriber could access broadband Internet service at speeds of 3.1-14.4 Mbit/s, which is comparable to a DSL connection. Consequently, FB subscribers gradually increased over time as the implementation of the first broadband strategy and the growth of FB flattened at the end of 2010, and rapid growth of MB continues (see Figure 3). To be specific, 33%, 13% and 16% of broadband subscribers are connected via DSL, cable and LAN/Fibre, respectively; while MB has gained an increasing share from less than 1% of broadband subscribers at the end of 2006 to more than 33% in mid-2010 (see Figure 4). This may indicate that mobile broadband may well become a common way for Swedes to access the Internet.



Source: PTS Statistic Portal
Note: *This is a summation of subscribers of DSL, cable, and fiber Internet connections

Figure 3 FB and MB subscribers

[7] HSPA is specified as permitting transmission rates downstream of 14 Mb per second and 1.9 Mb per second upstream (PTS, 2007a).



Source: PTS statistic portal
Note: * at June 30, 2010

Figure 4 Share of Internet connections

The broadband market is currently divided between Telia (37.7%), Telenor (19.2%), Tele2 (12.2%), Com Hem (11.9%), Hi3G (6.5%) and several minor players, including private ISPs and municipalities (PTS, 2010a) (see Table 4). Telia is an incumbent in fixed telephony and mobile telephony. Its broadband services can be delivered over DSL, MB and fibre infrastructures. Telia has DSL infrastructure due to its network legacy of fixed telephony. Its fixed telephony infrastructure was upgraded to provide ADSL service since 2000. Telia accounted for 61% of DSL subscribers by the end of 2009. Telia has also upgraded its UMTS infrastructure, which is jointly owned with Tele2[8], and Telia now has the largest market share of MB subscribers with around 30.9% of the subscribers for the same period. Telia started to build networks with Long Term Evolution (LTE) technology or fourth generation (4G) MB in Sweden and Norway in 2009 and launched services commercially in Stockholm and Oslo at the end of that year (Telia, 2009). Telia has also been involved in several collaborative local municipal projects and has connected some buildings with fibre-LAN extensions in a few major cities since 2000 (Telia, 2000). The company currently has a 14.8% share of the fibre subscriptions.

[8] Telia and Tele2 have formed a joint UMTS network company, SULAB, which now holds the original Tele2 licence (PTS, 2006).

Table 4 Market players and their market shares at the end of 2009

	Market share				
	Overall	xDSL	Cable	Fibre	MB
Telia	37.7	61.0		14.8	30.9
Telenor	19.2	24.9		27.6	26.0
Tele2	12.2	6.9	4.9	6.3	19.1
Com Hem	11.9		90.2	0.1	
Hi3G	6.5				22.5
Other	12.5	7.2	4.9	51.2	1.5

Source: PTS statistics Portal

Telenor is second in the broadband services market. It provides broadband services over three different technologies, which is similar to Telia. Telenor mainly operates DSL and MB services. It also owns a subsidiary, Bredbandsbolaget, which is very active in fibre Internet connection. By the end of 2009, Telenor and its subsidiary company had 24.9% of DSL, 27.6% of fibre and 26% of MB.

Tele2 is the only broadband provider that delivers broadband services over four major technologies. Tele2 has the lowest market share of MB even though it is the second largest mobile operator in Sweden. In contrast, Hi3G entered the mobile market with UMTS technology in 2003, providing only MB service to the end-users, and it has 22.5% of the MB subscribers. One possible reason for Hi3G's high MB market share is that two-thirds of Hi3G's subscribers have connections of 10 Mbit/s or more whereas its major competitors, e.g. Telia and Tele2, have fewer subscribers connecting at those speeds. Nonetheless, Tele2 and Telenor formed a joint venture called *Net4Mobility* in 2009[9] with an aim of providing 4G services and rolling out nationwide coverage of a 4G network. This would give these broadband providers the opportunity to offer higher speed connection through a MB infrastructure.

Another important player, Com Hem, an incumbent cable TV provider, provides broadband service mainly over a cable network. It has a 90.2% market share of cable modem connection. As mentioned, cable coverage is fairly limited and concentrated to more densely-populated areas. Cable is subject to indirect competition with other FB technologies as well as MB. Com Hem has its own arena, however, since it has signed contracts with several apartment owners in order to have an executive right to deliver broadband services to these apartment buildings[10].

In the Swedish broadband market, about a hundred small players provide broadband Internet services. Most of these are local municipalities and private companies. Municipal authorities have played a crucial role in providing alternative broadband Internet access through fibre networks to their residents and businesses. Municipal authorities are forced to open up their fibre networks to service providers by the central government. This boosts competition in the regional and local telecommunications markets.

The FB and MB service providers are almost identical. For example, the incumbents of FB, Telia and Telenor, also offer MB technology. There are thus relatively few major players. Moreover, the current trend indicates that people are more likely to subscribe to MB services than FB services due to the

[9] http://www.net4mobility.com/

[10] The same strategy was applied by Bredbandsbolaget when it rolled out a fibre network to apartment buildings (Shim et al., 2006).

convergence of prices and comparable speed of connection. It is likely that incumbents in FB will use their market position to sustain their market shares.

2.3 Current situation of bundled service in Sweden

Technology advances in the telecom sector have resulted in higher efficiency of infrastructure utilization. Swedish telecom operators use IP-technology to deliver different types of telecom services, such as telephony, data communications, and media, through the same electronic pipe (PTS, 2007c). Telecom operators not only offer telecom services individually, but also provide a package of services and sell it at a single price for bundling services.

There are at least two major reasons for telecom operators to offer bundled services to end consumers. Cost saving is one of the reasons. Telecom operators can share administrative costs, such as customer service, with other telecom services while offering bundling services. In addition, telecom operators can offer more services, as well as bundled services, without significant investment in infrastructure if they already have IP-based technology network. Another reason for offering bundling is that telecom operators can gain more revenue stream if they broaden their range of services from their core businesses (PTS, 2007c).

Bundling has been on the Swedish telecom market for several years, but has become more noticeable in recent years (PTS, 2010c). Sweden demonstrated the biggest percentage point increase (22%) between 2006 (21%) and 2009 (43%). There is also evidence that most countries with a high rate of broadband Internet access, including Sweden, have a high rate of bundling (European Commission, 2010). There are three groups of bundles: double play, triple play, and quadruple play. A double play is a combination of two telecom services, such as fixed telephone and fixed broadband access, or fixed broadband Internet access and cable TV service, etc. Triple play consists of three services including fixed telephony, fixed broadband Internet access, and cable TV service. Quadruple play means a triple play package plus mobile telephony (see Table 5).

At the initial stage, the bundling was offered as double-play, and this has been the most popular of the bundling packages. Double-play accounts for almost 60% of bundled services. By mid-2010, more than 80% of double-play users had applied for fixed telephony combined with broadband Internet access. Recently, triple-play, in particular fixed telephony, broadband and TV service, has also played an important role in the bundling service. More than four hundred thousand households used this package in the same period. This resulted in more than 40% of the bundled services using triple-play. This contrasts with quadruple-play, which is not yet a popular service. Only five thousand households used that kind of service (see Table 5).

Table 5 Number of bundled purchasing by household and bundle penetration

Unit: thousands

Type of bundle	Jun 2008	Dec 2008	Jun 2009	Dec 2009	Jun 2010
Double-play:	*336*	*440*	*478*	*610*	*702*
Fixed telephony and broadband	254	340	370	496	593
Fixed telephony and television	13	16	18	20	21
Fixed telephony and mobile telephony		8	16	14	17
Television and broadband	68	74	70	76	71
Other combinations		2	4	4	
Triple-play:	*235*	*299*	*405*	*442*	*483*
Fixed telephony, broadband and television	203	252	357	394	447
Fixed telephony, broadband and mobile telephony	32	47	48	48	36
Quadruple-play:	*2*	*2*	*1*	*4*	*5*
Fixed telephony, broadband, television and mobile telephony	2	2	1	4	5
Total	*573*	*740*	*884*	*1 057*	*1 190*
Bundle penetration		32%		43%	

Source: PTS Statistic Portal and EU Commission (2008, 2009)

Several telecom operators provide different kinds of telecom services in this market. Not all telecommunications carriers provide bundled packages, however. The PTS reported that seven telecommunications providers offered bundled packages (see Table 6). Two of them provide all types of bundled packages. They are Bredbandsbolaget, or Telenor, and Telia. Tele2 and Com Hem supply double- and triple-play packages. AllTele, Bredband2, and Glocalnet only provide a double-play package. The rest do not offer bundled packages, but sell individual services, even though they provide more than one service (see Table 6).

Table 6 Services offered by telecom operators

Operator	Core business	Individual service				Bundling		
		Fixed telephony	Fixed broadband	Cable TV	Mobile	Double-play	Triple-play	Quadruple-play
Bredbandsbolaget/Telenor	Telecom	O	O	O	O	O	O	O
Telia	Telecom	O	O	O	O	O	O	O
Tele2	Telecom	O	O	O	O	O	O	
Com Hem	Cable TV	O	O	O		O	O	
Glocalnet	Telecom	O	O		O	O		
AllTele	Telecom	O	O			O		
Bredband2	Telecom	O	O			O		
Universal Telecom	Telecom	O	O		O			
ACN	Telecom	O			O			
Megaphone	Telecom	O			O			

Source: PTS Statistic Portal and company websites

Com Hem, Glocalnet, and Bredbandsbolaget launched bundled packages early on. Com Hem reported that one third of its broadband customers subscribed for bundles at the end of 2007 (PTS, 2007c). In addition, Com Hem offered its customers a combination of broadband, fixed telephony and television (PTS, 2007b). Bredbandsbolaget started its business by launching an alternative broadband access network in the form of fixed Ethernet to be connected to households and businesses, and is officially offering all kinds of bundled services in synergy with Telenor (PTS, 2000; 2006).

Telia, as well as Tele2, began offering this service at a later stage. Telia used its market position in the fixed telephony service for broadband Internet service by requiring end-users to have a telephone subscription for the provision of a broadband access line. PTS ordered Telia to stop this practice, beginning in 2006, however (PTS, 2007b). Telia started offering digital television combined with broadband from the last quarter of 2006. At the same time, Tele2 also used its fixed network by supplying a double-play package, early on, and began to provide triple-play (PTS, 2007b).

Table 7 displays individual prices for telecom services and a price for bundled packages. Unsurprisingly, it is cheaper to buy a bundled package than to buy the services separately. Com Hem offers a 47% reduction if the customer buys double-play, while Telia only offers a 5% discount. Telia gives the highest discount (26%) on the Triple-play package, compared with other bundled providers.

Table 7 Price comparison between individual services and the bundling

Operator	2 individual services/ double-play			3 individual services/ triple-play		
	2 individual Services	Double-play	Saving (%)	3 individual Services	Triple-play	Saving (%)
Bredbandsbolaget (Telenor)	298	248	17	397	347	13
Telia	358	339	5	457	339	26
Tele2	269	199	26	368	287	22
Com Hem	273	145	47	372	289	22

Source: http://www.telepriskollen.se, company websites and compiled by the author

Telecom providers who offer bundled packages can also sell individual telecom services separately with market recognition. It may be more profitable and efficient for the carrier side to supply bundled services, however, due to economies of scope. It may also be of more benefit to the consumer to buy telecom services as one-stop shopping and have the same bill for all telecom services with fewer payments than if buying them separately. The consumer will be more likely to buy additional telecom services from the same operator if he has had positive experience with that operator (PTS, 2007c). Nevertheless, service providers could also lock in their customers through their discounted bundled packages. Telecom operators usually required bundled services users to sign a long term contract, 12 – 24 months. The bundled subscribers can receive a full discount on the bundle during that period. However, the discount will be reduced if the subscriber removes one of the services from the bundle. In addition, exchanging one service is often considered as switching subscriptions. This then results in the entire contract being terminated, and new fixed costs being charged the subscribers. This will remove the incentive for consumers to take out individual services from the bundle and also decrease any incentive to switch operators (PTS, 2010c).

3. LITERATURE REVIEW

This chapter discusses the main characteristics of telecom market in relation to competition in the market. The first section mainly discusses main characteristics of telecom market and how telecom operators can gain benefits by utilizing these main characteristics. The second section presents definition, role of switching costs, the impacts of switching costs toward competition in telecom markets. In addition, a discussion of bundling and switching costs is provided in this section. Roles of network effects, in particular tariff-mediated network effects and local network effects are presented in the last section. This relevant literature provides the crucial rationale why the telecom regulators as well as scholars need to pay great attentions on these issues.

3.1 Main characteristics and competition in the telecom market

Telecom services (fixed telephony, mobile telephony, and Internet) share the main characteristics of network industries. The markets for these services are unlike other markets, such as grain, dairy products, and apples (Shy, 2001). The main characteristics include:

- Complementarity, compatibility and standards
- Consumer externalities or network effects
- Switching costs and lock-in
- Significant economies of scale in production

Telecom operators usually compete with '*a dynamic competition'*. A dynamic competition refers to the operators choosing other strategies other than pricing[11] to differentiate themselves from their competitors. They focus to competing on quality, service packages, brand loyalty, location of delivery, long-term contracts, etc. (Bauer, 2003-as cited in Groenewegen, 2005). Mobile operators, for instance, apply handset subsidy associated with long-term contract to compete for customers and at the same time they can be used to raise consumer switching costs and lock-in existing customers. Moreover, incumbent mobile operators in the past intentionally refused to connect their networks with those of smaller mobile operators, in order to enhance their direct network effects and make networks of smaller operators inferior from the point of view of consumers. This indicates that incumbents utilize the advantages of the main features associated with various strategic instruments to limit competition[12] in mobile communication market (Gans, King, & Wright, 2005). The competition in the telecom market therefore fits well with the dynamic competition concept, because telecom operators can apply those strategies to reduce uncertainty in price reduction and loss of profit margin which resulted from entry regulations.

[11] In *static competition*, new entrants came to the market with the homogenous product as incumbents. They compete on price as well as minimize production costs. In addition, the operators also compete by using transaction costs. If the firms fail to compete on those issues, they may not survive in the market (Groenewegen, 2005). It should be noted that in telecom markets, new entrants come to produce the same services as incumbents while also minimizing production and transaction costs. However, telecom operators also compete in dynamic competition by introducing various strategies in order to make themselves superior to their competitors.

[12] Gans et al. (2005) state that there are two main causes to limit competition in wireless communications. The possibility of tacit collusion is the first reason. This may due to the historical market structure, which allowed only two networks to exist in the country. There is evident indicating that tacit collusion existed in the U.K., the U.S., and Germany in different periods of time. The last cause is that incumbents can apply strategic instruments to limit competition in wireless communications market.

Others strategic instruments are applied by mobile operators as means to compete. These strategic instruments consist of a lack of number portability, incompatible standards, termination-based price discrimination (or network-based price discrimination), and differential coverage (Valletti & Cave, 1998; Valletti, 1999, 2002). For instance, incumbent mobile operators usually oppose the implementation of number portability regulation. The classical argument they use is that number portability is costly. The operators cannot be able to fully pass on this cost to consumers who wish carry with them their numbers, resulting in higher costs to operators (Gans et al., 2005). In fact, incumbents gain benefits from a lack of number portability. Their customers will not switch to their competitors because, by so doing, they would lose their numbers, even though they would get better deals from competitors. This raises consumer switching costs and enables incumbents to retain their market shares, profits, and market power. However, it is less important in today's competition because telecom regulators in most European countries[13] have implemented number portability regulations on the market in order to reduce consumer switching costs (see detailed discussion on Section 3.2). The issue of incompatible standards of mobile communications is also less significant. Different mobile technologies, such as GSM and CDMA, are present in the same handset. Mobile subscribers do not need to purchase a new handset when changing mobile operators, as mobile operators provide different mobile standards.

Termination-based price discrimination is currently a matter of great concern to industrial organizations economists, marketing researchers, and telecom regulators. Mobile operators in many countries set off-net prices higher than on-net prices. This has been investigated both in theoretical and empirical studies regarding the impact of price discrimination on competition in mobile markets, and their main conclusion is that termination-based price discrimination makes smaller networks less attractive (e.g. Berger, 2002; Hoernig, 2007; Gabrielsen & Vagstad, 2008; Kim & Kwon, 2003; Fu, 2004). In addition, if this makes on- and off-net calls incompatible from the mobile subscriber's point of view, then mobile subscribers will less likely place calls on rivals' network because off-net prices are expensive (Grajek, 2010). This demonstrates that mobile operators again apply the main features of network industries, such as network effects and incompatibility to raise consumer switching costs (for more detailed discussion, see Section 3.3).

As mentioned, telecom operators now compete on product differentiation, and one of their product differentiation strategies is the implementation of bundled packages. It is convenient for consumers to buy more telecom services from the same operators, and it is beneficial to the consumers as they can receive a single bill as well as a significant price reduction when buying bundled packages. Moreover, buying several telecom services from a single provider will mean less concern about the compatibility among the services. In addition, it reduces transaction costs as well as compatibility costs of consumers and raises consumer benefit (e.g. Lee & Norsworthy, 1998). At the same time, bundling is also valuable for telecom operators as it can be utilized to raise consumer switching costs and win consumer loyalty (detail discussion is in Section 3.2.4).

The nature of telecom market is dynamic and telecom technologies have changed relatively fast compared to other service markets, such as postal services. Telecom operators have invested in both fixed and wireless or mobile infrastructure to response to heterogeneous consumer demand and technological changes. In some countries, such as Sweden and Japan, most of telecom operators offer various kinds of broadband connections including fixed (DSL, cable, and FTTH) and mobile

[13] UK and the Netherlands introduced MNP in 1999, while Sweden was the fifth European nation to do so since 2001 (Buehler et al., 2006).

technologies. This development will lead to an FB and MB substitution situation. Consumers will switch from FB toward MB because both FB and MB offer similar speed of connection and prices, but MB has an advantage of mobility. However, switching among broadband technologies may occur just within the same operators because the customers may confront switching costs in broadband migration (Ida & Sakahira, 2008).

In sum, telecom operators use different kinds of strategies (i.e. termination-based price discrimination, bundling, and multi-service provision in broadband) associated with main features in order to compete in this industry, to increase consumer switching costs and sustain the incumbent market position.

3.2 Switching costs and their impacts on telecommunications

3.2.1 Definition and causes of switching costs

Switching costs are all costs associated with switching from one provider to another (Chen & Hitt, 2007). These costs occur even when firms' products are functionally identical (Klemperer, 1995). Switching costs are present in various products and services (e.g. Borenstein, 1991; Kim, Kliger, & Vale, 2003), and telecommunications, in particular, mobile telephony (e.g. Shy, 2002; Kim, Park, & Jeong, 2004; Lee, Kim, Lee, & Park, 2006; Grzybowski, 2008; Maicas, Polo, & Sese, 2009a).

Klemperer (1995) reveals that switching costs, in general, include not only those costs that can be measured in monetary terms but also those with psychological aspects. Switching costs are categorized into compatibility, transaction, learning, uncertainty, contractual (or discount coupons), and search costs. The following explanation presents each type of switching costs regarding to telecom services.

Compatibility costs arise when users switch standards. In the past, a mobile user could not switch from CDMA to GSM phones immediately because mobile phones were not made for both standards. These costs, however, are less important because mobile phones now work with any mobile standard.

One example when discussing *transaction costs* in telecommunications market is *'number portability'*. Transaction costs occur when subscribers switching between operators cannot retain their numbers. It means that moving from the existing fixed or mobile operator to a rival would require a customer to change number. This is costly to subscribers, who must inform their colleagues and friends of the new number. It is more costly to business subscribers since they lose potential sales. Again, transaction costs seem to be less significant in the telecommunications industry since mobile or fixed line users can now leave their operator while keeping their same number through the number portability regulation.

To change mobile operators, mobile users need to spend time learning how this works even though these operators provide identical functions. Of course, mobile customers may not need to learn how to make calls or send SMS and so on. But they may need to learn a new customer service telephone number for the new provider and/or how to pay a bill. Then, mobile users encounter *learning costs*.

Telecommunications services are experience goods. Consumer uses the service to determine its quality, to decide whether to repurchase a brand, or try another brand of unknown quality (Farrell & Klemperer, 2007). Hence, *uncertainty costs* arise if a consumer is not sure whether or not a rival operator will provide an equivalent quality of service.

Contractual costs can occur in single and multi-service markets. In specific service, a mobile customer is offered a discount related to mobile services (e.g. a lower per-minute price and a discounted handset). To receive these discounts, the customer must sign a long-term contract (e.g. 12 -24 months).

If the customer wants to break the contract, a contract termination fee is applied. Telecom operators can also apply similar conditions to bundled packages.

In addition, *search costs* are another component of switching costs. Search costs are the costs of gathering information about characteristics of services and suppliers. These costs usually occur not only when a consumer makes an initial purchase of a product but also when a consumer wishes to change supplier.

3.2.2 Impacts of switching costs on competition in telecommunications

A series of theoretical studies by Klemperer (1987, 1989, 1995) have investigated markets with switching costs, and their impacts. The findings conclude that switching costs can raise average prices[14], create deadweight losses, discourage entry, and reduce product variety available to consumers. Switching costs can reduce competition, shift the nature of competition and, as noted by Klemperer (1995), make *ex ante* identical homogeneous products, heterogeneous *ex post* (as cite in Maicas, Polo, & Sese, 2009b). In vertically-related markets, when switching costs are high, an upstream operator will not enter a downstream market to directly compete for market shares in downstream market at first. But it will choose to integrate with a downstream operator in the second stage to extract all profits from captured customers in the downstream market instead (Valletti, 2000). Further, market players can choose to either raise or to lower switching costs in order to reduce inefficiency, to enhance market power, to deter new entries, or to extract returns from a new entrant (Farrell & Klemperer, 2007). In sum, switching costs are often seen to have significant negative impacts which dampen market competition through market power.

Knittel (1997) constructs an empirical model to test for the presence of search and switching costs and their influence on price cost margins in the interstate long-distance rates in the US. His results illustrate that rates have failed to fall due to the importance of search and switching costs in the industry, even though AT&T was broken up vertically in 1984 into local providers and a long-distance provider, and entry was encouraged. In addition, he concludes that both search and switching costs have provided long-distance carriers with market power. Epling (2002) also studies competition in the long distance telephony market in the US. She finds there is significant heterogeneity in subscriber switching costs, and subscribers with high switching costs pay significantly higher prices. Viard (2007) examines the effects on switching costs in toll-free services market where firms could not price discriminate between new and existing users. One of main results shows that market prices are reduced in response to a decline of switching costs.

In mobile communications services, Grzybowski (2008) uses a mixed logit model to estimate switching costs in mobile telephony in the UK. The results show that consumers of mobile services in the UK face significant switching costs, which vary according to network operators. A similar estimation of switching costs in Portuguese mobile communications market is done by Grzybowski and Pereira (2011). Their main findings show that switching costs are considerable and decrease

[14] Switching costs can also intensify price competition or lower average prices if firms can price discriminate between old and new customers, 'customer poaching'. Firms will set aggressive prices to attract their rivals' customers and this will lead to lower prices for (all) customers. See Belleflamme and Peitz (2010) for a detailed discussion. However, there are some studies, such as Chen (1997) and Taylor (2003) that show that in markets with switching costs, firms charge higher prices than do their rivals to their old customers in period 2. Then, consumers with low switching costs switch firms and consumers are worse off overall (Farrell and Klemperer, 2007, p. 1991).

product substitutability. They finally conclude that the reductions in switching costs would increase consumer surplus.

Several empirical studies pay attention to roles of switching costs in customer retention, customer loyalty, and customer churn in mobile communications. Gerpott, Rams, and Schindler (2001), studying the German mobile cellular phone market, show that 'phone number constancy', 'image of the competitor', and 'network quality' are important factors to explain customer retention, loyalty, and satisfaction. Most importantly, a lack of number portability has strong effects on customer retention of mobile subscribers even where their loyalty or satisfaction is low. The efficient implementation of number portability will reduce switching costs and promote competition.

Kim and Yoon (2004) examine determinants of subscriber churn and customer loyalty in the Korean mobile communications market. They find that the duration of subscription to a mobile operator has a negative impact on churn. This means that the longer a customer has subscribed with an operator, the more likely the subscriber will stay with that operator. It suggests that the existence of a "customer lock-in" due to switching costs. Kim, Park, and Jeong (2004) investigate the determinants of subscriber churn and customer loyalty, and the effects of customer satisfaction and switching barriers on customer loyalty in the same market. Their results show that mobile operators must focus more on service quality and offer customer-oriented services to heighten customer satisfaction and to promote customer loyalty. In addition, raising a switching barrier by building a long-term relationship with customers through a further investment in customer relationship management is also important to construct customer loyalty. The study by Aydin, Özer, and Arasil (2005) shows similar evidence for the Turkish mobile phone market that switching costs affect loyalty and has a moderator effect on both customer satisfaction and trust. Operators can raise consumer switching costs through an improvement of their quality of services and their relationship with customers.

Few studies have investigated switching costs in other telecommunications services, Such as Internet services. Madden, Savage, and Coble-Neal (1999) and Ida and Sakahira (2008) are among these studies. Madden et al. (1999) develop a model relating to the probability of subscriber churn market to various service attributes and subscriber characteristics in the Australian ISP market. Their results illustrate that churn is more likely when subscriber has had an account with another ISP. This may indicate that subscribing with multiple ISPs leads to the lower switching costs for the subscriber. Ida and Sakahira (2008) are interested in the significance of developments in FTTH in Japan. Then they develop models to examine broadband migration (from DSL to FTTH) and lock-in effects in the Japanese high-speed Internet access services. They find that the previous customers of NTT's DSL (a dominant player in DSL Internet services) migrate to NTT's FTTH rather than the FTTH of other carriers. This suggests that switching costs in broadband migration exists. Broadband subscribers desire to move from an old to a newer broadband technology within the same telecom operators.

In sum, switching costs can potentially reduce competition and raise prices of telecom services. It is empirically shown that telecom operators attempt to improve services quality and build a long-term relationship to win customer satisfaction as well as raise consumer switching costs.

3.2.3 Number portability as an instrument to lower switching costs

Telecom regulators implemented mobile number portability (MNP) as a policy to reduce switching costs and increase competition among providers (Buehler, Dewenter, & Haucap, 2006; Lee, Kim, Lee, & Park, 2006; Lyons, 2006; Maicas, Polo, & Sese, 2009b). MNP enables mobile phone users to keep their telephone numbers when changing network. In other words, MNP reduces transaction costs for

mobile subscribers. This means that there is no need for mobile subscribers to spend time, money, and effort to inform their social network of a new telephone number.

Recently, several studies (e.g. Lee et al., 2006; Lyons, 2006; Shin, 2007; Shin & Kim, 2007; Shin & Kim, 2008; Maicas et al., 2009b) investigate the impacts of an implementation of MNP on switching costs in various countries. The common finding shows that MNP plays an important role in lowering switching costs. For instance, a study by Maicas et al. (2009a) reveals that customers who maintain their mobile phone number when switching providers (adopt MNP) have lower switching costs, compared with customers who do not maintain their number (do not adopt MNP).

However, the magnitude of switching costs remains high even after MNP is in place. Lee et al. (2006) note that to reduce further switching costs, a fair evaluation of the quality and prices of mobile providers is needed to reduce the uncertainty costs associated with switching. Further, Lyons (2006) shows empirical evidence that in order to reduce switching costs, MNP should be processed in less than five days.

Moreover, switching costs in mobile communications are also caused by SIM-card locking. Mobile operators usually ask mobile phone manufacturers to lock their handset so it can be used exclusively within their networks. This makes it is difficult to customers to switch. Users interested in changing their current operator have to invest in a new handset. Nakamura (2010) reveals that the SIM unlock policy would reduce switching costs in the Japanese mobile communications market. This study shows that at least 20% of consumers in the Japanese market would benefit from a SIM unlock policy even if standardization of platforms is postponed.

3.2.4 Bundling and switching costs

Incumbents and new entrant telecom operators in most countries provide multi-service, in particular, complementary telecom services. They offer fixed telephony, mobile telephony, and fixed broadband Internet access. Some providers even provide additional services, i.e. cable TV and/or mobile broadband Internet access. This results from the advances in telecom technology that enables telecom operators can be able to deliver sounds, pictures and data through the same electronic pipe (Crampes & Hollander, 2006). Today, telecom operators can provide individual services as well as bundled packages. Note that prices of bundles are generally cheaper (since telecom operators offer a discount) than the same telecom services bought separately. Therefore, telecom operators can utilize main features, such as complementarity, with significant discounts to compete with rivals and maintain their market positions as well as profits.

Theoretical studies on impacts of bundling on competition and social welfare show inconclusive findings[15]. Several studies show that bundled strategies can improve social welfare. Providing bundles to consumers increase consumer surplus (Bakos & Brynjolfsson, 1999) by lowering consumer switching costs. Bundled subscribers will reduce their shopping costs or search costs and they will gain benefits from receiving several services from a single service provider. At the same time, buying a bundled service also reduces customer transaction costs (Lee & Norsworthy, 1998) and learning costs in term of payment and contacting the back office, which is in contrast to the case of buying several services from different service providers. In addition, offering bundling could increase competitive pressure among firms who provide bundles (Maturates & Regibeau, 1992; Lee, 2009). This will lead to decreased prices and lower firms' profit (Maturates & Regibeau, 1992; Anderson &

[15] See nice literature survey on economic motivation for bundling from Le Blanc (2001).

Leruth, 1993; Crampes & Hollander, 2006; Reisinger, 2006; Thanassoulis, 2011). Firms can use bundled strategies to synergize their services and to save on administration costs (Salinger, 1995; Arlandis, 2008).

Nonetheless, bundling can be a potential instrument to create social loss. Bundled strategy can be used as a barrier to entry (Whinston, 1990; Nalebuff, 2000, 2004; Choi & Stefanadis, 2001), entry deterrence (Carlton & Waldman, 2002), and as an entry foreclosure device (Whinston, 1990; Nalebuff, 2004; Rey & Tirole, 2007). For example, a firm can use its market power over the services by bundling them together. This will be a burden to a new entrant to the market since the entrant may need to offer similar products and packages in order to compete with existing providers (Nalebuff, 2004). Moreover, firms use bundling to reduce consumer heterogeneity (Stole, 2007; Crawford, 2008). Bundling reduces consumer choice, and consumers are then forced to self-select the bundle that they feel best meets their needs (Schmalensee, 1984). It then is easier for firm to extract consumer surplus from more homogeneous consumers (Armstrong, 1999) and firms will receive higher profit (McAfee, McMillan, & Whinston, 1989; Thanassoulis, 2004, 2007; Crawford, 2008).

Importantly, firms can use bundling to increase consumer switching costs (Maturates & Regibeau, 1992; Nalebuff, 2004), win consumer loyalty, as well as attract new customers (Henten & Godoe, 2010), and maintain their own market position (Bughin & Mendonça, 2007; Lee, 2009). Bundled services can raise search costs (one type of switching costs) of consumers when switching to other providers. Consumers have to gather all of information about rival service providers to ensure that they will switch to a more beneficial provider. In addition, it is difficult for consumers to switch since telecom providers usually offer complex menus of telecom services (Papandrea, Stoeckl & Daly, 2003).

As bundling in itself does not create added value for consumers, a discount must be offered to motivate at least some consumers to buy the bundle (Stremerch & Tellis, 2002). The discount could be monetary (e.g.10% off) or non-monetary (e.g. one service free). These discounts can be offered either immediately on purchase or sometime after purchase (Agarwal & Frambach, 2003). However, consumers need to sign a long term-contact, normally 12-24 month, in order to get the discount offer. A long term-contract will lead to contractual costs for bundling subscribers. Firms can exploit the advantage of contractual cost with a bundle discount, to encourage customer loyalty. Economides (2010) called the difference between the price under the bundling condition and the à la carte price a “disloyalty penalty” for not accepting the bundle. In other words, some consumers are forced to buy the bundle even though they value one of its components at below production cost (Adams & Yellen, 1976). Therefore, consumers may not prefer to patronize more than one firm due to high compatibility cost and contractual cost.

Though bundling is likely to play a major role for the telecom industry in the future due to technology convergence, the impacts of bundling on switching cost and competitions are ambiguous. The survey of literature shows no clear conclusion about the impact of bundling on switching cost and competition. For example, it depends on whether there is competition between bundles or competition between a bundle and independent service. In the case of competition between bundles, it seems that there will be less transaction costs but perhaps higher compatibility costs (Nalebuff, 2000; Hurkens, Joen & Menicucci, 2011; Thanassoulis, 2011). Moreover, under the competition between bundles, firm realizes a lower profit than competition between independent services. For large bundles, an incumbent supplier can benefit from bundling, while its rival is hurt (Hurkens et al., 2011). Nevertheless, most of studies on bundling and its impacts have been done by theoretical modelling. Therefore, empirical studies are needed to show the impacts in reality.

3.3 Network effects

3.3.1 Definition

Katz and Shapiro (1985) define network products as ‘products for which the utility that a user derives from consumption of the good increases with the number of other agents consuming the good’. In addition, both current and expectations of future sales could simulate network effects (Farrell & Saloner, 1986). In sum, network effects mean that a utility a consumer derives from adopting or using a product (positively) depends on the current and future number of other consumers using the same product.

Network effects seem to give a positive impact to the society since they give more benefit to consumers who consume the same goods or services. However, from a firm point of view, network effects would give even more benefit to larger networks than smaller networks due to the ‘positive feedback effect’ (Arthur, 1989, 1990). This term suggests that increasing network size makes a larger network much more attractive to new purchasers, and it makes services that permit access to that network much more valuable. Hence, consumers tend to purchase products or services from larger network due to a higher level of benefits from network effects, and firms with a large market share are able to obtain a higher level of profitability (Farrell & Saloner, 1985; Katz & Shapiro, 1985, 1994; Farrell & Klemperer, 2007). In an extreme case, network effects may create ‘winner-takes-all’ markets (Arthur, 1996). There will be a company who may have superior products or technologies and acts as a dominant player, forcing other firms to abandon the market due to lack of competitive advantage due to network effects (Shapiro & Varian, 1999; Liebowitz, 2002).

Network effects are described in the literature (Katz & Shapiro, 1985, 1994; Church & Gandal, 1992) as either direct network effects or indirect network effects. Note that the distinction between direct and indirect network effects refers to the source of benefit to the participants in the network (Page & Lopatka, 1999).

Direct network effects are present if the quality of a good is directly linked to the number of other consumers of the same good. This means that an individual’s utility function is not independent of another individual’s consumption choices. Instead, utility increases with the other individual’s presence on the same network (Birke, 2009). A telecommunications network is a typical example of direct network effects. The purchase of communications services (telephones, fax, Internet access) directly benefits existing communications subscribers, who now have an additional person with whom they may communicate, assuming that each subscriber may at some point wish to communicate with every other subscriber (Economides, 1996).

Indirect network effects arise when products or services have complementary relations between goods. Many products have ‘consumption interdependence’ characteristics. There will be less value if consumers adopt these products in isolation. However, value will be generated when consumers consume products with other complementary products. Computer hardware and software is a good example in explaining indirect network effects. An adoption of computer hardware is only valuable if computer software is available. In addition, when demand for computer hardware increases, demand for compatible computer software is stimulated. At the same time, the number of application software programs available in the market will encourage demand for hardware. The recent example is the implementation of ‘Apple iPhone’ (a mobile phone terminal). Its mobile operating system and several thousands of mobile software applications could stimulate massive demand for iPhones in the coming years.

3.3.2 Direct network effects and telecommunications service diffusion

Gruber and Verboven (2001) and Koski and Kretschmer (2005) study the role of standardization (which induces network effects) on mobile communication diffusion. Gruber and Verboven (2001) study the 1G mobile communications technology, while Koski and Kretschmer (2005) focus on the 2G mobile technology. They find that setting a single technological standard or standardization accelerates the diffusion of analogue technology (Gruber & Verboven, 2001) and also facilitates the diffusion in 2G markets (Koski & Kretschmer, 2005). With standardization, mobile users gain benefits since their search and switching costs are reduced. This may suggest that network effects stimulate diffusion in mobile communications through a single technological standard. Madden, Coble-Neal, and Dalzell (2004) apply a dynamic model to examine the growth of global mobile telephony and the economic factors that affects growth. They find that more mobile installed base customers lead to more growth of mobile customers. This suggests that network effects are important in explaining the mobile network growth. Recently, studies of network effects in mobile communications services are also presented in a specific country. Doganoglu and Grzybowski (2007) and Grajek (2010) estimate network effects in Germany and Poland, respectively. Their results confirm that network effects play a significant role in the diffusion of mobile services.

Network effects not only present an essential role in a particular generation of technology, but they also play roles in intergenerational technology. Liikanen, Stoneman, and Toivanen (2004) introduce an econometric model to analyse the effect of an old generation of mobile communications (1G) on the diffusion of 2G mobile technology during a transition period. They find that 1G can have a positive impact on the diffusion speed of 2G technology. However, 2G mobile technology will finally take over 1G due to substitution effects. This reveals that network effects are also present in an 'intergenerational' situation, i.e. from 1G to 2G. Mobile subscribers to either 1G or 2G mobile technology could benefit from network effects since they can reach any mobile subscribers of 1G and 2G. Bohlin, Gruber, and Kouroumpis (2010) conduct a similar investigation on intergenerational technology in mobile communications but they expand their study to third mobile generation (3G) technology. They show that diffusion of 1G technology boosts the adoption process of 2G networks (this is in line with Liikanen et al, 2004), but 2G adoption negatively affects adoption 3G technologies. However, network effects still exist as long as 2G subscribers could contact to 3G subscribers either by voice or data communications (i.e. SMS, MMS, and Internet access). A recent study by Grajek and Kretschmer (2009) confirms that different technological generations, fixed-line and mobile communications technologies, could induce network effects in term of usage. Subscribers of fixed and mobile communications could gain almost the same benefits.

3.3.3 Tariff-mediated network effects, local network effects and switching costs

The implementation of interconnection regulation in telecommunications market in the late-1990s seemed to enhance network effects to telephony subscribers. Both fixed-line subscribers and mobile subscribers are able to interconnect. However, the benefits of network effects, in particular for mobile subscribers, are reduced by the introduction of termination-based price discrimination. Termination-based price discrimination means that an operator charges different prices for calls placed on its own network and rival networks. An operator usually charges a higher price for calls placed on rival networks (off-net calls) and a lower price for calls placed on its own network (on-net calls). Termination-based price discrimination induces network effects because it is convenient for mobile subscribers to choose the operator with the largest customer base as Laffont, Rey, and Tirole (1998) define as *tariff-mediated network effects*.

The investigations of impacts of tariff-mediated network effects have been done in both theoretical and empirical literature. In theoretical literature, for example, Berger (2002), Hoernig (2007; 2008), Gabrielsen and Vagstad (2008), and Harbord and Pagnozzi (2010) investigate the impacts of on-net and off-net price differentials. They find that setting higher off-net than on-net prices gives consumers an incentive to subscribe to the same network as friends and make individual subscribers more unwilling to switch supplier at a later stage. In addition, a large network charges significantly higher off-net prices and set a higher on-net and off-net differential to limit off-net calls of its customers in order to make the smaller network less attractive. Further, tariff-mediated network effects can make larger networks more attractive, place smaller networks at a competitive disadvantage, and are particularly damaging to long-run entry and competition and resulting in welfare losses (Harbord & Pagnozzi, 2010).

A number of empirical studies have been conducted to examine the impacts of tariff-mediated network effects in mobile communications markets. The conclusions of previous studies indicate that consumers prefer the mobile phone network with a largest number of subscribers, and the largest networks will get a much larger share of new subscribers, compared to their smaller rivals when they use termination-based price discrimination (Kim & Kwon, 2003; Fu, 2004). Additionally, termination-based price discrimination also impacts network traffic. Users of a large network spend most of their airtime within their own network, while customers who are part of a small network are forced to place calls on other networks. As noted before, on-net call prices are usually cheaper than off-net call prices. Therefore, mobile subscribers choose to select the larger operators rather than smaller providers so as to minimize their phone bills. Birke and Swann (2006) examine the role of network effects on the consumer's choice of mobile phone operators in the UK. One of the main results is that the proportion of off-net calls falls as mobile operators charge a premium for off-net calls. Higher charges for off-net calls lead to lower (higher) amount off-net (on-net) calls being made by mobile subscribers. Gerpott (2008) examines the impacts of termination-based price discrimination in European mobile communications markets and concludes that this price discrimination increase barriers to switch for end customers. It also makes larger mobile operators superior over smaller ones. Recently, Grajek (2010) mentions that the discount for on-net calls can lower the level of compatibility of mobile networks, despite full interconnection of mobile network being applied. This implies that on-net call discounts could make mobile operators incompatible in the eyes of subscribers. Mobile subscribers may reluctant to make calls to other networks due to high off-net calls prices. Hence, the on-net discount will distort benefits of interconnection.

Farrell and Klemperer (2007) note that network effects may be local. A smaller group of adopters is more valuable than an entire population of adopters. It will be more convenient for a mobile subscriber to be with the same mobile operator as his family members and friends since he will make calls to these people the most frequently.

Several studies investigate the role of local network effects on mobile users' choice. Studies by Birke and Swann (2006, 2010) examine the role of local network effects in the UK and some Asian countries. They find that an individual's choice of mobile operator is heavily influenced by the choice made by household members and friends. These effects are far stronger than the effects of overall network size. Corrocher and Zirulia (2009) also investigate the role of local network effects in the Italian mobile market. This study relies on a survey of 193 Italian students and finds that consumers who are more interested in local network effects are more intense and aware users of mobile phone services. These consumers take account of local network effects when choosing mobile operators. Moreover, Maicas, Polo, and Sese (2009a) show that the probability that a customer selects a mobile

phone company increases with a number of members of her social network already subscribed to that operator.

In sum, the previous literature concludes that tariff-mediated network effects and local network effects influence consumers' choice. A consumer selects a mobile operator according to size of customer base, his family members, and friends to exploit benefits from network effects, such as cheaper prices and greater convenience. His choice of mobile operator has been made by coordinating between his social network members, and it will later be difficult to switch without consulting them to co-ordinate the benefits of switching. Hence, it indicates that both types of network effects may increase switching costs since a consumer will not be willing to switch as long as he can make cheaper calls.

The summaries of related literature are presented in Table 8. The literature is classified according to their main conclusions and research method. The main findings of both theoretical and empirical studies indicate that switching costs can potentially reduce consumer surplus and social welfare. The major causes of switching costs in mobile communications market come from lack of mobile number portability and termination-based price discrimination. In addition, telecom operators can induce consumer switching costs by implementing bundles. However, it is uncertain from empirical literature whether or not bundling can potentially increase consumer switching costs. Consumer switching costs can be reduced by buying bundles since it reduces transaction costs. At the same time, bundles significantly increase search costs because the customers need to gather a great deal of information about bundled packages, and telecom operators usually offer fairly complex menus.

Theoretical and empirical literature indicates that network effects are one of crucial factors in telecom market. It is explicitly seen from prior studies that larger mobile operators can gain significant benefits by utilizing tariff-mediated network effects and local network effects.

Table 8 Summary of relevant literature

Author(s)	Main conclusion	Research method	Telecom services
Switching costs and their impacts on telecommunications			
Klemperer (1987, 1989, 1995) and Valletti (2000)	Switching costs have significant negative impacts, which dampen market competition through market power.	Theoretical	In general
Knittel (1997) and Epling (2002)	Subscribers with high switching costs pay significantly higher prices.	Empirical	Interstate long distance telephony
Gerpott et al. (2001), Kim et al. (2004), Kim and Yoon (2004) and Özer and Arasil (2005)	Operators could raise consumer switching costs through an improvement of their quality of services and relationship with customers.	Empirical	Mobile telephony
Grzybowski (2008) and Grzybowski and Pereira (2011)	Switching costs are large and decrease product substitutability in mobile market	Empirical	Mobile telephony
Madden, Savage, and Coble-Neal (1999)	Churning is more likely when subscriber has had an account with another ISP	Empirical	Internet

Author(s)	Main conclusion	Research method	Telecom services
Ida and Sakahira (2008)	Switching costs in broadband migration exists. Broadband subscribers desire to move from an old to newer broadband technology within the same carriers.	Empirical	Internet
Number portability as an instrument to lower switching costs			
Lee et al.(2006), Lyons (2006), Shin (2006) Shin and Kim (2007, 2008), Maicas et al. (2009)	MNP plays an important role in lowering switching costs	Empirical	Mobile telephony
Nakamura (2010)	SIM unlock policy could reduce switching costs	Empirical	Mobile telephony
Bundling and switching costs			
McAfee et al. (1989) and Thanassoulis (2004, 2007)	Firms will receive higher profit when offer bundle	Theoretical	In general
Whinston (1990), Nalebuff (2000, 2004), Choi and Stefanadis, 2001), Carlton and Waldman (2002), and Rey and Tirole (2007)	Bundled strategy can be used as barrier to entry, entry deterrence, and an entry foreclosure device.	Theoretical	In general
Maturates and Regibeau (1992) and Nalebuff (2004)	Telecom operators use bundling strategy in order to create switching costs	Theoretical	In general
Maturates and Regibeau (1992), Anderson and Leruth (1993), Crampes and Hollander (2006), Reisinger (2006), Lee (2009), and Thanassoulis (2011)	Offering bundling could increase a competitive pressure among firms who provide bundles, and it leads to declining prices and lower profit for firms	Theoretical, Empirical	In general, Telecom
Salinger (1995) and Arlandis (2008)	Bundling can be used to synergize firms' services and save administrative costs. Bundling also create economies of scope.	Theoretical	In general
Lee and Norsworthy (1998)	Bundling can reduce the transaction costs to consumer	Theoretical, Empirical	In general, Telecom
Armstrong (1999) and Stole (2007)	Firms use bundling to reduce consumer heterogeneity. It then is easier for the firm to extract consumer surplus from more homogenise consumers	Theoretical	In general
Bakos and Brynjolfsson (1999)	Bundling will increase consumer surplus since it increases competition among firms	Theoretical	Internet

Author(s)	Main conclusion	Research method	Telecom services
Papandrea, Stoeckl and Daly (2003)	Bundling services could raise search costs of consumers who want to switch to other providers	Empirical	Telecom
Bughin and Mendonça (2007) and Lee (2009)	Telecom operators can use bundling strategy to maintain their market position	Theoretical	Telecom
Crawford (2008)	Bundling yields a heterogeneity reduction and increases firm profit	Empirical	Cable TV
Economides (2010)	Firms can exploit the advantage of contract cost with a bundle discount to encourage customer loyalty	Theoretical	In general
Henten and Godoe (2010)	Firms can use bundling to win consumer loyalty as well as attract new customers	Empirical	Telecom
Network effects: Definition and literature			
Farrell and Saloner, (1985), Katz and Shapiro (1985, 1994), Arthur (1989, 1990) and Farrell and Klemperer (2007)	Consumers favour to buy products or services from larger network due to more benefit from network effects and firms with a high market share are able to obtain a higher level of profitability	Theoretical	In general
Economides (1996)	A purchase of communications services directly benefits existing communications subscribers, who now have an additional person with whom they may communicate	Theoretical	In general
Direct network effects and telecommunications services diffusion			
Gruber and Verboven (2001) and Koski and Kretschmer (2005)	Network effects stimulate diffusion in mobile communications through a benefit of a single technological standard	Empirical	Mobile telephony
Madden, Coble-Neal, and Dalzell (2004), Doganoglu and Grzybowski (2007) and Grajek (2010)	Network effects play a significant role in the diffusion of mobile services	Empirical	Mobile telephony
Liikanen, Stoneman, and Toivanen (2004) and Bohlin, Gruber, and Kouroumpis (2010)	Network effects play roles in intergenerational technology	Empirical	Mobile telephony
Grajek and Kretschmer (2009)	Different technological generations, fixed line and mobile communications technologies, could induce network effects in term of usage.	Empirical	Fixed and mobile telephony

Author(s)	Main conclusion	Research method	Telecom services
Tariff-mediated network effects, local network effects and switching costs			
Laffont, Rey, and Tirole (1998)	Termination-based price discrimination induces network effects because it is convenient for users to adopt the operator with the largest customer base	Theoretical	In general
Hoernig (2007) and Gabrielsen and Vagstad (2008)	Setting higher off-net than on-net prices give consumers an incentive to locate on the same network as friends. Large networks charge significantly higher off-net prices in order to make smaller network less attractive.	Theoretical	Mobile telephony
Kim and Kwon (2003), Fu (2004), Birke and Swann (2006) , Gerpott (2008), and Grajek (2010)	Consumers prefer mobile phone networks with larger number of subscribers and the larger networks will attract a much larger share of new subscribers compared to smaller rivals, when they use termination-based price discrimination	Empirical	Mobile telephony
Birke and Swann (2006, 2010), Corrocher and Zirulia (2009) and Maicas, Polo and Sese (2009a)	An individual choice of mobile operator is heavily influenced by the choice made by household members and friends who communicate with each other	Empirical	Mobile telephony

Source: Author

4. METHODOLOGY

This chapter presents the flow of study and data collection. It explains the rationale of five appended papers and the compilation thesis in Section 4.1. Data collections as well as statistical methods are provided in Section 4.2. A discussion on creditability, reliability, and representative of samples are also given.

4.1 The evolving research questions throughout the studies

The initial idea of the thesis was developed from a specific instrument in the mobile communications market known as termination-based price discrimination. Several studies (e.g. Kim & Kwon, 2003; Fu, 2004; Grajek, 2010) have shown that consumers prefer mobile phone networks with a greater number of subscribers and the larger networks will get a much larger share of new subscribers than their smaller rivals when they use termination-based price discrimination. Hence, the first study is conducted, but the main purpose is different from the prior studies. The main aim of the study was to examine the determining factors, including termination-based price discrimination, that prompts mobile subscribers to remain with their current mobile operators in Sweden, since mobile penetration at the end of 2007 was 111% (ITU, 2007). There is also a possibility for mobile operators to use several strategies to compete in retaining their own customers because most of potential customers have been captured by mobile operators.

The first study pays attention on the decision to switch or remain with a mobile operator, made at a specific point in time. The second study is introduced to fill in the gap of the first study. The study has a dynamics perspective and the decision of subscribing to mobile operators by different consumers is made at different times. The second study aims to examine the impacts of termination-based price discrimination, tariff-mediated network effects, on-net call prices, and the size of networks on subscriber attraction in the Swedish mobile communications market. The period of analysis starts from 2003 and continues to 2009 (the latest data that can be obtained) because mobile operators started to introduce termination-based price discrimination in 2003. The main hypothesis is that larger mobile operators will be able to attract more mobile subscribers than will the smaller ones. The major reason is that mobile subscribers will take the benefits of termination-based price discrimination into consideration when subscribing to a specific mobile operator.

There are many factors that prompt consumers to subscribe to mobile services. The third study of this thesis was conducted in order to identify the determinant factors for subscribing to mobile services. This study, in fact, aims to support the conclusions of the two prior studies to the effect that consumers will not take only price and/or service quality into account when making the decision to subscribe to, remain with or switch from mobile operators, but they also take their social network (family members, friends, and colleagues) into account. Most subscribers will make most of their calls to members of their social network or calling clubs. Hence, subscribing to the same network as their social network can make mobile subscriptions more convenient because it then becomes easier connect to subscribers in the same network from a technical perspective. Mobile traffic can go through a single network rather than across networks. It is even more beneficial for mobile subscribers if mobile operators apply termination-based price discrimination, so that mobile subscribers can make cheaper calls. Farrell and Klemperer (2007) define this situation as local network effects. It is a subset of direct network effects. Certain groups of the population matter more than the whole population. However, local network effects in this thesis are defined as the benefit a mobile subscriber gains from being in the same network with their social network, and the benefit mobile subscribers obtain from termination-based price discrimination. Importantly, the study aims to identify individual characteristics that affect the

importance consumers attach to local network effects, and examine whether network-effects-oriented users pay lower monthly bills than other users, as they are typically more aware users.

The three studies focus on the possible roles of termination-based price discrimination and calling clubs which mobile operators can use them to raise consumer switching costs and increase their level of attractiveness in the Swedish mobile communications market. Mobile operators, in fact, can use other strategic instruments in this market, such as handset subsidies and differential network coverage, to increase consumer switching costs. One may apply similar models to investigate the roles of those two strategies in relation to consumer switching costs. This will give a complete picture analyzing competition in the mobile communications market. Nevertheless, it is beyond the scope of the thesis, which is limited to investigating the roles of termination-based price discrimination and calling clubs to enhance network effects (both tariff-mediated network effects and local network effects) and thereby increase consumer switching costs.

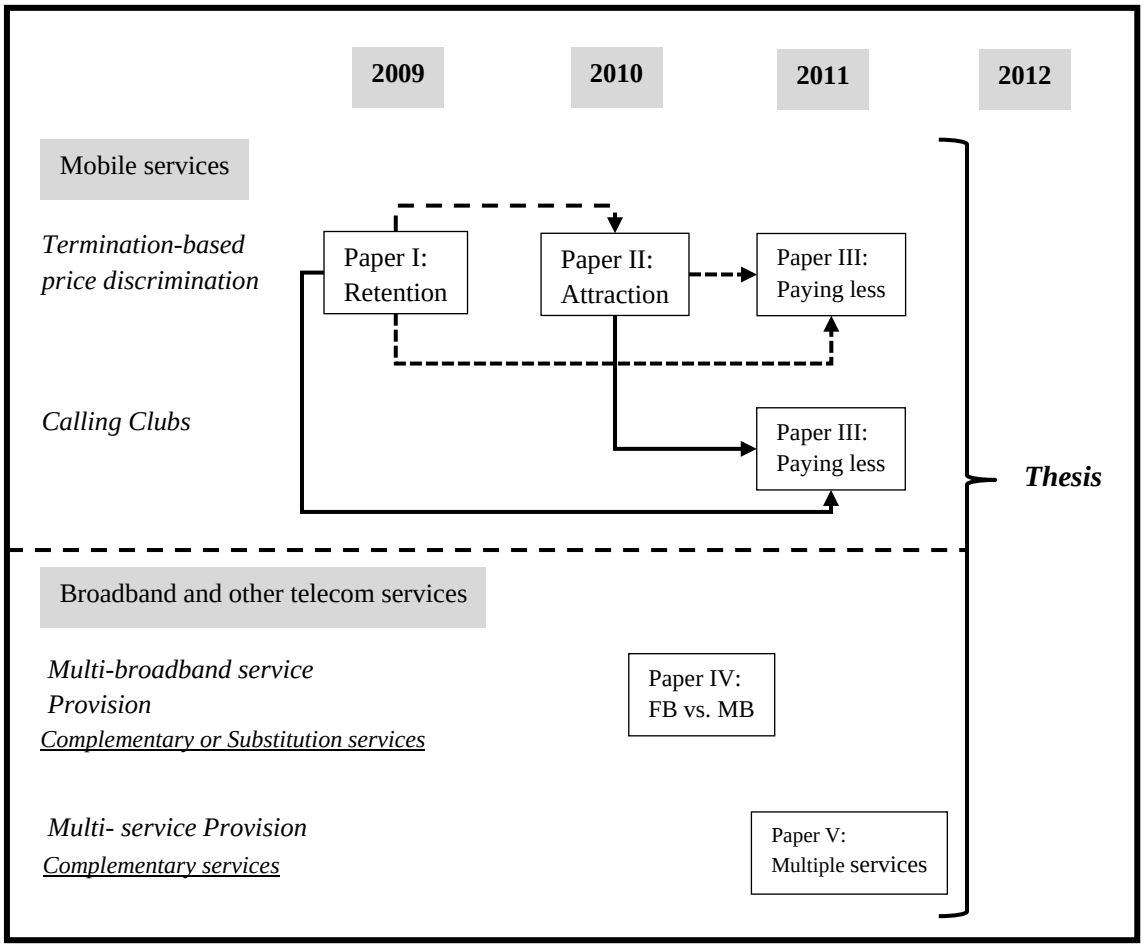


Figure 5 Flow of study

Note: ----------▶ The idea is driven by termination-based price discrimination

——————▶ The idea is driven by calling clubs

Source: Author

The focus of the thesis has been shifted to investigating consumer switching costs for other telecom services (i.e. broadband Internet services and other complementary services, fixed telephony and pay TV.) It is actually driven by the fact that major telecom operators in Sweden provide several

broadband Internet technologies and also various complementary telecom services. Telecom operators may use these characteristics to gain subscriber recognition and switching costs. Hence, two studies have been implemented in order to gain some insights on multi-service provision and consumer switching costs.

The fourth study of this thesis deals with the issue of complementarity and substitution between FB and MB. Sweden is one of the countries where has a well-developed infrastructure and a high rate of adoption for both FB and MB. The advanced development of MB in Sweden gives an opportunity to MB subscribers to connect to Internet at a comparable speed and at comparable prices to FB. Some of people may consider MB as a substitute service to FB, as MB has a mobility feature, but some people may use both FB and MB as complementary services. Hence, this study has been conducted to examine the current situation of FB and MB complementarity and substitution in Sweden from consumer perspective. Own- and cross-price elasticities are provided in order to show the stage of substitution or complementarity. The findings of this study are crucial to the telecom regulators in revising the broadband Internet market definition. In addition, a comprehensive discussion on multi-service broadband provision and switching costs is supplied to give insight to telecom regulators, as incumbents may use this situation to encourage their existing subscribers to migrate from FB to MB (within the same operators) to avoid a the high level of regulation of FB.

As described, major telecom operators in Sweden offer various complementary telecom services. They do not only sell these services separately to the end users, but also sell them as bundled packages. The customers can either buy several individual telecom services from the same (or several) telecom operators, or purchase these bundled packages. This is called multiple services. However, the bundling can be seen as a subset of multiple services and it is a combined package offering more than one telecom service from the same service provider and sold at a single price. Prices of bundles are generally cheaper (since telecom operators offer a discount) than the same telecom services are bought separately.

The bundling strategy can be beneficial to customers, as well as telecom operators. The customers will receive the complementary services with fully compatible among services because all services (in the packages) are provided by the same operator, and they will also receive the cheaper prices due to the discount on bundled packages. In addition, customers will benefit from receiving a single bill and dealing with a single back office. In other words, buying a bundled service package also reduces consumer transaction cost and learning costs. At the same time, telecom operators can apply bundled strategy to lock in existing customers and attract new ones. For instance, bundles can raise search costs of existing customers. Switching from a bundled package would require the customer to gather all of information about rival service providers to ensure the switch will be beneficial for the customer. In addition, it is difficult for consumers to switch since telecom providers usually offer complex menus of bundled packages.

Moreover, a significant increase in adoption of bundled packages has been observed in Sweden in the recent years. Bundled penetration in this country increased from 21% to 43% in the course of three years (2006 to 2009). This may indicate that bundled offers are an important factor for customer's choices in adopting more telecom services. Therefore, the last study of this thesis takes place and aims to examine the determinant factors of buying multiple services from the same telecom operators in Sweden. The bundled services are included in multiple services and are taken into account regardless of specific combinations. Discounts, telecom operators, and socio-economic variables are taken into account in the analysis. The findings provide insights for telecom regulators in reviewing competition in telecom markets and regarding market definitions for bundled services.

The five research papers are expected to give some insights regarding competition in the Swedish telecom market in relation to consumer switching costs. Telecom operators do not use only the issues of network effects and switching costs to compete, but can also use some other strategies, such as handset subsidies, differential coverage, long-term contracts with apartment owners, and so on, to increase consumer switching costs and gain greater competitive advantages. It is, therefore, important to continuously investigate and examine competition in this market in order to ensure that consumers will obtain desirable consumer surplus.

4.2 Data collection

To be able to analyze the problems arising the thesis research questions, reliable data is crucial. This thesis utilizes various sources of data (see Table 10) in order to answer the different purposes of the papers. However, data from *Post- och telestyrelsen (PTS)*, the Swedish telecom regulator, is the main source of data in most of studies.

Three out of five appended papers (Paper I, IV, and V) use the PTS annual survey of individuals. The PTS started to conduct the nationwide survey of individual in use of telecom services in 2002. The survey is performed annually by postal mail during August and September of each year. It consists of several questions related to all kind of communications services and television in order to gain knowledge of the market from the consumer perspective. The questionnaire is distributed to about 4,000 individuals, between 16 to 75 years old, randomly selected throughout the country. The response rate is quite high. In the 2009 survey, for example, it reached 53%. The survey data is publicly available upon official request.

Paper III uses data obtained from the author's survey in 2011. The survey was conducted in order to examine the role of local network effects. To the answer main research questions of the paper, that author's own survey of individuals was needed since data could not be obtained from the PTS survey. Hence, a self-administered online survey was performed In February and March 2011. That study focused on a sample of mobile consumers in Sweden. The questionnaires were distributed to members of online communities living in every part of the country. A total of 727 completed questionnaires were received, which represented a response rate of 36.35% from a sample of 2000.

The data collected from the PTS survey, as well as the author's own survey, is well representative of the Swedish population (see Table 9), even though there is an over-representation of males in the author's own survey in 2011. This means that the results produced from these data sources, are credible and reliable as representing the behaviour of Swedish mobile subscribers. In addition, if another person analyzes the same issues and employs the same data and assumptions, he or she will be able to obtain the same results. In other words, these studies can be replicated.

Table 9 Representativeness of the survey

Characteristics	PTS survey 2007	PTS survey 2009	Own survey 2011	Swedish National Statistics
Age (head of household - mean)	45.08	48.65	44.65	44.00
Education: college and university	31.69%	37%	47.47%	32%
Gender: male	46.47%	53%	76.20%	49.77%
Household size (mean)	2.45	2.5	2.32	2.1
Housing: having own house	N/A	55%	45.56%	50.87%

Source: PTS Survey (2007, 2009), own survey (2011), and Statistics Sweden (2009)

Moreover, data from the PTS statistics portal are also utilized in Paper II. PTS collects the market data from all telecom services provided by telecom operators. This data are also publicly available via PTS website[16]. Data collection from the official website of the telecom regulator will provide data credibility and reliability. Hence, the results produced from this source of data are reliable. Further, one can replicate the study by employing the same data set and assumptions and be able to obtain the same findings.

The studies apply different statistical analyses in order to answer different objectives of studies (see Table 10). For example, paper I employ a logit regression model which relates the decision of mobile subscribers 'to remain' or 'to switch' mobile operators with some service attributes and socio-economic factors. However, details of the statistical methods are provided in each appended paper.

Table 10 Data sources and methods

Paper	Data source			Statistical Method
	PTS Statistics Portal	PTS survey	Others	
I: The determination of mobile subscriber retention in Sweden	-	2007	-	Logit regression model
II: Termination-based price discrimination and mobile subscriber attraction in Sweden	2003 - 2009	-	Telepriskollen (2003 - 2009)	Dynamic panel data regression model
III: Paying less with local network effects: An empirical analysis of the Swedish mobile communications market	-	-	Own survey (2011)	Factor analysis, cluster analysis, logit regression model, and OLS regression model
IV: Fixed and mobile broadband substitution in Sweden	Broadband coverage and availability (2009)	2009	Broadband providers	Nested logit model
V: An empirical analysis of multiple services and choice of consumers in the Swedish telecom market	-	2009	-	Generalize Poisson regression model

Source: Author

[16] www.statistik.pts.se

5. SUMMARY OF APPENDED PAPERS

This thesis is based on five papers, which are appended in full at the end of this work. This chapter briefly presents the main findings.

The five papers are categorized into two groups of studies. The first group is related to switching costs, tariff-mediated network effects, and local network effects in the mobile communications market. In this group, three research papers have been conducted. One of the key findings of this group is that consumers of larger mobile operators face higher switching costs than consumers of smaller operators. Termination-based price discrimination plays an important role in locking in existing mobile subscribers in Sweden. In other words, termination-based price strategies can enable larger operators to gain a competitive advantage. In addition, they can be used in competing for new mobile subscribers. The last study of this group was conducted to demonstrate that mobile users do not only take the size of a network into account when subscribing with a mobile operator, but they also consider social networks. The findings confirm that there is the so-call network-effects-oriented group exists in mobile subscribers' population. Members of this group consider tariff-mediated network effects, as well as local network effects, when they apply to a mobile operator.

The last two studies consider the impact of multi-service providers with market dominant positions on switching costs. For example, broadband providers who own both FB and MB infrastructure can avoid many regulations regarding FB by encouraging their consumers to migrate to MB technology, which is less regulated, and subject to fewer competitors. Owning both FB and MB infrastructures can also provide an alternative for existing consumers and new consumers to either choose one or both broadband Internet connections. This will help providers keep their customers. Additionally, telecom providers who offer several telecom services can utilize other services related to their core business service by offering bundled service packages to increase customer retention.

5.1 Paper I: The determinants of mobile subscriber retention in Sweden

The study was conducted to examine the potential for 'lock-in' of Swedish mobile telephone subscribers. A binomial logit model is based on a 2007 telecom regulator survey. The model is intended to examine whether operator service attributes including termination-based price discrimination impact on subscriber retention. The results of the study suggest operator brand image management effort is fruitful. Furthermore, low on-net prices negatively affect retention. This suggests that termination-based price discrimination could encourage a higher level of competition in the market. This pricing strategy could promote switching behaviour of existing mobile subscribers. In addition, subscribers of larger operators are more likely to remain with their operator. Meanwhile, subscribers of smaller operators, in particular mobile virtual network operators (MVNOs), are least likely to be loyal. This suggests that larger operators (Telia, Tele2, and Telenor) can 'lock in' their existing subscribers. Moreover, on-net or termination-based price discrimination variables are considered along with operator variables. Their combined positive effect suggests that Telia and Tele2 can utilize the termination-based prices better than other operators. That is, existing Telia and Tele2 subscribers are more likely to be loyal. Meanwhile, Telenor and MVNOs report negative total effects, even though they implemented similar termination-based price plans. Hence, the study concludes that termination-based price strategies enable larger operators to gain competitive advantage. This creates high switching barriers for large-operator subscribers due to low on-net prices. Consequently, termination-based price strategies could stimulate market concentration.

5.2 Paper II: Termination-based price discrimination and mobile subscriber attraction in Sweden

The first study pays attention on impacts of termination-based price discrimination to lock in existing mobile customers in Sweden. The second paper is conducted to provide a complete picture of impacts of termination-based price discrimination on attracting new customers by using the Swedish mobile phone market as a case study. In this market, mobile operators have offered termination-based price discrimination to their customers since 2003. Therefore, the study empirically investigates roles of termination-based price discrimination, on-net prices, size of existing mobile subscribers, and tariff-mediated network effects on the number of new mobile subscribers.

The results show that price differential between on- and off-net prices (termination-based price discrimination) tends to result in the operator gaining additional mobile subscribers. However, setting too high a price differential between on- and off-net calls may not attract new mobile subscribers. Further, the size of a network has a positive impact on attracting new mobile customers in this market, with a larger number of existing mobile subscribers leading to greater additional mobile customers. These findings are in line with prior studies that state that the mobile operators with a larger number of customers will gain more new subscribers than operators who have smaller groups of customers. Lastly, larger mobile operators could not apply tariff-mediated network effects to gain new mobile subscribers in the period of study. Nevertheless, it is possible that larger mobile operators would gain more benefits from termination-based price discrimination, and this may be potentially harm smaller mobile operators, as well as impair competition in the market in the long run.

5.3 Paper III: Paying less with local network effects? An empirical analysis of the Swedish mobile communications market

As mentioned in the literature review chapter, network effects may be localized. Certain groups of adopters may matter more than a whole population. This third study was conducted to investigate the roles of local network effects in the Swedish mobile communications market. The study has three objectives. The first aim is to investigate the determining factors taken into account when consumers choose a mobile operator. The second aim is to identify individual characteristics that affect the importance consumers attach to local network effects. The last objective is to examine whether users who value network effects (network effects oriented) pay lower monthly bills than other users, as they are typically more aware. A Web-based survey of the Swedish mobile communications market in 2011 was distributed to online communities living in every part of Sweden, and data were analysed by employing the factor analysis, cluster analysis and econometric models.

The findings relating to the first objective indicate that Swedish mobile consumers take three factors into account when subscribing to a specific mobile operator: bundling, local network effects (including on-net prices and social network members with the same operator), and service quality and tariffs. According to cluster analysis, characteristics of mobile consumers can be used to classify them into four groups: (1) Bundling-driven, (2) Network-effects-oriented, (3) No specific pattern, and (4) Quality- and tariff-oriented, even though the respondents are heterogeneous.

As mentioned, this paper also aims to investigate what the characteristics of the network-effects-oriented group are. The findings show that price awareness, experience of changing mobile operator, spending on voice communications and being younger than 25 years old, could contribute to being a member of this group. In addition, members of the network-effects-oriented group pay lower monthly bills than the other groups, although this is not statistically significant. Moreover, considering the network-oriented variable along with operator variables, the combined negative effect suggests that

mobile consumers of small operators (Telenor and Tre) pay substantially more than those of large operators (Telia and Tele2), even though these group of consumers take local network effects into account, and all of the operators offered a discount on on-net calls. Therefore, the local network effects can create switching barrier for consumers of larger mobile operators and also put the smaller mobile operators at disadvantage.

5.4 Paper IV: Fixed and mobile broadband substitution in Sweden

Sweden is one of leading countries in broadband infrastructure development. FB and MB networks have been deployed nationwide, and now are available in most populated areas. In recent years, MB subscription has increased substantially, and its speed has also improved. Some people consider MB is a substitute service to FB, but some do not. It is interesting to investigate the state of complementarity and substitution in the Swedish broadband market. Importantly, FB and MB providers in Sweden are the same players. It will be more likely that those providers who provide both broadband platforms can avoid high level of regulation in FB by encouraging their customers to migrate to MB services supplied by the same provider.

This study is conducted on the basis of the 2009 PTS survey, and prices for broadband services obtaining from providers. The model has been estimated by using the nested logit model. Through an estimated model, the effects of price, socio-economic background, type of housing and service provider on the likelihood of broadband usage are analyzed. The findings indicate that price and housing type are the most important determinants for broadband connections. In addition, the living areaneighbourhood and service provider affect the probability of broadband access. In particular, the provider's own price and cross-price elasticities show that MB is a substitute service for FB in most geographic areas of Sweden. The magnitude of substitution varies by area.

5.5 Paper V: An empirical analysis of multiple services and choices of consumer in the Swedish telecommunications market

It is commonly known that telecom operators in most countries provid*e 'multiple services'*, in particular, horizontal integration services (fixed telephony, mobile telephony, fixed broadband and Internet access). Some telecom providers may provide cable TV and/or mobile broadband Internet access. Recently, telecom operators put their services into baskets that are sold for a single price.

Sweden shows a 22% increase in bundling service adoption between 2006 and 2009[17]. To understand the multiple and bundling services situation in the Swedish telecommunications market, this study discusses the current situation of multiple and bundle services and examines the determining factors that explain the consumers' decision to buy multiple services. This study was conducted using the 2009 PTS survey. The model is estimated using a Generalized Poisson regression model. The effects of discounts, service provider, socio-economic background, type of housing, and area of residence on the likelihood of buying multiple services is analysed through an estimated model. The results show that discounts, and service providers, education, level of income and area of residence are the major determinants for multiple services adoption.

The study confirms the findings from theoretical literature that service providers use a discount as a price discrimination instrument and their market positions, cable TV and telecommunications service incumbents, to lock-in existing consumers. The incumbent in the cable TV and telecommunications

[17] This is according to the E-Communications Household Survey. This survey is requested by Directorate-General for the Information Society and Media, coordinated by Directorate for Communication.

services expands its market position by adding other relevant services to its core business. Switching costs and market definition for bundled services have become important issues for the telecommunications regulator to investigate.

6. ANALYSIS AND DISCUSSIONS

Chapter 6 contains three sections. Section 6.1 and 6.2 provide the answers for the two sub-research questions. The last section presents some possible policy recommendations to the telecom regulator. These recommendations aim to reduce consumer switching costs, increase the level of competition, and provide a better analysis of competition in this market.

6.1 Tariff-mediated network effects and local network effects induce switching costs for mobile subscribers

Mobile operators introduce a termination-based price discrimination strategy by charging lower prices for calls placed in their own network and higher price for calls placed to other networks. This strategy aims to retain existing mobile customers and attract new ones. The results of this dissertation confirmed these arguments.

The finding shows that the combined positive effect of the advantage of size of network and low on-net price of a larger mobile network encourages existing subscribers to remain with larger mobile operators. This is in line with a study by Gerpott (2008) that showed that termination-discriminatory pricing erects switching costs for consumers, and makes consumers may favour remaining with larger mobile operators. This suggests that termination-based price discrimination could make mobile subscribers of larger operators, such as Telia and Tele2, unwilling to switch to other mobile operators. Particularly, existing subscribers of larger mobile operators could benefit from low on-net prices to a large number of subscribers within the same network. Larger mobile operators could raise switching costs by creating tariff-mediated network effects. This could help prevent their customers from changing mobile operators, and will reduce the level of competition in the Swedish mobile communications market.

Termination-based price discrimination strategy could also be seen as a high barrier for subscribers of larger operators who may wish to switch to other networks. Subscribers who belong to large networks with many subscribers prefer not to switch to relatively small operators, since they receive larger network effects from the large number of consumers. In addition, mobile subscribers face different levels of switching costs, depending on their operators. Mobile subscribers of Telia, Tele2 and Telenor are more likely to remain with the current operators than are Hi3G subscribers. Meanwhile, subscribers of mobile virtual network operators (MVNOs) are less likely to remain with their current operators. In other words, the mobile network providers (Telia, Tele2, and Telenor), can lock in their existing subscribers, but the virtual operators cannot. In addition, the subscribers of Telia are confronted with the highest switching costs, followed by those of Tele2, Telenor and the MVNOs.

In addition, brand image appears to be a significant factor to lock in existing subscribers in the Swedish mobile telephony market. This result is in line with the conclusions of previous studies (Gerpott et al., 2001; Chen & Hitt, 2002; Kim et al., 2004; Kim & Yoon, 2004) that service attributes can significantly determine the ‘decision to remain’ of subscribers. If mobile operators retain their brand image investment, their subscribers are more likely to remain with them.

Since mobile operators in Sweden have used termination-based price discrimination for several years, it is important to investigate the impacts of this price discrimination strategy on the attractiveness of mobile operators.

Findings of the thesis show that mobile operators can utilize termination-based price discrimination to successfully attract new mobile subscribers. Setting a higher gap between on- and off-net prices could

lead to additional mobile subscribers. However, if mobile operators set too huge a gap between on- and off-net prices, the number of new mobile subscribers will decrease. This may indicate that mobile subscribers may be aware that they cannot avoid making off-net calls. Then, setting too high prices between on- and off-net may not attract new mobile subscribers. Furthermore, on-net prices have a negative impact on the number of new mobile subscribers. It is obvious that if mobile operators set high on-net prices, they will not attract new mobile subscribers. Moreover, size of network has a significant impact on attracting new mobile customers in the Swedish market. More existing mobile subscribers will lead to even more mobile customers. In other words, new mobile customers make a decision to subscribe to a mobile network by considering the size of existing mobile subscribers of mobile operators. These results are in line with prior studies (e.g. Kim & Kwon, 2003; Fu, 2004) which state that the operators who have installed a certain critical mass of subscribers will subsequently attract more new subscribers than the others who have not.

Interestingly, a finding of this thesis indicates that tariff-mediated network effects could not enable larger mobile operators to gain new mobile subscribers in the period of study. This result contradicts the findings of prior studies (e.g. Fu, 2004; Birke & Swann, 2006, 2010; Hoernig, 2007; Gabrielsen & Vagstad, 2008; Grajek, 2010; Harbord & Pagnozzi, 2010). However, this situation may be one that prevailed on the Swedish mobile communications market during the period of study. For example, Hi3G, the smallest mobile operator, implemented termination-based greater price discrimination heavier than other mobile operators in order to gain market share and establish itself in the market. Hi3G charges lower prices on both on- and off-net calls (see Figure 6) than other mobile operators. Hence, Hi3G was able to attract new mobile subscribers, and this may also indicate that new mobile subscribers do not consider the benefits of tariff-mediated network effects when they make their decisions to subscribe to mobile operators.

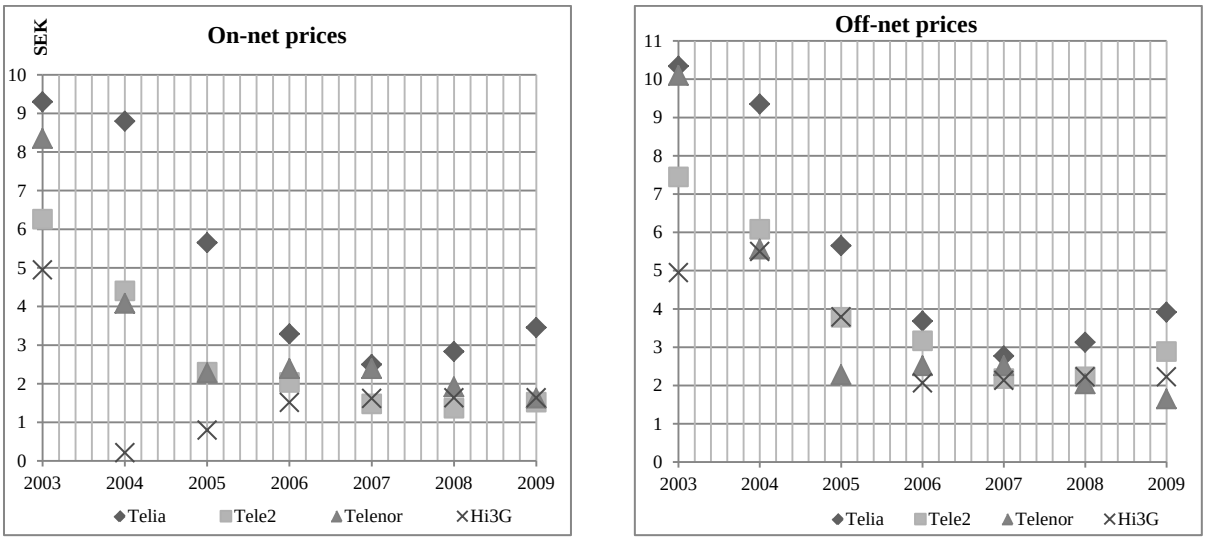


Figure 6 Comparison of average on- and off- net prices among mobile operators

Source: PTS Statistics Portal
Note: Prices are average prices on two minutes call with connection fee.

However, all mobile operators had set similar on- and off-net prices in 2007 and 2009. Larger mobile operators may gain more benefits from termination-based price discrimination because all of mobile operators set closer prices to each other for both on- and off-net calls during the last three years of the analysis (2007 - 2009). New mobile subscribers, in this later period, may have consider the benefits of

tariff-mediated network effects and made decisions to subscribe to mobile operators with a larger subscriber-base in a near future since they can make cheap calls to more subscribers within the same network.

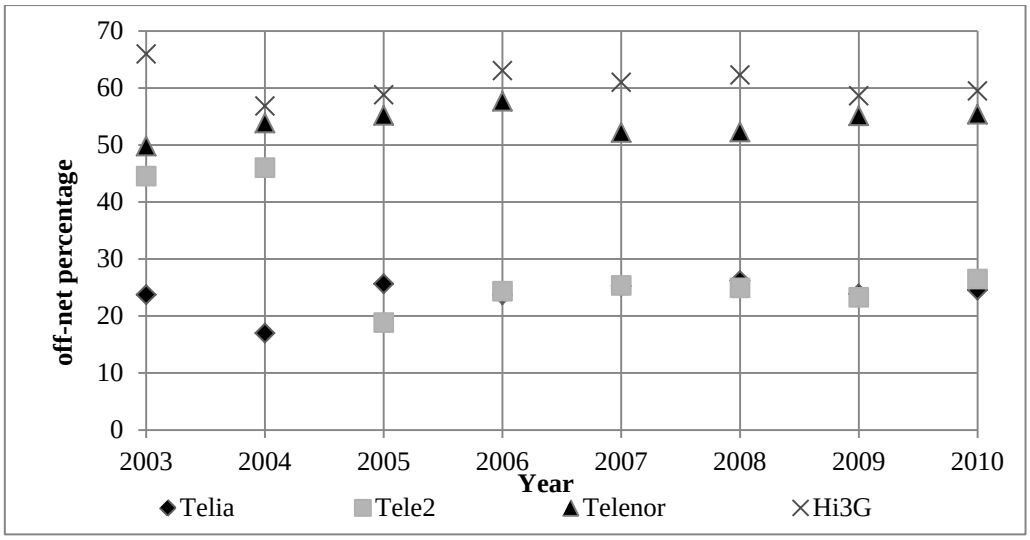


Figure 7 Off-net calls percentage

Source: PTS Statistics Portal

In addition, the implementation of termination-based price discrimination has also resulted in a biased proportion of off-net calls for Swedish mobile operators. Call traffic between large and small networks will not be in balance (see Figure 7), even though there is the same probability of each mobile subscriber calling the other (‘*balanced calling pattern’*) (Hoernig, 2007; Harbord & Pagnozzi, 2010).

Approximately 25% of the calls had been made outside the network, in the case of Telia and Tele2, while more than 50% of calls made from Telenor and Hi3G are in that category. Customers of larger mobile operators will have higher probability of placing and receiving calls within the same network. At the same time, customers of smaller mobile operators will tend to place calls outside their networks, since most have contracted with rival mobile operators. Hence, larger mobile operators will receive a greater revenue stream from termination charges as there will be a higher probability of smaller mobile operators will place off-net calls with them, and a lower probability of subscribers with large operators placing off-net calls to subscribers of smaller mobile operators.

One may argue that this situation can happen even without the introduction of termination-based price discrimination. However, with termination-based price discrimination, larger mobile operators will gain even greater benefit than smaller mobile operators. Larger mobile operators can force their customers to make most of their calls within the network by setting high on- and off-net price differentials. Subscribers, then, will consider remaining with larger mobile operators and new subscriber will tend to choose larger mobile operators as resulted from tariff-mediated network effects. Therefore, existing and new subscribers will consider this impact when making a decision to switch and subscribe to another mobile operator.

Not only tariff-mediated network effects can stimulate consumer switching costs in mobile communications, but local network effects can also play a significant role in creating consumer switching costs.

In mobile communications, the recent empirical literature (Birke & Swann, 2005, 2006, 2010; Corrocher & Zirulia, 2009; Maicas et al, 2009a) conclude that local network effects will exist if customers' decision to choose a mobile operator is influenced more by his social subset than by the rest of the users in the network. In addition, a mobile subscriber will be better off if he has the same operator as the person(s) he calls most, as it will be more convenient and his monthly bill will be less, as a result of low on-net prices. Ultimately, local network effects would encourage a mobile user and his social network members to be subscribers of the same mobile operators because they could benefit from paying a cheaper monthly bill. Therefore, local network effects could induce consumer switching costs.

The results of this thesis demonstrate that '*local network effects*' are one of three important factors[18] for subscribing to a specific mobile operator in Sweden. Mobile subscribers consider it important to have their family members, friends, and partners subscribe with the same mobile operator. Moreover, mobile subscribers also consider the importance of low on-net tariff when subscribing to a mobile operator. They can, then, make calls to their local network easier and cheaper since the calls are made within the same network.

The results of this thesis also show that mobile subscribers in this market are heterogeneous. They can be categorized into four groups. One of the groups is 'network-effects-oriented group'. It consists of mobile users who choose their carrier by taking the benefits of network effects into consideration. The members of this group are driven, in particular, by price awareness, pre-paid subscriptions, and the experience of changing mobile operator. This reveals that members of the network-effects-oriented group are aware of mobile tariffs and spend time studying and screening different options before adopting a specific mobile operator. In addition, members of this group pay lower monthly bills than others. However, the difference is not statistically significant. This result is similar to that reached by studies by Corrocher and Zirulia (2009) and Huacap and Heimeshoff (2011) showing that consumers who take into account the choice of their social contacts when choosing their own operator pay lower monthly bills.

Moreover, the results show that small operators' customers (Telenor and Hi3G) pay significant higher monthly bills than customers of large operators (Telia and Tele2), even though these consumers are member of the network-effects-oriented group and all of the operators offered a discount on on-net calls. This result suggests that local network effects can create switching barriers for mobile subscribers. In particular, consumers of larger mobile operators who are aware of benefits of local network effects, can take advantage of being in the same network as their social network members, and also benefit from paying lower monthly bills. Local network effects would be a disadvantage for consumers of smaller mobile operators since these consumers have to pay higher monthly bill. In the long run, when more mobile subscribers realize the advantages of local network effects and become members of the network-effects-oriented group, they and their social network member will consider moving to larger mobile operators in order to receive the benefit of lower bills. This will be to the detriment of smaller mobile operators.

6.2 Multi-service provision generates switching costs

The switching costs do not exist only in the mobile communications market but they are also present with regard to other telecommunications services. Telecom operators introduce more services to

[18] Two other factors are bundling and quality and tariff of service.

maintain their market position and to win customer loyalty by offering several broadband Internet technologies and bundling services.

In Sweden, broadband Internet service providers offer several broadband technologies (both FB and MB), to their customers. FB includes DSL, cable, and fibre technology. Telia, Tele2, and Bredbandsbolaget offer all kind of broadband Internet connections. Meanwhile Com Hem, an incumbent carrier for cable TV services, provides two main Internet connections - cable modem and MB. Several small players, including many municipalities and private companies, are providing fibre broadband connections. Tre (Hi3G), the smallest mobile network provider, also entered the market to compete for MB subscribers. However, considering both FB and MB providers, they are almost identical broadband service providers. It suggests that people have several choices of broadband Internet access but there are relative fewer broadband Internet providers to choose.

Recently, MB has experienced substantial growth in the Swedish broadband Internet market. At mid-2010, MB penetration was 25 per 100 inhabitants and covered 99% of the populated areas. MB subscribers can access the Internet at speeds of 3.1 – 14.4 Mbit/s, which is comparable to DSL technology. Moreover, prices of MB are relatively lower than DSL and fibre technology with the comparable speed. This may place a high uncertainty factor on FB services since subscribers may prefer to switch to MB. The issue of substitution between FB and MB should be investigated. Nonetheless, different populated areas have different broadband Internet connections available.

The geographical areas in Sweden are divided according to the availability of broadband technologies. Area 1 refers to regions where consumers can choose DSL, cable, fibre, or MB as a primary broadband Internet access. Area 2 are the areas where DSL, fibre, and MB are available, with Area 3 having only DSL and MB accessible for consumers.

The results of the thesis show that DSL and MB are sensitive to price changes for its own price than cable, and LAN/Fibre. The non-zero of cross price elasticities indicates that FB connections substitute for MB, in particular DSL and MB. The magnitude of substitution varies by area.

For Area 1, the results show that the own-price elasticity of all types of broadband connection is greater than 1 and this indicates that broadband Internet access is elastic. Demand for broadband access is sensitive to price changes. In addition, the cross-price elasticity is non-zero and this result confirms that different broadband Internet technologies in this area can be substituted. Interestingly, DSL and MB have relatively high cross-price elasticity. This suggests that these types of broadband Internet access are close substitutes. However, cable broadband connection has the smallest cross-price elasticity. This reveals that subscribers of cable connections are less sensitive regarding changes in price for the broadband technology of other providers.

Similarly, the results from Area 2 indicate that demand for all of broadband connection is elastic. Own-price elasticities are in range of -1.553 to -2.667. LAN/Fibre is, however, less sensitive on price changes of broadband connection of others. Moreover, the magnitude of cross price elasticities is in range of 0.370 to 0.845. The non-zero cross-price elasticity suggests that all broadband connections are substitutable.

In addition, the results of cross-price elasticities of Area 3 also indicate little substitution between DSL and MB, since the magnitude of cross price-elasticities are 0.163 and 0.811. This may indicate that those users who are still using DSL do not perceive MB as an equally good substitute. In other words, MB could not be in the same market as DSL in this area.

There are many possible reasons explaining the FB and MB substitution in the Swedish market. One possible explanation is that multi-service broadband providers want to avoid a higher level of regulation on the FB market by putting an attractive promotion on MB. For example, broadband providers charge lower prices on MB at a comparable speed of connection. By doing so, multi-service broadband providers will not lose any of their broadband customers because the customers just migrate from FB to MB technology. The results are in line with Ida and Sakahira (2008) who conclude that broadband subscribers desire to move from an old to a newer broadband technology within the same carriers. This confirms that multi-service provision of broadband providers can create switching costs by offering multi-platform broadband services. Broadband customers will more likely to choose a new broadband service within the same service providers.

Moreover, telecom operators in Sweden currently have a horizontal integration in their service structure. The E-Communications Household Survey of the European Commission, Sweden shows a 22% increase in bundling service adoption between 2006 (21%) and 2009 (43%).

This calls attention the need to study the determinants of buying multiple services and the impacts of buying more services from the same services provider, in particular, on switching costs in the Swedish telecommunications market. The results demonstrate that the discount for buying more services from the same operator has a positive effect on the decisions of consumers. It suggests that consumers who receive discounts have a higher probability (0.82 times) of buying bundle services or selecting more services to be included in their service basket than consumers who buy individual services. The discount offering can lock in and stimulate the consumers to include more services in their service basket. This indicates that multi-service providers utilizing their capability to provide multi-service with a discount could create switching costs for their customers, since the consumers tend to buy more telecom services from the same providers. This result fits well with prior literature (e.g. Stremerch & Tellis, 2002; Agarwal & Frambach, 2003; Crawford, 2008; Economides, 2010).

Importantly, the results of the thesis show that the current customers of an incumbent cable TV operator (Com Hem) and an incumbent telecom provider (Telia) tend to buy more telecom services from their current providers. This indicates that the current consumers of these providers are locked in. They prefer to add more telecom services from their current providers rather than from others. Search costs and the costs of uncertainty may also encourage consumers to use the service from the service provider they have used (Crampes & Hollander, 2006)[19]. This confirms that multi-service providers who have a dominant position in a specific telecom service could utilize their dominant position to encourage their existing customers to buy more services.

[19] Crampes and Hollander (2006) demonstrate that incumbent telephone operators can use bundling to retain a competitive advantage over older customers because these customers are less likely to switch to new and unfamiliar providers. However, cable operators may capture younger consumers since they are already familiar with mobile telephony and the Iternet.

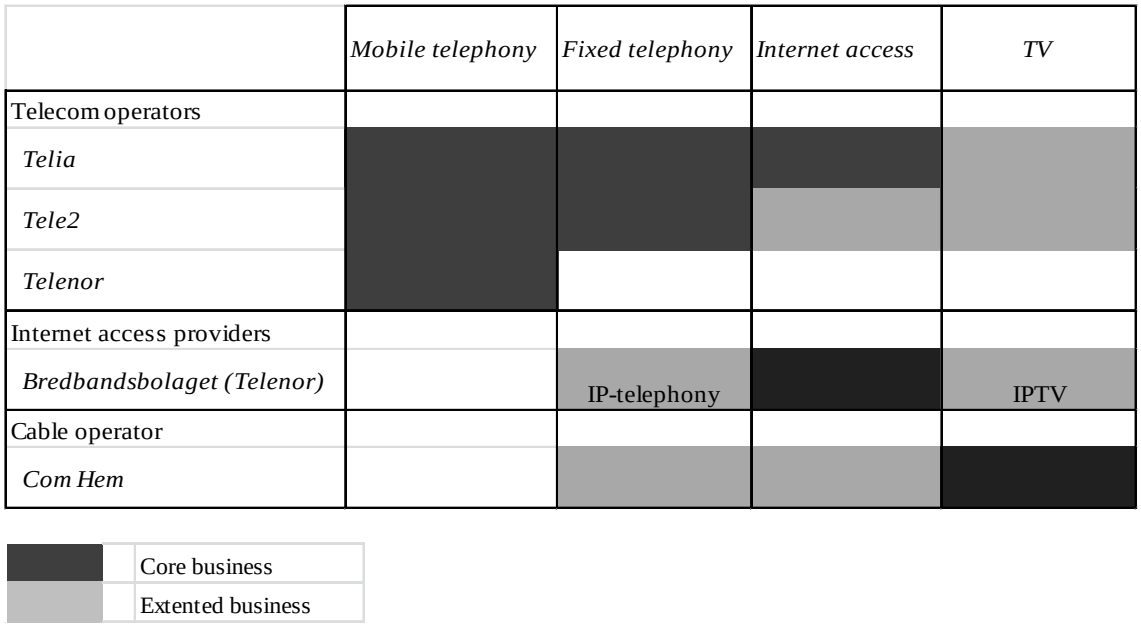


Figure 8 Current situation of various players in term of service offering

Source: Partly adopted from Pernet (2006)

The results of the thesis also indicate that customers of Com Hem have higher probability (0.75) to put more services in their basket than customers of Telia (0.55). Com Hem has only cable TV as its core business, while Telia is considered a leader in all telecom services (see Figure2, Table 4, and Figure 7). The reason could be Com Hem that already has the expertise to program TV content and perhaps provide relatively more attractive content. Its TV content could lead its customers to prefer to buy more related services from Com Hem. This is in line with the study by Lee (2009). Lee suggests that the company would benefit if it makes efforts to differentiate through video services other than voice and data services. This may suggests that TV content or video is one of potential factors for inducing consumers buy more services.

6.3 Policy Implications

6.3.1 Bill-and-keep and price awareness campaign

This thesis finds that the implementation of termination-based price discrimination and the existence of local network effects are the main components of switching costs confronted by mobile subscribers on the Swedish mobile communications market.

To reduce and prevent the potential impacts of tariff-mediated network effects, one possible recommendation would be to change the interconnection charge scheme toward a bill-and-keep model. A move to bill-and-keep relative to the mobile termination charge would possibly result in a more efficient wholesale and retail price structure. This pricing scheme will not allow mobile operators to charge termination fees to each other, and would set zero termination charges. Then, incumbents could not set a high termination charge to raise their rivals' off-net prices. This would mean that operators would not have an incentive to set different prices between on- and off-net calls if they cannot utilize termination-based price discrimination to create attractiveness for mobile customers (Harbord & Hoernig, 2010). Moreover, incumbents would have no incentive to encourage their customers to place most calls within their own network, since they will not pay and get money from interconnection services.

In addition, a bill-and-keep scheme can also be used to avoid the bottleneck monopoly problem that usually appears when the calling party pays (Littlechild, 2006). Harbord & Pagnozzi (2010) indicate that the countries which apply bill-and-keep (Canada, Hong Kong, Singapore, and the United States), have lower retail prices in the mobile communications market. Harbord & Hoernig (2010) confirm that moving to much lower mobile termination rates with bill-and-keep often results in the largest increase in overall welfare. It also eliminates barriers to entry caused by 'tariff-mediated network effects', increasing competition and welfare in mobile markets in the long run. Last but not least, a bill-and-keep arrangement would be simple to put in practice and it would give higher incentive to invest (Cambini & Valletti, 2003). Some authors have suggested that a regime based on 'bill-and-keep' is an efficiency way of sharing the value created by a call when both callers and receivers benefit from it (DeGraba, 2003) and it would indeed increase general welfare, compared to cost-based access pricing (Berger, 2005). It is also costly and time consuming for regulators to investigate real costs of interconnection (Stennek & Tangerås, 2008). Bill-and-keep would instead eliminate the need for regulatory intervention and enable telecom regulators to devote their resources to other necessary policies.

Switching costs caused by local network effects may also be reduced if price awareness campaigns can be implemented by telecom regulators. A price awareness campaign aims at encouraging mobile subscribers to carefully study their price plans. This will make mobile subscribers more well-informed consumers.

In fact, the Swedish telecom regulator established the telecom price-comparison website[20] to promote price information of telecom services. This website provides price information for all kinds of telecom services, including mobile price plans. It is helpful to the consumer as he/she can select the average number of minutes for on-net calls and/or off-net calls and the number of SMS per month. Then, the website will suggest the mobile carrier who offers the lowest monthly bill. However, the price-comparison website needs to be emphasized by the regulator to ensure that mobile consumers are well-informed. When the mobile subscribers are informed customers, they will seek to minimize their costs. At the same time, they will also look for a better service quality. This will probably raise the level of competition, in both price and quality of service, in the Swedish mobile communications market.

6.3.2 Market definitions for bundling services and broadband Internet access

In general, the market definition of telecom services is defined explicitly for fixed telephony, mobile telephony and the Internet market. These markets are regulated by the telecom regulator. Market definition does not cover bundled service, however. An examination of competition on individual telecom service may be different from the investigation of bundled service. For instance, the regulators may observe that the competition in double-play (e.g. broadband Internet and fixed telephony) is less competitive, adequate competition may be found in both broadband Internet and fixed telephony, when these are examined individually. Thus, it is important for the telecommunications regulator to determine the market definition for bundled services separately.

In addition, it is obvious that the market definition for broadband Internet access should be revised if there is evidence indicating that FB and MB are substituted services. The findings of the thesis have shown that FB and MB can be substituted services in some geographical areas in Sweden. The Swedish telecom regulator should, therefore, continue its investigation on the issue of substitution

[20] www.telepriskollen.se

between FB and MB and perhaps prepare to revise market definitions for broadband and relating competition regulations. Moreover, geographical market definition should be taken into consideration when redefining broadband market definitions. The empirical examination suggests that in different residential areas, broadband subscribers are confronted with different sets of broadband alternatives. One area may have a higher degree of substitution than others. Geographical market definitions will provide useful information for the telecom regulator in evaluating competition in broadband market.

7. CONCLUSIONS AND FUTURE RESEARCH

7.1 Conclusions

The literature shows that network effects and multi-service provision can impact social welfare both positively and negatively. This thesis aims to provide evidence indicating that network effects, in particular those caused by termination-based price discrimination and calling clubs, as well as multi-service provision, can potentially raise consumer switching costs in the Swedish telecom market. Two research questions were then formulated to examine the impacts from network effects and multi-service provision. The first research question is as follows:

RQ1: "What is the impact of termination-based price discrimination and calling clubs on consumer switching costs?"

The empirical findings from this thesis show that mobile operators, in particular larger ones, can utilize termination-based price discrimination together with their size of subscribers-based, tariff-mediated network effects, to lock in existing subscribers. Larger mobile operators can use these effects to raise consumer switching costs by reducing consumers' willingness to switch. Hence, subscribers of larger mobile operators face high switching costs. At the same time, mobile operators can also use termination-based price discrimination to compete for new mobile subscribers. Larger mobile operators tend to gain more new mobile subscribers. But the larger mobile operators were not able to use tariff-mediated network effects to gain new mobile subscribers during the period studies. However, there is a possibility that larger mobile operators can utilize tariff-mediated network effects in a near future since both larger and smaller mobile operators now charge similar prices on both on- and off-net calls. Subscribing to smaller mobile operators would not produce the same benefits as larger ones. New mobile subscribers may tend to subscribe with larger mobile operators instead of the smaller ones.

The empirical findings also show that mobile subscribers in this market are heterogeneous. They can be divided into four different groups. One of the groups, network-effects-oriented, takes 'calling clubs' and 'low on-net tariff' into account when they subscribe to a specific mobile operator. Members of this group can make calls at cheaper prices to their calling club and pay lower monthly bill than those who are not. The members of this group who are subscribers of smaller operators (Telenor and Hi3G) pay a higher monthly bill than those of large operators (Telia and Tele2), even though all of the operators offered a similar discount on on-net calls. This suggests that local network effects[21]can create switching barriers for mobile subscribers. Particularly, consumers of larger mobile operators who are aware of benefits of local network effects can take advantage of being in the same network as their social network members and also benefit from paying less on their monthly bill. However, local network effects would give a disadvantage to consumers of smaller mobile operators since they have to pay higher monthly bills, even though they are aware of the benefits of local network effects.

As described in Chapter 2, mobile operators in Sweden do not only operate in wireless voice communication, but most also provide MB and others FB to end customers. They also offer fixed telephony, TV services, and bundled packages. Major market players are almost the same in each

[21] The appended Paper III shows that local network effects can be caused by calling clubs and termination-based price discrimination. Certain smaller groups of customers matter more than a whole population of mobile subscribers.

telecom service. In other words, telecom providers in Sweden have multi-service provision. The second research question is as follows:

RQ2: What is the impact of multi-service provision on consumer switching costs?

The thesis shows that the cross price elasticities of FB and MB are positive. When prices of FB increase, the probability of using MB also increases, and vice versa. This means that FB and MB are substitution services in most part of Sweden. However, the magnitude of substitution varies by area.

As mentioned, most of broadband providers in Sweden are multi-platform broadband providers, providing both FB and MB across the country. They can take advantage of this situation by running an attractive promotion on MB to avoid a higher level of regulation on FB. Hence, there will be a high possibility that broadband customers will migrate from FB to MB technology within the same providers. As a result, broadband providers will not lose any of their broadband customers because their customers can switch from FB to MB technology. These can suggest that multi-service provision of broadband providers can create switching costs by offering multi-platform broadband services. Broadband customers will more likely to choose a new broadband service within the same service providers.

Receiving a bundle of services can also increase a consumer's switching costs. Providers usually sell several telecom services together as a package for a discounted single price. The empirical findings of this thesis reveal that the discount is an important factor making customers buy more services from the same operator. This indicates that the discount offered can stimulate consumer lock-in since consumers will tend to buy more services from the operators they already have experience with.

Moreover, an incumbent cable TV operator (Com Hem) and an incumbent telecom provider (Telia) tend to have higher advantage than other multi-service providers. Their customers will put more services into the service basket. This indicates that customers of these providers have higher switching costs than customers of other service providers, and confirms the fact that multi-service providers who have a dominant position in a specific telecom service can utilize their dominant position to encourage their existing customers to buy more services.

Concluding remarks

From the thesis's findings, it has been observed that larger telecom operators can use their customer-based and termination-based price discrimination, local network effects, and multi-service provision to raise consumer switching costs (see Figure 8). With these strategies, dominant telecom providers can increase consumer switching costs to strengthen their dominant position. If there is no further intervention by the telecom regulator, dominant players will be stronger and perhaps can take all customers.

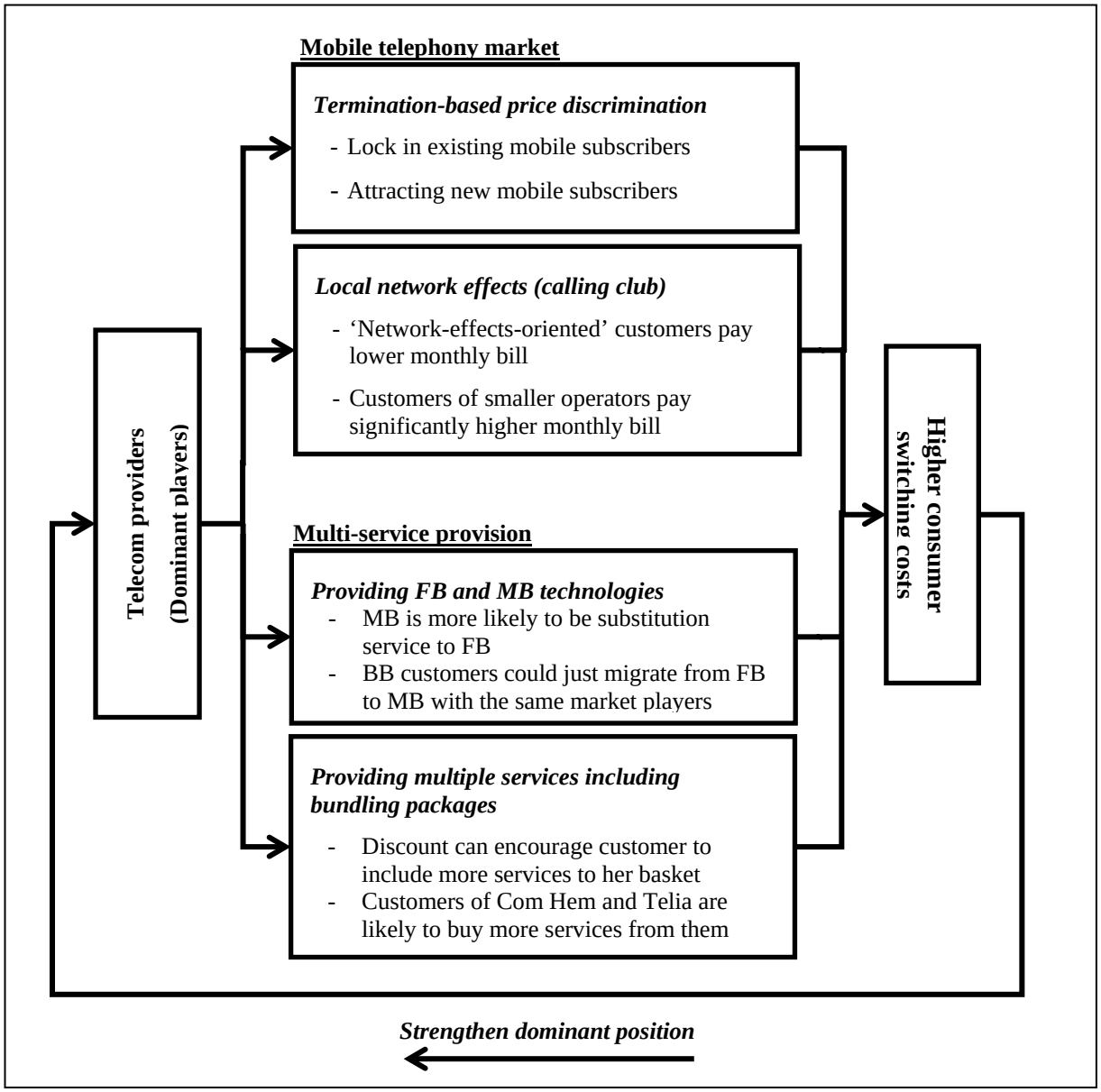


Figure 9 Summary of findings

7.2 Future research

The results of this thesis show that strategic instruments, such as termination-based price discrimination and calling clubs, can produce consumer switching costs in the Swedish mobile telephony market. However, there is no clear evidence indicating that larger mobile operators can be able to utilize tariff-mediated network effects to attract new mobile subscribers. A future investigation of this issue is needed. In addition, there are other factors that could explain switching costs in mobile telephony, such as handset subsidies. Mobile operators sell handset at a substantial discount as part of a long-term (often 24 months) subscription contract. In Sweden, mobile operators do not simply give free mobile terminals to their new customers. They apply a monthly payment basis to a customer instead of a full-amount payment when a customer wants to subscribe to their networks. The mobile customer must have a certain period of subscription in order to get such a discount. Hence, it would be interesting to investigate the empirical impacts of handset subsidy on consumer switching costs in this market as a future research project.

MNP was implemented in Sweden beginning in late 2001. Mobile subscribers can switch mobile operators while retaining the same mobile number free of charge. However, of the 10% of Swedish mobile subscribers who switched to other operators in 2007, only 7% utilized their MNP rights. This may suggest inefficiency in implementing MNP. An investigation of determinants for non-MNP adopters is worth undertaking, and should take into account duration of porting and consumer awareness of MNP.

Mobile operators currently offer several price plans to their subscribers. They revise their price plans regularly in order to compete with their rivals. Mobile subscribers, then, have at least three alternatives when making a decision: not making a change, changing their price plan within the same operator, and changing mobile operators. The results of this study will be helpful for both telecom operators and the telecom authority in the revision of their business plans and related regulations.

The thesis has also discussed that FB and MB, as substituted services in Sweden. The results implicitly indicate that there is a possibility that current FB customers will switch to MB service within the same operator. However, this issue has not been explicitly investigated in this thesis due to data limitation. In addition, speed of connection and prices are currently comparable for both FB and MB technology. It is important for the telecom regulator as well as broadband providers to know the probability of migration from FB to MB technology within the same provider. The results will provide insights for the telecom regulator to analyze related regulations (i.e. infrastructure investment and spectrum allocations, as well as market definitions). Telecom operators will benefit from future research when setting up new business plans.

Last but not least, it is important to investigate switching among broadband technologies. Since several broadband Internet access technologies are available for consumers in Sweden, people are able to choose any broadband Internet access, and perhaps free to switch to other broadband technologies. The results will be useful for the telecom regulator as a way of showing how infrastructure-based or multiple platforms competition works. It can also point out the major obstacles to switching broadband providers and technologies.

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