Essential Traits for the Economics of Network and ICT: Theory and Practice

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A thesis for the Doctor in Economics

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Introduction

Recent rapid developments in technology seem to overcome boundaries in life, but the world is still governed by natural law as discussed in John Bates Clark (1915) and Leibowitz (2002). Technologies change the world seemingly at the speed more than we can feel it.

However, the telecommunications market tends to be a “captive market” that suppliers let customers in a certain circumstances, and customers must choose from the selection they offer like shops in an airport or a station after “checking-in”. In other words, they ask customers to accept additional or collateral conditions to use their main service. There is no choice for customers to arrange their own contracts freely according to their preference or usage.

This thesis analyzes the characteristics laying rapid developments in the ICT (Information and Communication Technology) industry, especially in the telecommunications market. For that purpose, we consider a cost incentive exploring characteristics in the contract between operator and customer, and the relationship with/between additional factors normatively and positively. The analysis shows how those “captive” attitudes affect the market and interact with influential and additional factors.

In chapter 1, we review a historical background of privatization and liberalization of the market in 1980’s, and clarify theoretical characteristics from earlier literature. Chapter 2 also reviews the characteristics of the market in the ICT era theoretically, and bridges the cost reduction incentive in earlier literature to the cost incentive in question. Chapter 3 analyzes empirically the incentive of practices implemented in the market taking those factors into account. Chapter 4 also analyzes recent telecommunications market empirically.

Above all, this thesis shows that the market that formerly considered as a structural issue now turns to a practical issue of the operators, and the incentive in the market affects competitive circumstances.

1. Background: The Regulatory Issues and Discussions of Price in 1980's

1.1 Background on Incentive

Chapter 1 reviews the historical background on regulations for traditional telecommunications market. In its early stage, the market was mostly owned by the government and controlled by the regulation[1]. Therefore, as Joskow (1973a, 1973b) pointed out, what matters most was the "threshold" the regulatory agency set. This chapter also reviews the existence and its definition of the incentive in the traditional policy measures.

As for incentive, we follow the assumptions by Ramsey (1927) using the Pigou's terminology that private and social net products are equal by the government interference not included in the taxation; we take the existence of the taxation a policy scheme or a contract in our case discussed later. In other words, the profit maximization implies cost minimization in the competitive market. We assume that the cost incentives exist in the difference between the outcomes of the objective functions caused by the existence of those schemes. The difference in the outcomes is an excess profit that may distort the competitiveness in the market.

As Baron and Myerson (1982) discussed, the historical policy measures in this chapter modify the market from the first best solution by implementing optimal regulation considering a socially expected goal. So we stand at the starting point to discuss here how the difference is realized under each schemes as following chapters. It is important to note that we have to clearly distinguish between effects come from competitive market and the excess profit come from factors seemingly outside the market.

Following sections review past policy tools to clarify its purpose, effects, and what caused those effects.

1.2 The Price-Cap: United Kingdom

1.2.1 The Historical Review

Here we overview the drift of the discussion until the Littlechild Report based on Beesley (1993, 1997). Fixed phone and postal services in the UK were operated by British Postal Office (BPO) until 1981. BPO had improved their equipment under restrictions set by British Ministry of Treasury. Beesley and Laidlaw (1993) pointed out and explained three

[1] The review in this chapter is based on an earlier review, Kobayashi (2010).

points that showed the status in 1981; (1) poor quality of services, (2) delays to modernize national network, and (3) difficulty for customers in obtaining permission of the most recent equipment.

The BPO was responsible literally for postal and telecommunications, which had wide range of responsibilities. Therefore, the operator at that time did not pay attention to marketing and customer relations.

In modernization, ignoring demand on simple services and its equipment like answering machine caused poor quality in services. The digital switching equipment was also developed as a major national project, but they consequently procured the equipment from overseas and its introduction was delayed.

In 1980, Beesley, a professor of London Business School, proposed an assessment for liberalization of VANS (Value Added Network Services), and published the Beesley Report in January 1981, which allowed freeing resale and entry into the market to get more competitive. Consequently, this report caused that the telephony tariff in local call went up and that in long distance lowered so called cross-subsidization.

In July, the 1981 legislation passed as the British Telecommunications Act 1981 and the divestiture between postal and telecommunications was accomplished. As a result, BT (British Telecommunications plc.) was established. At this point, BT had an exclusive privilege on public telecommunications services and a right to give permission to other operators. Therefore, control were overlapped by the government and BT. The government anticipated other operators to enter VANS, but there was no clear classification between fixed telephone services and VANS.

While the Littlechild Report proposed the price-cap regulation, the report referred to the rate-of-return regulation shown in section 1.3 and evaluated other possible regulatory schemes. The report was written in 1983 for the Telecommunications Act. The purpose of the report at that time was to remove the BT's privilege in section 12 of the 1981 Act, and to treat BT as the licensed private firm. Therefore, promoting competition by removing the privilege and offering services by other operators were expected by the Littlechild Report.

As a result, the 1984 Telecommunications Act passed, and liberalization spread to VANS. Interconnection was also allowed in 1985. Those events caused that BT had to concentrate on basic service like telephony. The independent regulatory agency Oftel (Office of Telecommunications) which was established in 1984 set the *RPI-X* formula to assess retail price of the charge. This regulation called the price-cap regulation. The charge was calculated by the service price basket selected in advance by the agency. Operators allowed to set its price flexibly according to profitability within the range of the cap.

1.2.2 The *RPI-X*

An issue in the regulation is the one in setting the rate of "*X*". The reason of setting the rate was never opened to the public, and the agency just explained that they concerned lots of factors on price. Table I-1 shows the changes in *X*. What the Littlechild Report concerned was the benefit of reducing local call charge. The idea was coming from a discussion of regulation for other area before liberalization. The *RPI-X* formula was applied to the monopolized service charge, and the agency tried not to raise its price over *(RPI-X)* %. As a result, the agency decided to set 3% in *X*, but the process of the decision was not open to the public.

However, in 1986, there was an argument that BT's profit was excessive even under the regulation. The agency claimed it was appropriate, and the price was set below its upper limit for two years. In 1989, the agency changed the level of *X* from 3% to 4.5%. For fear of BT's high profitability in international call, the basket included international call in 1990. The rate was changed to 6.25% in September 1991, and BT reduced their profits for the first time after privatization. Furthermore, the rate of *X* was reviewed according to phased increase of the rate of return in capital in 1993, and reviewed again to 7.5% until mid-1997.

After mid-1997, the rate of *X* was reduced to 4.5% for relaxation of the regulation toward its removal. The rate of 4.5% was expected to continue until 2001, but extended to mid-2002. The cap was changed to *RPI-RPI* until May 2005, and changed again to *RPI-0* after that. To avoid rapid price increase caused by the removal, the agency confirmed competitiveness in telephony market and the regulation was removed in July in 2006[2]. Following subsections explain what happened in each term according to the rate of *X*.

[2] For further its process, refer to BT's Annual Reports 2006.

Table I-1 Changes in RPI-X

Terms Effective	RPI-X (%)
1984-1989	RPI-3
1989-1991	RPI-4.5
1991-1993	RPI-6.25
1993-1997	RPI-7.5
1997-2002	RPI-4.5
2002-2005	RPI-RPI
2005-2006	RPI-0

Source: Cave (1997), BT Annual Reports

1.2.3 The 1984-1991 Era

Since 1984, the market in the UK had been promoted competition by Oftel[3]. Until 1991, participants of the market which could operate national and international calls were the only two firms: BT and Mercury. This period was literally the era of duopoly.

During this era, Oftel decided interconnection conditions in October 1985, but conditions were asymmetric. Services offered by Mercury could provide through BT's network, but agreements were needed to provide Mercury's services to BT's customers. Consequently, Mercury could open its way to gain customers in metropolitan area anyway. While Mercury's local call charge was 20% less than that of BT's, the charge of calls to areas outside London became higher than that of BT's.

Therefore, Oftel had to consider Mercury's access deficits [4] coming from interconnection fee, and made an effort not to charge it to customers. In other words, the interconnection fee became a burden for entrants unless charging it to customers. The interconnection rule was an important issue not only for competition but also cooperative actions in the market.

[3] By the Communications Act 2003, the regulatory agency in the UK was reorganized to Ofcom.
[4] Access deficit is the situation where the amount of the interconnection fee paid to the incumbents excesses that received by the entrants. The issue of the access deficit was discussed in Armstrong (2002); Beesley (1997); Laffont, Rey, and Tirole (1998a, 1998b).

1.2.4 The 1991-1997 Era

In the 1989 Review, the government changed the duopoly policy to competition to deal with issues faced in 1991. In November 1990, the UK government announced to start reviewing duopoly policy, and the review was formally published in March 1991 by Department of Trade and Industry. In the review, the UK government decided to end duopoly policy. They issued licenses to 150 new entrants at that time.

The main market in this era was still fixed telephony market. The number of subscribers increased rapidly because of the decline of retail price due to the cap. While this rapid growth, the mobile market started up in this era as shown in figure I-1[5]. Developments in communications technology explored possibilities like VANS.

The mid-1990's was a turning point for telecommunications industry in the UK. The diffusion of the Internet caused some increases in demand not only for telephony service but also communications services using computers as shown in figure I-2, I-3. Although its charging scheme was at a certain level of affordable rates, higher knowledge and skills were needed to use the Internet through user interface (UI). So, the difficulty prevented from diffusing the Internet[6].

1.2.5 The 1997-2002 Era

In 1997, the rate of *X* was changed to 4.5% from 7.5%. Oftel released the status in October 2000, which stressed some improvements in competitiveness. But still BT kept at the level of 60-70% market share[7]. The fixed telephony market was allowed pre-selection services that customers could choose an operator in advance, and there is no need to push specific numbers to call from the operator chosen. This policy also fueled competition to gain new customers and switch operators.

Instead of existing ISDN (Integrated Services Digital Line) that communicates over PSTN (Public Switched Telephone Network), Operators introduced xDSL (Digital Subscriber Line) that uses residual bandwidth available in copper cables.

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[5] All figures is this section are shown at the end of the section.
[6] At the same era, Microsoft introduced Windows 95 and made people easy to access to the internet using graphical user interface (GUI). This event exploded its demand to diffuse exponentially.
[7] Refer to Oftel annual Communications Market Report in the year 2000.

Unlike ISDN, xDSL made possible to charge at a flat rate because there was no technological limitation caused by the bandwidth. Few people subscribed to xDSL yet in this era, but the number of subscriptions grew rapidly in the next era.

1.2.6 The 2002-2006 Era

The regulation moved forward to its removal from 2002. As shown in figure I-8, duration time of local and long distance calls fell drastically, so the circumstances in the market also changed rapidly. Unlike the 1990's, the number of fixed subscription decreased drastically as shown in figure I-6. On the contrary, the number of mobile subscription grew exponentially as shown in figure I-7.

A data communications service like xDSL showed rapid growth in figure I-9, while the growth of existing dial-up was declining steeply. As shown in figure I-10, households' expenditure for the communications service drastically increased based on the expenditure in 1995. The talk time in the fixed line also fell drastically at the same period as shown in figure I-8. These might be caused by the growth of the data communications services. The CPI (Consumer Price Index) in figure I-11 showed a drastic decline in price of the telephone and telefax equipment, which was caused by the supply for the strong demand in the market. The flat-rate charging scheme could help the strong demand because of the easiness to introduce those services. In addition, innovations brought drastic decline of the equipment price, which contributed to the reduction of its price.

Furthermore, as shown in table I-2, the changes in the overall change in price started to rise after the rate effective since 2002. However, breaking down the CPI data shown in figure I-11, the decline of the equipment price showed more drastically than that of the service prices. Therefore, the decline of the equipment price contributed more to that of overall retail price. This implies that the price-cap was not necessarily the cause of the decline because the price drop in the equipment was too drastic to figure out that the cause of the decline simply came from the price drop in the services.

While subsection 1.2.6 showed that the price-cap worked for the reduction in retail price, the retail price rose as the policy moved toward the removal of the regulation. In other words, we might be hard to figure out where the decline came from while customers could feel the decline in retail price. Therefore, the experience of the price-cap in the UK shows that we have to break down the change in the price and figure out the cause of the decline.

Table I-2 Changes in Influences of the Cap and the Price Changes after the Cap

	Changes of RPI (%)	Rate of X	Required Reduction in Price (%)	Overall change in Price (%)
1995	3.52	7.5	-1.38	-1.82
1996	2.14	7.5	-4.92	-4.92
1997	2.94	4.5	-1.56	-1.56
1998	3.75	4.5	-0.73	-0.73
1999	1.35	4.5	-3.24	-3.24
2000	3.32	4.5	-1.2	-1.2
2001	1.93	4.5	-2.5	-2.5
2002	2.33	2.33	0	0.14
2003	2.89	2.89	0	-0.19
2004	3.03	3.03	0	0.46
2005	2.8	0	0	2.8
2006	3.2	0	0	3.2
2007	4.4	-	-	4.4
2008	4.6	-	-	4.6
2009	-1.6	-	-	-1.6
2010	5.0	-	-	5.0
2011	5.0	-	-	5.0
2012	2.8	-	-	2.8
2013	3.3	-	-	3.3

Source: BT Annual Reports, Office for National Statistics

1.2.7 The Market Circumstances realized by the Price-Cap

Until 2010, BT's market share had been above 50%, which shows that BT still have great market power to influence the market. As shown in figure I-12, the price-cap worked well to reduce retail price according to the rate of *X*. As shown in figure I-13, the number of BT's unbundled local loop had increased exponentially since 2005. This implies that the BT's local loop may have a strong market power because the revenue shares of the local call had been above 50% until 2009 in table I-3. As of 2007, local loop unbundling was completed and 118 operators were in service in the telephony market through Public Switched Telephone Network (PSTN) as shown in OECD (2009)[8]. In the same data of OECD (2013)[9], the number is down to less than 50 PSTN operators in service, and the number of fixed operators in total was also less

[8] See the numbers shown in table 2.1 of OECD (2009).
[9] See the numbers shown in table 2.1 of OECD (2013).

than the number in 2009, which might have some concerns on competitiveness in the fixed line market. Although optical fiber network grows rapidly these days, the fixed network still contributes not only to telephony service but also communications services like xDSL.

Furthermore, services available through fixed lines like PSTN are bundled in a package, so called “Triple Play”. The package provides telephony, data communications, and video service, but some operators offered more services to bundle. This practice works not only to lock customers in but also to increase their revenues.

Thus, BT’s revenue share dropped to below 50% in 3Q of 2009, and its yearly data are shown in table I-3. The status of competition can be measured by Herfindahl-Hirschman Index (HHI)[10]. HHI of the local call is shown in table I-3. Ordinary quantitative market share is not enough to examine the effect of price-cap. To take price factors into consideration, revenue share could be appropriate to examine not only the effect of the price-cap but also that of competition after the price-cap era as shown in table I-3.

In the consideration of the HHI, we assume the intuitive market status described as the “pseudo” HHI[11]. The revised HHI might be close to the actual sense of the status because the owners of the equipment are network operators like “major players” listed in figure I-3, and the services offered by the small entrants through the equipment seem not to be in the same conditions as those of major players. We know this assessment is a little bit rough to handle it, but we can show how different what consumers feel and the actual status of the market.

We have to note that the lessons from this section may be applied only to the fixed line market for the consistency in our analyses.

[10] HHI is an index to measure the degree of monopoly in a market. The index is calculated by the summation of squared number of shares in the market. The index of zero is perfectly competitive market, and 10,000 is perfectly monopolized market.

[11] The “pseudo” HHI is assumed that there are only a few major players only in the market listed in the table I-3. The reason for this assumption is that most new entrants are mostly small in the size of the network, and it is hard to offer the same conditions or better as major players do. That is why, we assume the case where it is negligible for customers to choose offers by small operators. In our case, the HHI is calculated simply by operators except the share of “others”.

Table I-3 Geographic (local) Call Revenue Shares by Operators & HHI

Geographic Call Revenue Share by Operator & HHI					
	BT	ntl: Telewest	Virgin media	others	HHI
2000	67.2%	13.5%		19.4%	5069
2001	63.0%	15.1%		21.9%	4675
2002	65.1%	15.1%		19.8%	4859
2003	64.8%	13.8%		21.5%	4845
2004	60.9%	13.9%		25.2%	4538
2005	56.8%		13.7%	29.5%	4285
2006	54.8%		13.0%	32.1%	4210
2007	56.1%		12.8%	31.2%	4278
2008	55.0%		11.8%	33.2%	4270
2009	54.7%		12.1%	33.2%	4240
2010	46.8%		17.2%	36.0%	3784
2011	47.0%		16.4%	36.6%	3818
2012	47.2%		15.7%	37.0%	3850
* Data includes (unlimited) dial-up connection					

Source: Ofcom Telecommunications Market Data Tables

Table I-4 Call Revenue Shares of "Major-Players-Only" Market and the "Pseudo" HHI

Geographic Call Revenue Share by Assumed Bundled Operator & HHI				
	BT	ntl:Telewest	Virgin media	HHI
2000	67.2%	13.5%		4694
2001	63.0%	15.1%		4194
2002	65.1%	15.1%		4469
2003	64.8%	13.8%		4384
2004	60.9%	13.9%		3904
2005	56.8%		13.7%	3417
2006	54.8%		13.0%	3177
2007	56.1%		12.8%	3306
2008	55.0%		11.8%	3168
2009	54.7%		12.1%	3137
2010	46.8%		17.2%	2486
2011	47.0%		16.4%	2476
2012	47.2%		15.7%	2480
* Data includes (unlimited) dial-up connection				

Source: Ofcom Telecommunications Market Data Tables

1.2.8 Remarks

In section 1.2, we reviewed the influence and the contribution of the regulation through the case of the United Kingdom. The price-cap is one of the major examples of market liberalization in the 1980s. From our review of the case in the UK, we reassured that the price-cap has an incentive to decrease price, and it had been working effectively till the end of the regulatory scheme.

And the equipment in local loop in the UK is legitimately unbundled, the proportion of the exchanges ready for the unbundling is favorably increasing. As we also pointed out in table I-3, the call revenue share implies that local loop has still been offered by BT at the high proportion. So a large share of the local loop network in the UK is still controlled by BT, and that seems to have been unchanged since the nationalized era.

While the regulation has an incentive to lower the price, the structure of the local loop seems not to be changed regardless of the market structure. The lack of the change in the local loop may cause the access deficit.

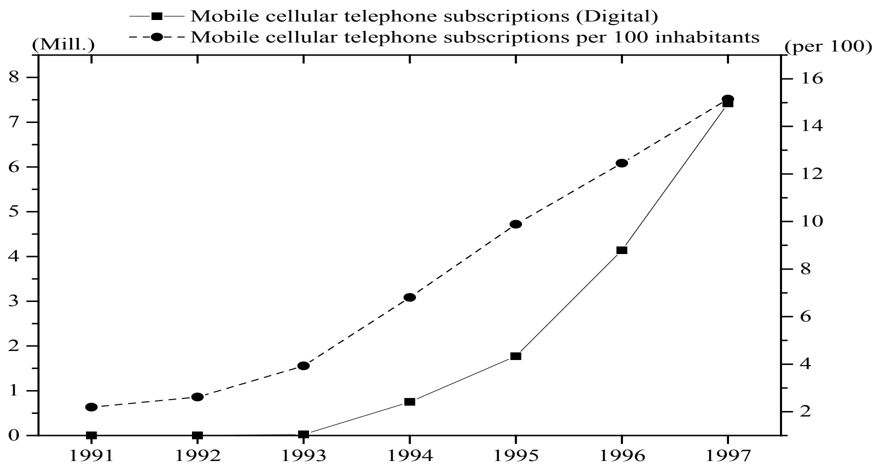
The reason why the entrants hesitate to enter the local loop is that a large amount of capital is necessary to build and maintain their own network and services. The access deficit becomes a burden for entrants and tends to be charged directly to customers.

As the eras we classified according to the rate of *X*, each era was led by the variety of services and the strong demand. The demand could be brought by the price drops. The price-cap is not major policy instrument in recent years, but its effectiveness may still work for the market in a different way.

Reviewing the case of the UK shows that it is necessary to consider further on innovation; the efficiency between installed base and new adopters with more compatible goods or standards[12]. All those topics are discussed further in chapter 2.

<Figures>

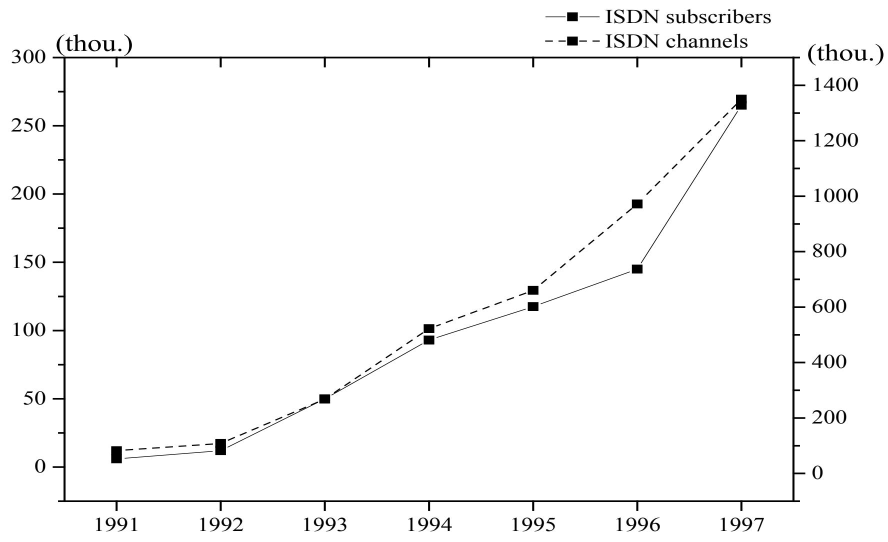
Figure I-1 1991-1997 Number of Mobile Subscription



Source: ITU World Telecommunications Indicators

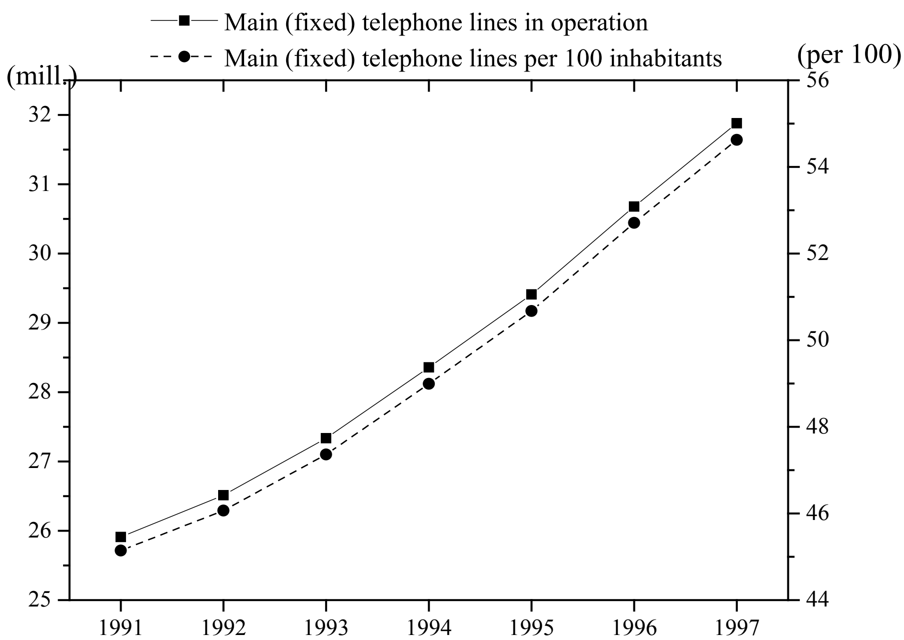
[12] Normative approach is discussed by Farrell and Saloner (1985, 1986). The discussion shows “excess inertia” and “excess momentum” exist. The excess inertia is an effect that a widely-used efficient standard or technology tends to keep using even though a more efficient newer technology is invented as the case of QWERTY keyboard. The excess momentum is the one that the early adopters called installed base momentary incur unavoidable costs if the newer standard is adopted. Katz and Shapiro (1986); Greenstein (1993) also discussed in the same kind of approach. All those topics are discussed further in chapter 2.

Figure I-2 Changes of Subscribers & ISDN Channels in 1991-1997 Telephone Lines in Operation



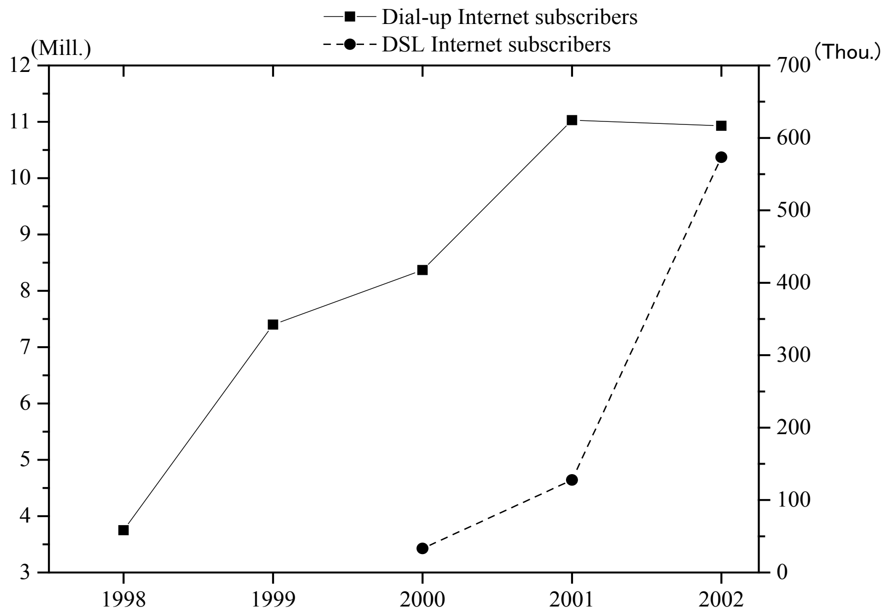
Source: ITU World Telecommunications Indicators

Figure I-3 Number of Fixed Telephone Lines in Operation



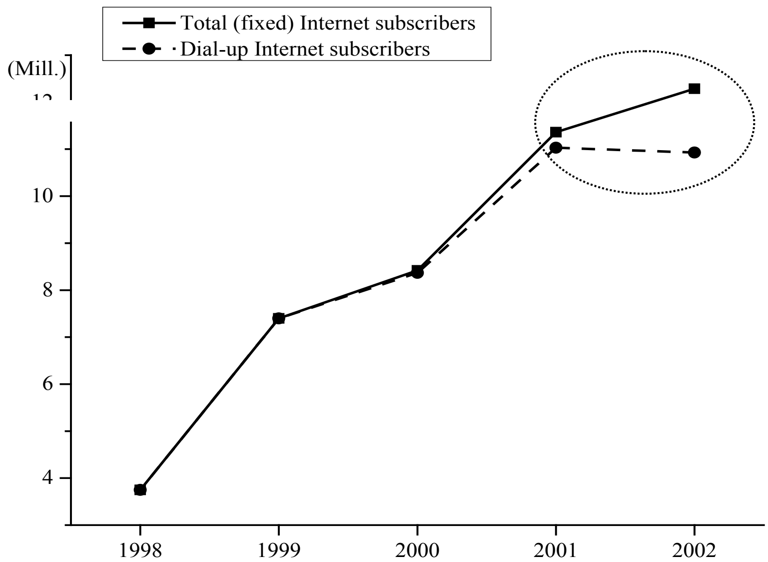
Source: ITU World Telecommunications Indicators

Figure I-4 1998-2002 Number of dial-up and xDSL Subscriber



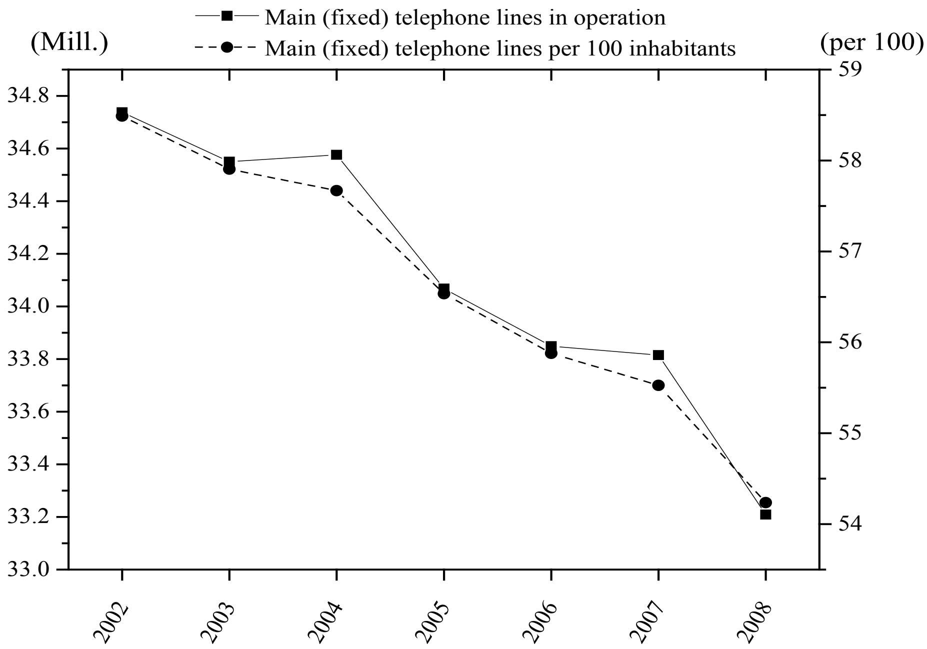
Source: ITU World Telecommunications Indicators

Figure I-5 Total fixed telephone subscribers accessing the Internet from 1998 to 2002



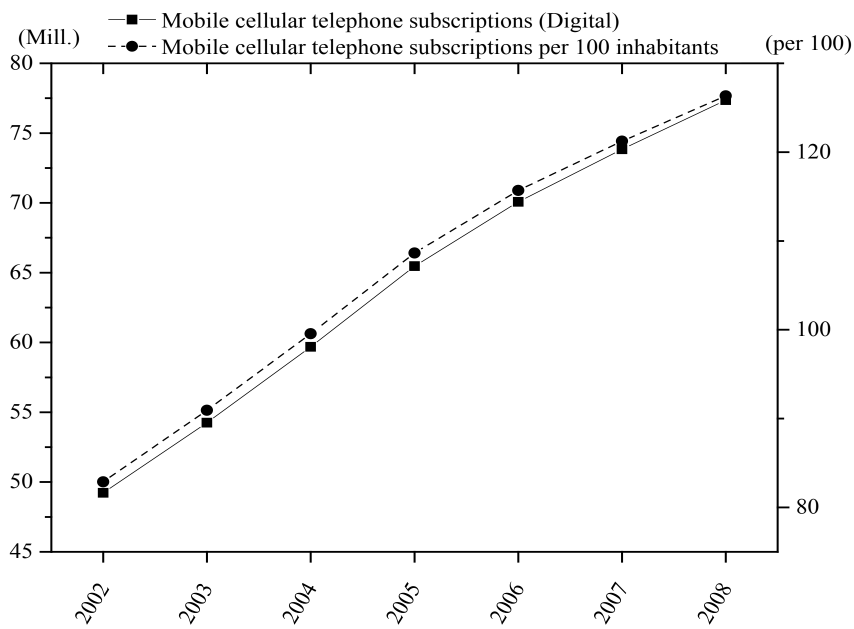
Source: ITU World Telecommunications Indicators

Figure I-6 Numbers of Fixed Telephone Lines in Operation



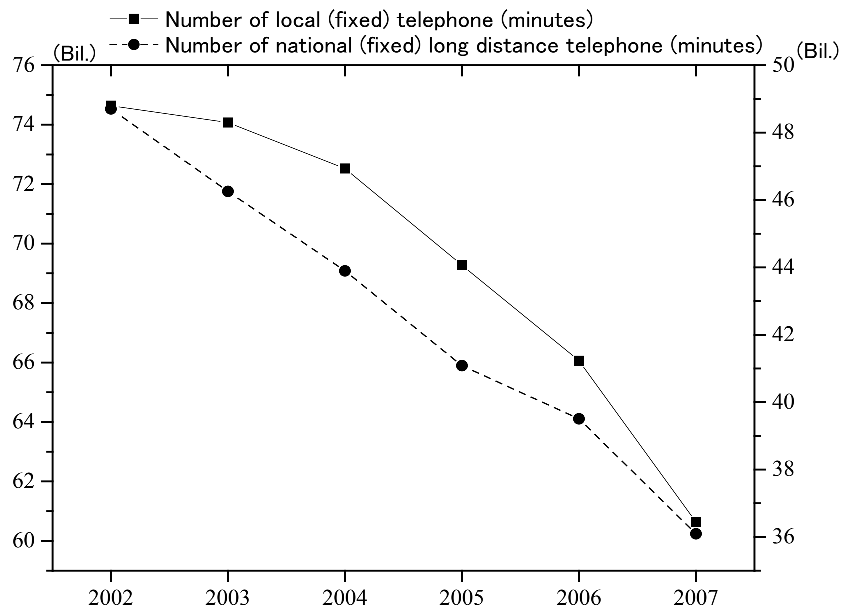
Source: ITU World Telecommunications Indicators

Figure I-7 Number of Mobile Cellular Telephone Subscribers



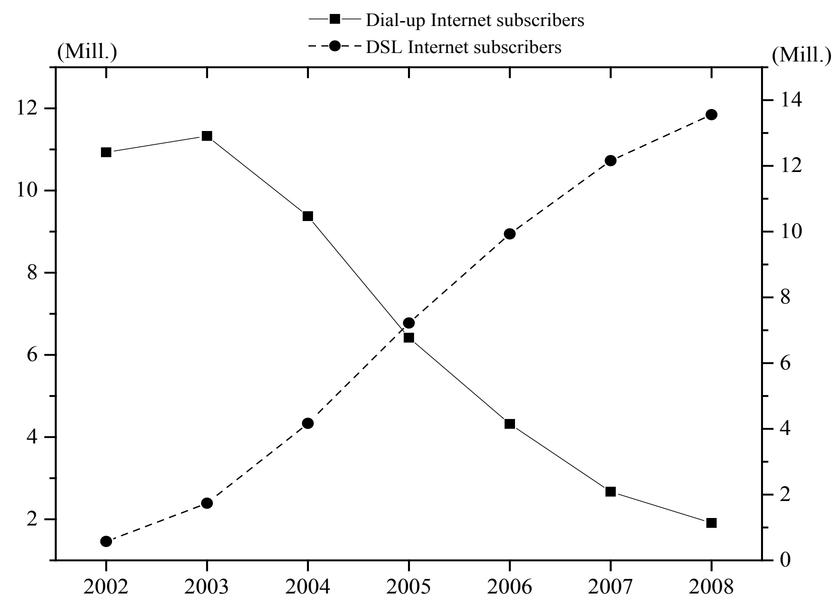
Source: ITU World Telecommunications Indicators

Figure I-8 Number of Fixed Telephone Talk Time



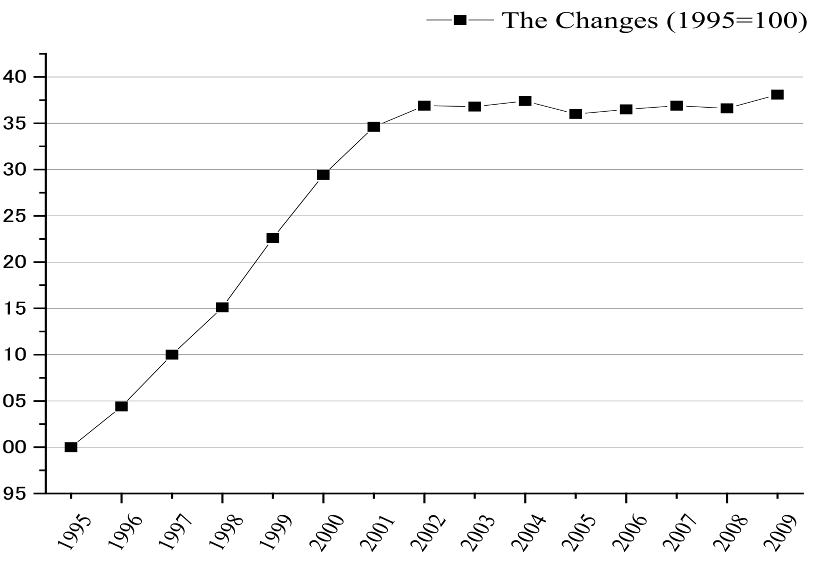
Source: ITU World Telecommunications Indicators

FigureI-9 Number of Dial-up and DSL Subscribe



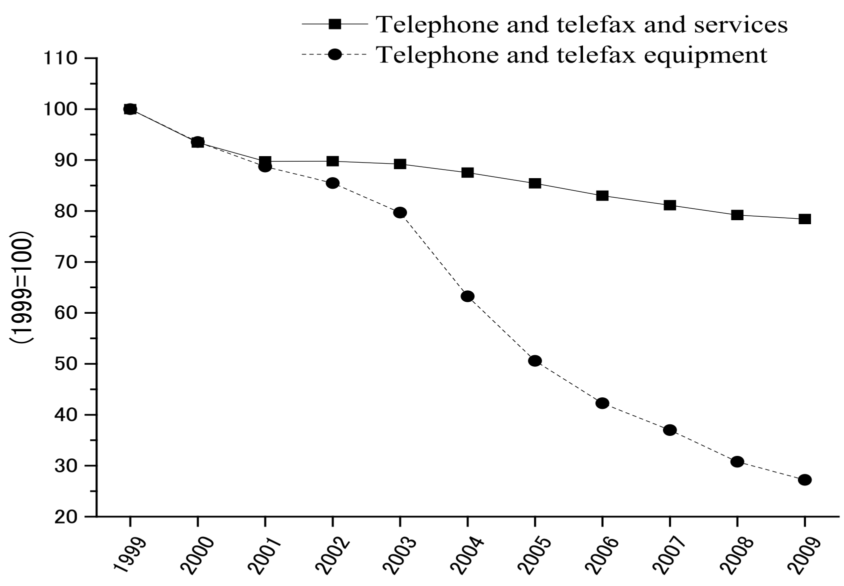
Source: ITU World Telecommunications Indicators

Figure I-10 Changes in the proportion of households' expenditure for Communications in OECD country



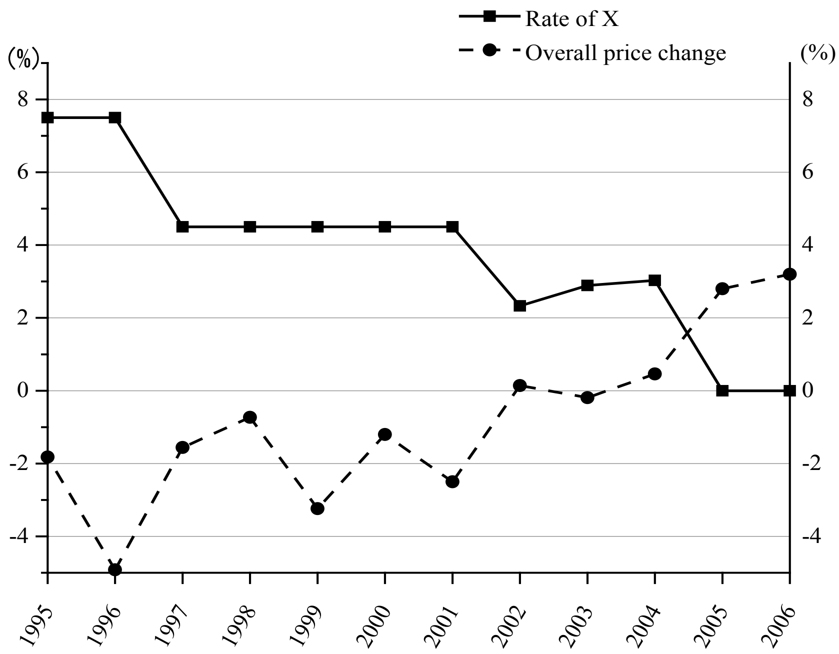
Source: OECD Communications Outlook 2011

Figure I-11 Trend of harmonized indices of consumer prices (HICP) for CommunicationEU-25



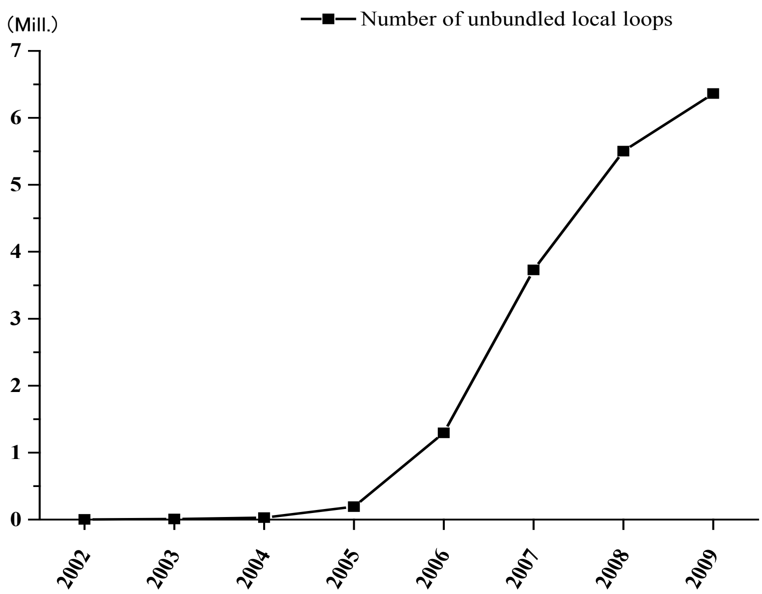
Source: OECD Communications Outlook 2011

Figure I-12 Changes in the Rate of X and the Retail Price under the Price-Cap



Source: BT Annual reports

Figure I-13 Number of Unbundled Local Loops



Source: OECD Communications Outlook 2011

1.3 The Rate of Return: United States

1.3.1 The Historical Review

The United States implemented the fair rate of return regulation to optimize the operator's profit. They can earn normal profits though the rate of return (ROR) regulation. This implies that they could not earn excess profits if the market was under perfect competition. Therefore, the regulation allows a certain amount of profits that can be offset by the capital investment in a long term. The return under the regulation that relates closely to the amount of capital investments should be the minimal for fear of interference by the regulation. So, the regulation was implemented to the operators formally owned nationally. Section 1.3 considers the effect of the ROR and its background. Next subsection 1.3.2 reviews the discussion of Averch-Johnson (1962) and how the ROR works effectively.

1.3.2 The Review of the Averch-Johnson (A-J) Model

The ROR regulation was discussed by Averch and Johnson (1962) considering a firm under the constraint by the regulation. The goal of the ROR was to set an optimal regulation for public utilities to encourage the market to competitive circumstances, but the A-J model showed that the regulation needed to care about the price level realized in advance. In other words, considering the regulation with a clear goal and its process was the key to the effectiveness of the regulation.

In earlier literature on the ROR regulation, Bailey and Malone (1970) showed that the profit maximization firm tends to overcapitalize, while sales or output maximizing firm tends to undercapitalize. Klevorick (1971) discussed the A-J model using normative and statistical approach. Takayama (1969) also pointed out that we should notice that we could not tell until the shift direction of the marginal product of capital curve is clarified. Sheshinski (1971) showed a necessary condition to be utility maximizing solution.

Our goal in this subsection is to confirm the effectiveness of the ROR and figure out how the ROR is applicable to the market. One of the problem in the A-J model is the optimality in costs.

The A-J model has two possible situations to bring;

- At the competitive level, the operator could sell below marginal cost to increase profit, then the operator builds assets and installed base.
- The regulatory agency allows the operator to set a price above the regulatory level.

In either case, the operators can set the price arbitrarily according to their strategy or financial situations. Therefore, the consequence directly affects consumers. Sappington (2002) also pointed out 8 drawbacks on the regulation:

① "[L]imited incentives for innovation and cost reduction"
② "[O]ver-capitalization"
③ "[H]igh cost of regulation"
④ "[E]xcessive risk imposed on consumers"
⑤ "[C]ost shifting"
⑥ "[I]nappropriate levels of diversification and innovation"
⑦ "[I]nefficient choice of operating technology"
⑧ "[I]nsufficient pricing flexibility in the presence of competitive pressures".

To review the regulation, we need to review every point of the drawbacks, and consider close relationships between drawbacks. We consider the profit maximizing firm under cost minimization,

$$Profit = Revenue - Cost\ of\ Factor\ K - Cost\ of\ Factor\ L.$$

The profit of the operator comes from the revenue minus cost of the two factors, and The ROR formula expects the revenue to be equal to the total cost spent as

$$Revenue\ allowed = Total\ Cost = Variable\ Cost + ROR \times Rate\ Base.$$

For optimal regulation, the ROR formula above can be that the profit is zero and the circumstances can be described so as to balance between the profit and the allowed return under the regulation,

$$Revenue - Cost\ of\ Factor\ L = ROR \times Rate\ Base.$$

The ROR regulation is the optimal regulation considering only the efficiency of the rate base which is observable to us. Moreover, the realized optimal situation in the A-J model implies that the unobservable factor L is also optimal. Consequently, the price of the market under the regulation can be calculated and set in a way that the rate base is multiplied by the rate, and divided by the quantity. In sum, the A-J model shows that the ROR solves the problem of observability in cost by the regulation.

1.3.3 Remarks

In all, this section reviewed the model of the ROR and we found some points to reassure. First, the ROR regulation could be effective to keep a certain market situation and to control the market. However, the problem of cost observability may continue to exist if the market situation goes more competitive for profitability by cost reduction.

For its feasibility, another key for the ROR is to find out the level of the favorable profitability under the ROR. Through the realized level of the optimal regulation, to what level of the price might be affordable or favorable for customers. Observations and considerations for this aspect are critical. However discussions on the level are outside of our discussion.

Second, as for operators assumed in their model, we may have a room to have the cost reduction incentive in two cases; when the incentive is at the level of the optimal regulation, and when the incentive away from the optimal regulation level. In other words, there is a room to reconsider the cost observability.

Furthermore, it is hard to assume the homogenous customer who is defined as a typical customer and to track each customer’s preference because recent services are well differentiated in price. Therefore, most regulatory agencies in developed countries gave up using policy adjustments or considering the optimal circumstances by the regulation because it was difficult to assume a certain customer and a market situation in reality.

1.4 Review of the Critical Changes in the Market Trends

1.4.1 Policy Oriented Market to Competition

As we reviewed in previous sections, first one is the change from policy oriented market to competition, which is our biggest event in the history of the market. In the case 1980's, the UK passed the Telecommunications Act, and the liberalization in the market spread to VANS. While interconnections were allowed between operators, BT had to concentrate on basic service like telephony at the early stage of the liberalization. The regulatory agency Oftel set the *RPI-X* formula to assess retail price of the charge. The policy oriented market control literally adjusts or modifies the market situation deliberately.

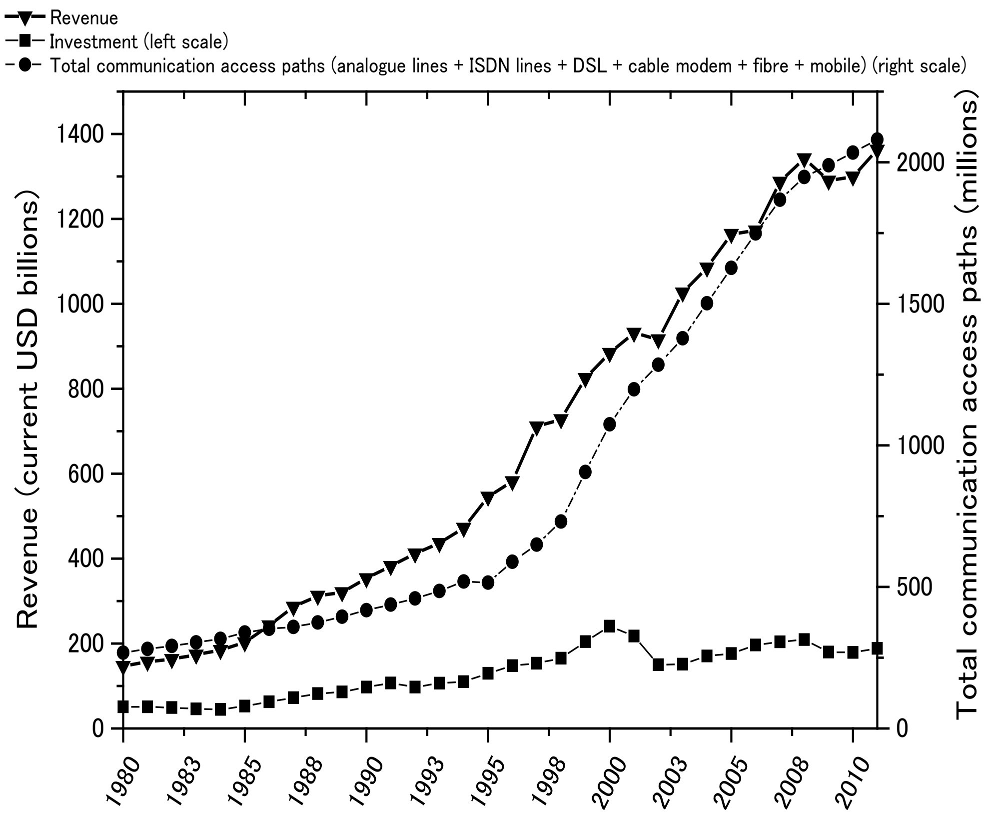
In the case of The US, they implemented the ROR to optimize the operator's profits in the 1980's. The rate of return (ROR) regulation implies that they could not earn excess profits if the market was under perfect competition. In the ROR, a certain amount of profits could be offset by the capital investment in a long term, though the problem of observability may exist.

In recent years, the convergence among networks and services using the Internet Protocol (IP). Policy makers are trying to take advantage of new capabilities to improve better circumstances in view of affordability and equity. Most countries have acknowledged the increasing influences of broadband networks, and the governments are preparing for more availability of not only fixed network but also mobile network. Figure I-14 shows that the growth in revenues and the number of access paths increases rapidly as the spread of the broadband. As we can see also in figure I-14, the levels of the two factors between the 1980's and 2000's are apparently different because of the rapid growth.

Furthermore, taking a constant level of investment taking into consideration in figure I-14, the resource allocation for the investments is of a great concern because operators need to invest efficiently to build a telecom network as a whole under the convergence between networks and services through IP.

Therefore, recent policymakers are trying to encourage operators to implement more innovative solutions for networks and services rather than to control the price or the market in a certain direction.

Figure I-14 Subscriber, Revenue and Investment Growth, 1980 – 2011



Source: OECD Communications Outlook 2013

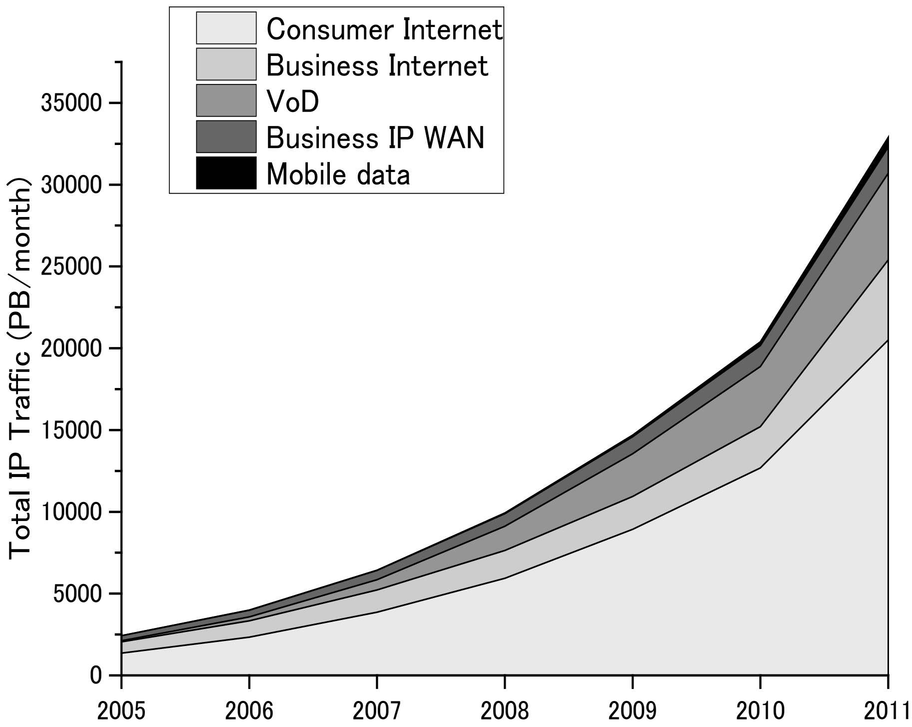
1.4.2 Fixed Network to Mobile Network

As shown in subsection 1.4.1, recent rapid revenue growth may come from the availability of accessing to the Internet. Figure I-15 shows that the total number of IP traffic in 2011 was more than ten times than that in 2005. This ten-fold phenomenon happened only in six years. As shown in figure I-16 and figure I-17, the cellular mobile traffic continues to grow in both the UK and the US. Although the share of the mobile traffic was small in the global IP traffic, the rapid growth of the mobile use showed that the mobile network plays a critical role for the recent market trend.

Therefore, figure I-18 shows how operators earn revenues against the change of the trend to mobile network. The trend of revenue source is about to change from fixed network to mobile network. On the traffic side, the share of mobile data traffic is very small, but the revenue share is almost even in 2011 though we showed in figure I-15.

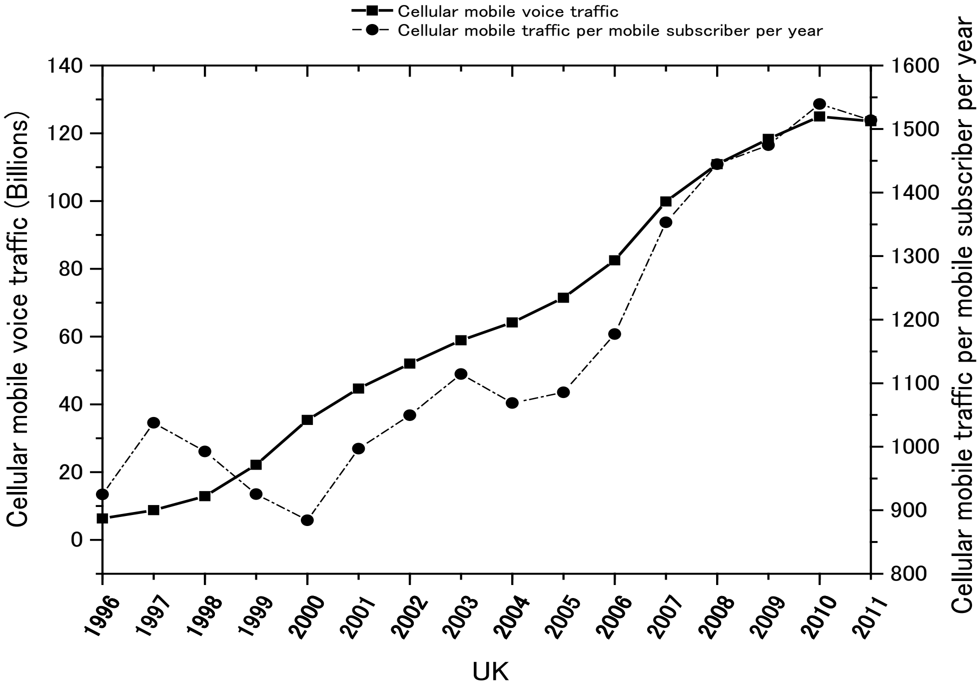
Taking the share of the mobile traffic into consideration, these data suggest that the cost for the use of mobile data might be extremely high compared to that for the use of fixed network. Nonetheless the convenience and the influence of the mobile network against our lives are getting better and greater day by day, which may be implied in figure I-19. The constant investments in figure I-14 also suggest that it is hard to catch up with the exploding demand for the mobile traffic use.

Figure I-15 Global IP Traffic, 2005-2011



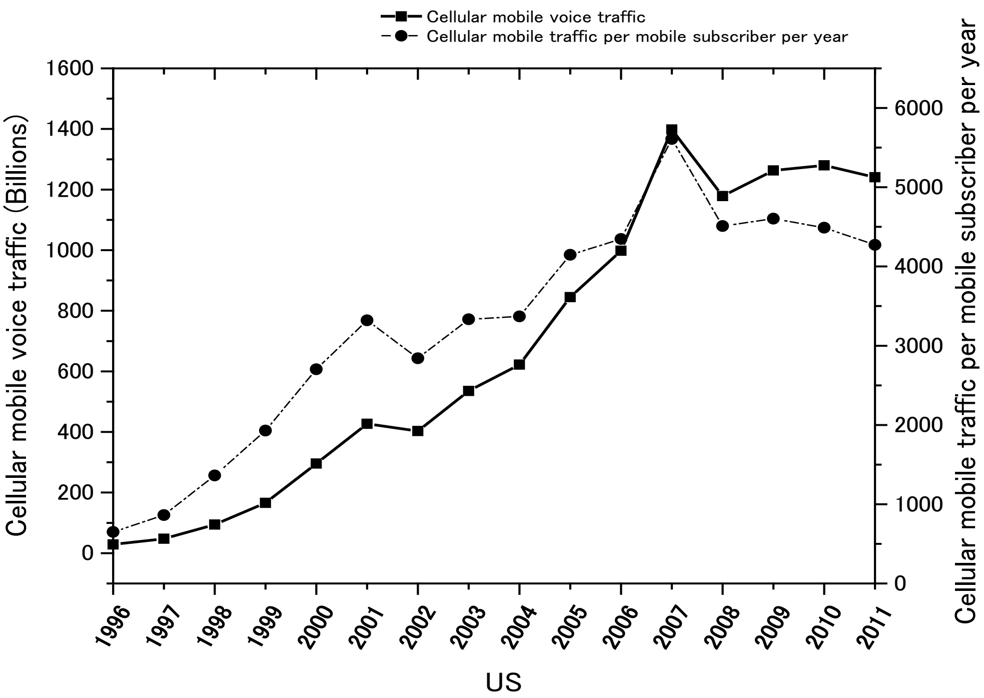
Source: OECD Communications Outlook 2013

Figure I-16 Cellular Mobile Traffic in the UK



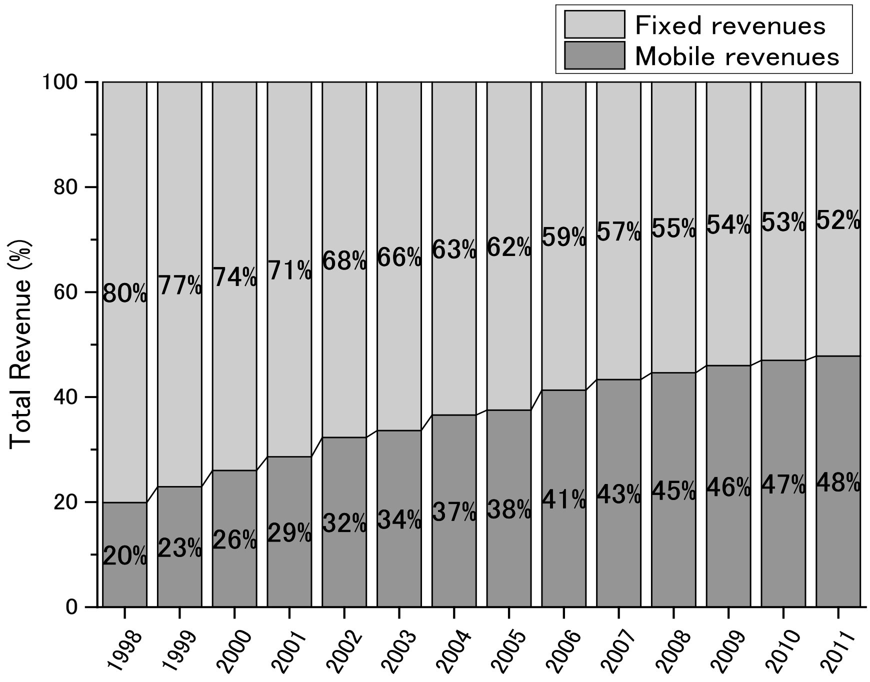
Source: OECD Communications Outlook 2013

Figure I-17 Cellular Mobile Traffic in the US



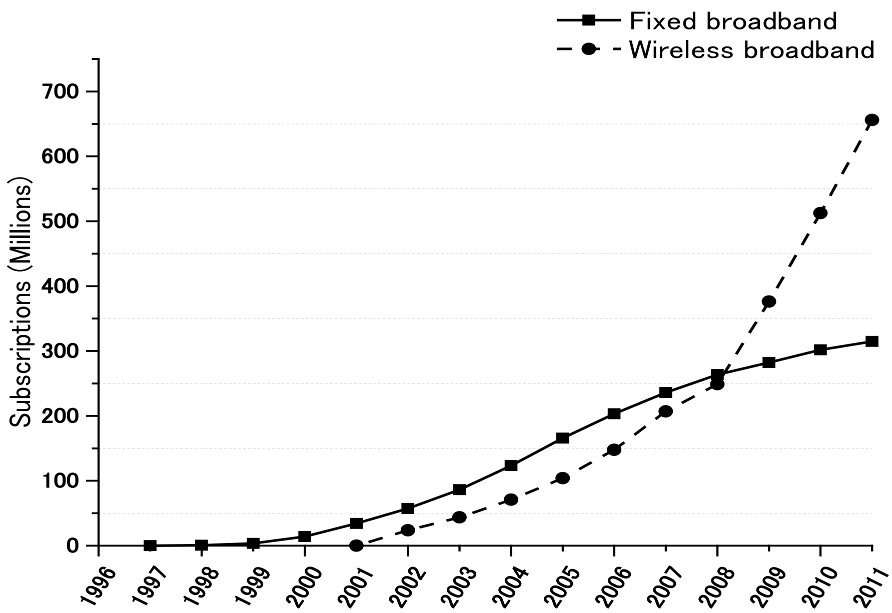
Source: OECD Communications Outlook 2013

Figure I-18 OECD Share of Mobile and Fixed Telecommunication Revenues, 1998-2011



Source: OECD Communications Outlook 2013

Figure I-19 Wireless and Fixed Broadband Subscriptions in OECD Countries



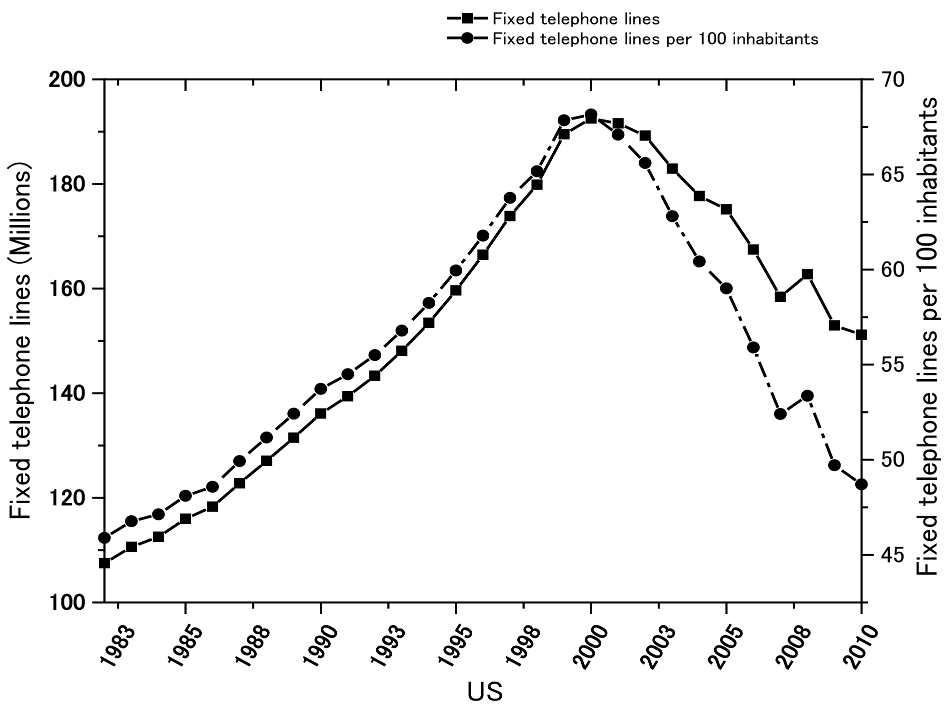
Source: OECD Communications Outlook 2013

1.4.3 Telephony Communication to Data Communication

As shown in figure I-6 and figure I-20, the number of fixed telephone lines is decreasing drastically. Consequently, figure I-21 shows that not only the number of the fixed lines but also that of access paths to the Internet are decreasing in OECD countries.

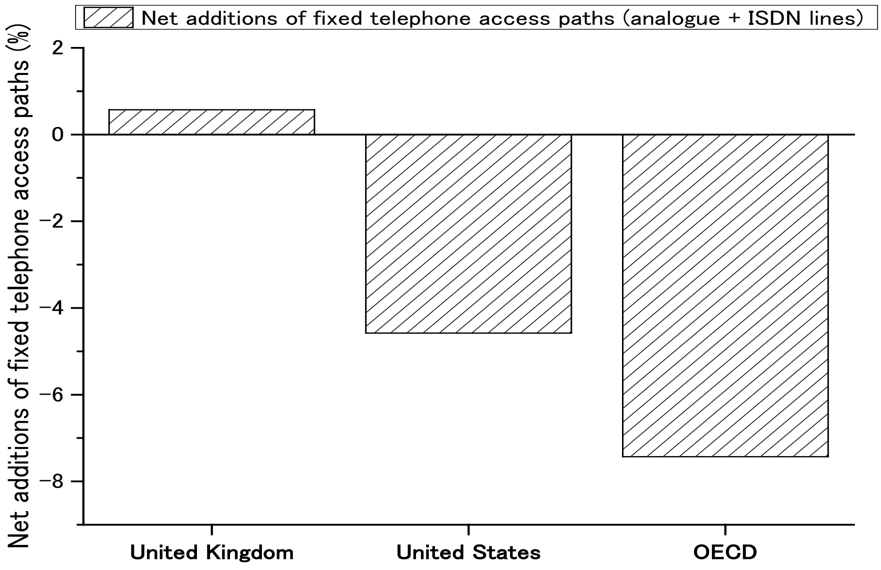
In the process of this trend, the way of communication changed from voice communication through telephony service to the data communication including voice through the Internet such as VoIP (Voice over IP) and SNS (Social Network Service). Although the talking minutes through telephony service are also decreasing shown in figure I-22 and I-23, but the people who have a wireline subscription may replace to the optical fiber network. The subscription of fiber network are offered bundled services that include voice, data, TV, and more services at affordable price. Consequently, this trend can be seen in figure I-24; fiber network attracts people by offering bundled services.

Figure I-20 The number of Fixed Telephone Lines in the US



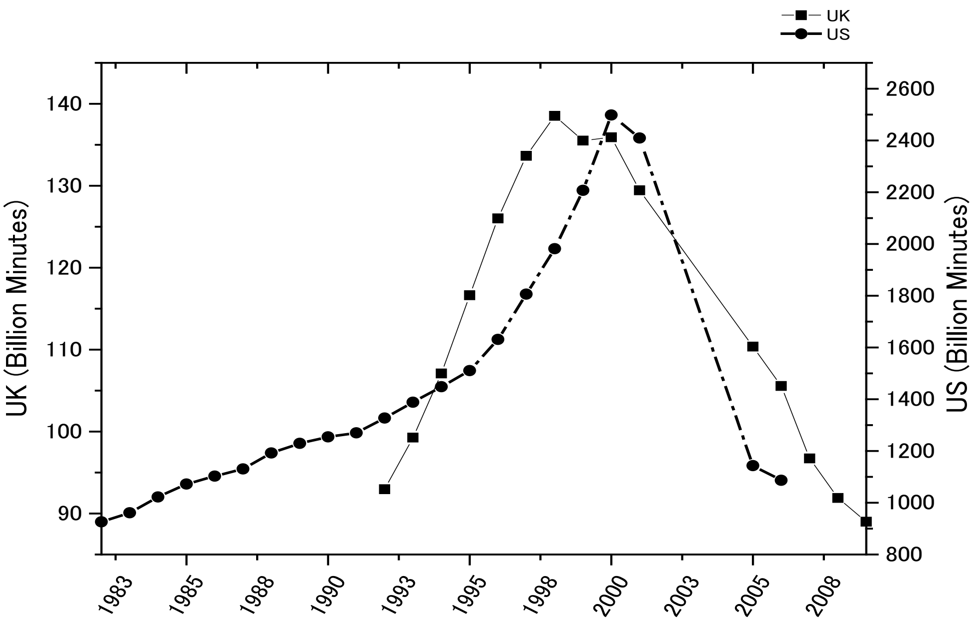
Source: ITU World Telecommunications Indicators

Figure I-21 Net Additions of Fixed Telephone Access Paths (analogue + ISDN lines) between 2009 and 2011



Source: OECD Communications Outlook 2013

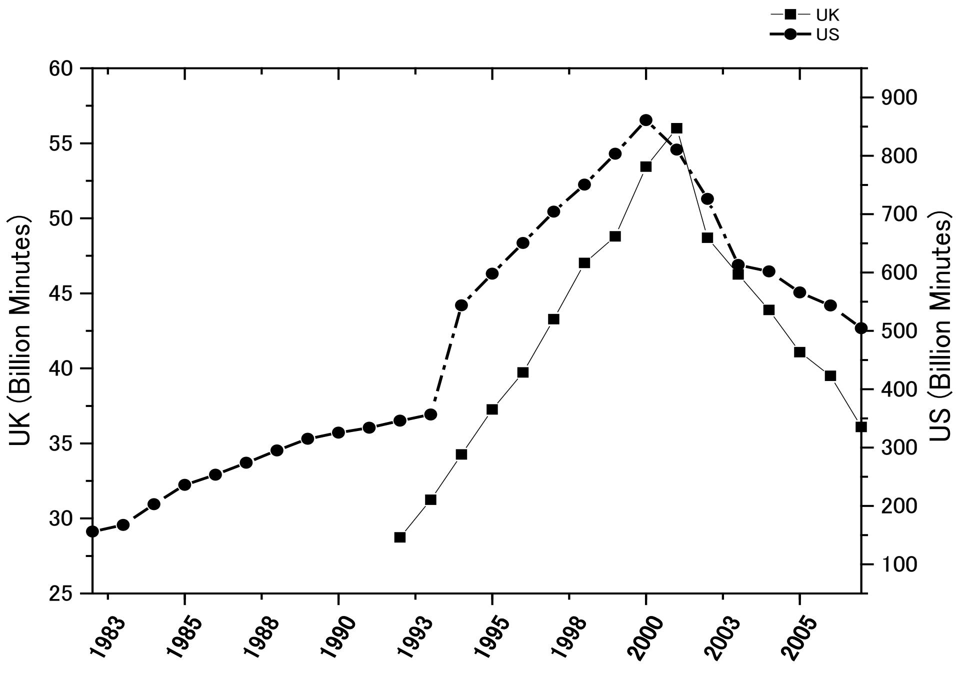
Figure I-22 Domestic Fixed-to-Fixed Telephone Traffic



＊ Data in 2002 through 2004 are missing in both countries

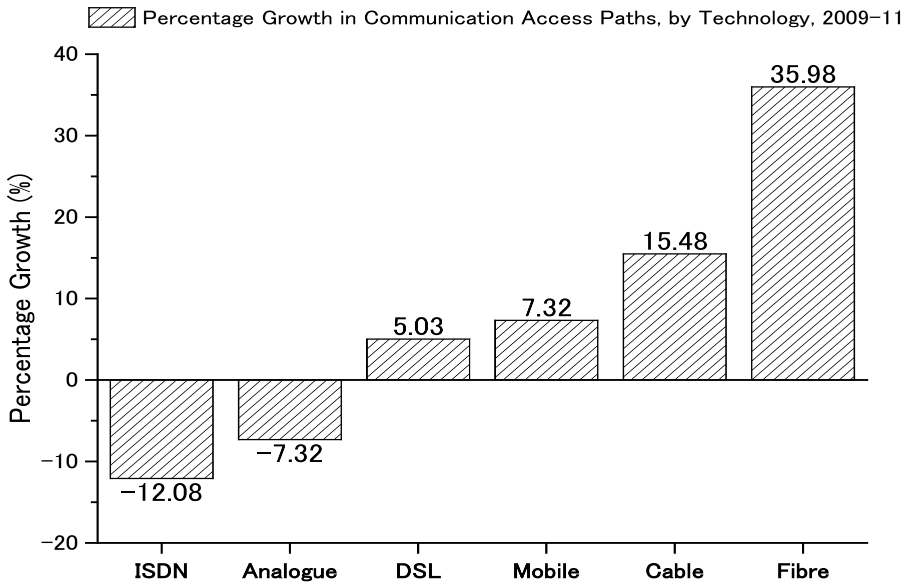
Source: ITU World Telecommunications Indicators

Figure I-23 Long Distance Fixed-to-Fixed Telephone Traffic



Source: ITU World Telecommunications Indicators

Figure I-24 Percentage growth in communication access paths, by technology, 2009-11



Source: OECD Communications Outlook 2013

1.4.4 Remarks

We reviewed three critical changes for the market that we need to take into consideration. Each of these changes influences not only our lives in every aspect but also the market.

The change to competitive market shows that policy makers are now trying to encourage operators to implement more innovative solutions rather than to control the price or the market in a certain direction. The more those factors are implemented to the market, the more difficult we calculate or evaluate those values in price and quantity though the innovative solutions that bring more convenience or profitability. The influences are brought by those innovative factors. So, the influences should be distinguished between the one from the market and the other from the innovations.

The change from fixed network to mobile is the biggest change in the history and the market. While the change is a chance to break through an old regime that causes negative effect for the market, the unexpected conflicts between the old regime and the expected innovative system or regime may well happen to rule the market. As we can see the historical reviews in this chapter how to eliminate the negative impact caused by the old regime, the trend that shifts to the mobile network makes the objective of policymaking change to encourage competition rather than continue to control the market.

Although the last change was brought mainly by the change of the trend to mobile network, the ways of communication drastically changed from voice communication through telephony service to the data communication using VoIP and SNS. The change of communication media affects competitive circumstances in the market as the talking minutes through telephony service decreases.

Chapter 2 considers some factors so called traits that causes externalities and we reviews how those factors influence the market. We go further to consider those influences and how the influences work each other.

2. The Essential Traits

The telecommunications market plays a key role for building a society with ICT, conveying or providing information as data which is sometimes in forms of voice, picture and movie through network.

This chapter considers the characteristics of network in economics and we pointed out the difficulties in policymaking. We also discuss the externalities of network and its characteristics as follows: compatibility, critical mass, path dependence, installed base and switching cost, and entry deterrence. Finally, we argue about policymaking in view of network externalities.

2.1 Network Effects

2.1.1 Compatibility

Katz and Shapiro (1985) analyzed the effect of externalities through cost and demand considering static one period oligopoly model that consisted of two type of costs: cost of production and cost of achieving compatibility. We assumed that the fixed cost is constant regardless of the size of the network as an externality. Thus, they set the equation of a price according to the expected size of network. This section finds some points to argue about compatibility.

Katz and Shapiro (1985) showed that the customers' expectations are of great importance discussing the expected size of the network shown by the Cournot equilibrium, which the output level can be chosen when the expected size of the network is given. This assumption showed that the network size that customers expected is equal to a Cournot equilibrium. Consequently, they considered the size of the network when the expected size of the other group is fixed. They used a unique concept of reaction function called the equilibrium reaction correspondence that showed *i*'s best response to the other group. Using this concept, they showed the existence of the externalities and its indirect effect[13].

[13] Katz and Shapiro (1986a, b) considered the externality focused on the price affected by a technological factor, and showed how it changes the price. Katz and Shapiro (1992) showed that *the excess inertia* has an incentive in the externalities, but insufficiency is the cause of the effect. They considers the insufficient function and its condition. Katz and Shapiro (1994) considers the externality in reality, and they pointed out that the market inefficiency is unclear and difficult issues arise in policymaking. Bental and Spiegel (1995) showed the largest network is of the highest value, and the price could be priced highest level. This result in the situation that people in the network would be only the richest one. Choi (1994) considers dynamic model of the technology change.

To ensure the effect of compatibility, some cases of its definitions are summarized as

- At the time of compatible, the model shows the relationship that the expected size of the network is equal to the expected number of customers.

the expected size of the network = the expected number of consumers

- At the time of incompatible, the model shows the relationship that the expected size of the network is equal to the expected total output.

the expected size of the network = the expected total output

  For complete incompatibility to be an equilibrium, the value of the other group depends on the value of the customers in the group according to the number of the other group.

- For partial compatibility, the expected value of the compatible part is equal to the additional value for the other group as the incentive so that the expected value of the compatible part of the network depends upon how large the other group.

Therefore, we reviewed the effectiveness of compatibility in the market under the assumptions as follows,

- If the size of the network is equal to the expected total output, this implies that the expected value of the network is equal to the willingness to pay for the market that customers have.

- If the size of the network is less than the expected total output, this implies that customers in the network can get more profit or additional value than that from an additional customer itself.

- If the size of the network is more than the expected total output, the opposite case of the former case, this implies that an additional customer not necessarily brings an additional output or less value than the value brought by the additional customer.

Above all, the expectations play a critical role for the increase in the value of the network. In other words, the expectations bring more expectations themselves and so do to the values for the network. This consequently brings more outputs.

To go further discussion, chapter 3, and 4 examine empirical considerations to prove what situation the telecommunications industry is in and how the policymakers think about the situation, problems, and its possible solutions. Next subsection considers how to determine the highest value of the network and how it works in the market.

2.1.2 Critical Mass

The former subsection 2.1.1 showed that the expectations matter in compatibility. This section focuses on the number of customers in a network. Economides (1995) and Economides & Himmelberg (1995) followed the discussion of network externalities, which defined the value of a good that depends on the number of consumers purchasing the same good. There is a critical mass point in goods with network externalities, and the point is defined as "the minimal non-zero equilibrium size of a network good". They showed that the critical mass point is independent from the market structure.

In the review of the definition of network externalities by Katz and Shapiro (1985), the expected size is equal to the actual size, and the willingness to pay increases with the number of units sold. The analyses show that the fulfilled expectations demand schedule does show upward sloping especially at the points where the network coverage is small or where the network starts building. However, the market does not exist at the points. The market exists when the size of the networks once reaches the critical mass.

Therefore, the possible critical mass point we see in their models may be chosen the highest, in another word, the critical network size that is Pareto dominant for the existence of the network. Some possible situations may be explained by the models. For a natural monopoly firm, they could always stand a position where is on the part of downward sloping after reaching at the critical mass for profitability. In the downward sloping state, the demand schedule follows the ordinary economic theory, and the state implies the cost also decreases according to the size of the network. For entrants, the network of the entrants may not exist as long as the entrants' network reaches. Therefore their investment never be realized before reaching the critical mass.

The considerations on critical mass show that a network exists when in a significant size and then, the cost starts reducing as the size of the network grows. This implies that a difficulty arises when a network has strong network externalities.

To establish a network like telecommunications network, a significant size of the network is of great importance. In view of telecommunications policy, a network does not exist until the deployment of the network reaches the size of the critical mass.

Their models also imply that the early adopters especially during a period to achieve a critical mass point might cost more than adopters after reaching at the critical mass size of the network. This means that the imbalance of costs between early and late customers. This discussion follows in section 2.2.

2.1.3 Path Dependence

This subsection shows that the "lock-in" occurs according to historical events or accidents regardless of its relevance to the efficiency or rationality. Paul David (1985) explained the lock-in through QWERTY keyboard standard and examined its reasoning of path dependence in three aspects: technical interrelatedness, economies of scale and quasi-irreversibility.

Technical interrelatedness requires system compatibility between hardware and software, which customers consider expected value depending on the availability of the product. The choice of customers affects the historical paths so that the subsequent customers choose an inefficient technology like QWERTY standard. Consequently, the economies of scale which shows that the decreasing cost schedule works and the number of customers using the inefficient technology increases.

Finally, quasi-irreversibility in investments showed an asymmetry between the cost of software and that of hardware. The asymmetry implies that the cost of software to guarantee the compatibility in products increases while the cost of hardware decreases because the hardware conversion is cheaper to obtain its compatibility in practical sense. The analysis of David (1985) emphasized that interferences may well exit so that firms may make wrong decisions for the products. Arthur (1994, 1989) showed that there is a market where customers are hard to determine which equilibrium to choose in the static oligopoly model with multiple equilibria.

The model of Arthur (1994) assumed two technologies adopted by a large number of consumers and the regulatory agency classified by preferences. And it showed that it is hard for the operator to change from the one formally selected to a more efficient technology because the benefits gained from early adopters with existing technology are still larger than those gained from new adopters with a new technology. In the model, the difficulty is caused by the "historical small events" defined as the set of events that are out of knowledge.

The historical small events in a model of increasing return have potential unpredictability and inefficiency because the externalities exist in the set of choices. Each choice affects the subsequent choices and its gains between the early and new customers or adopters after each event.

The judgment whether the choice is right or not can be defined as the path-efficiency. The path-efficiency could be examined whether the profit of the choice is larger than that of the other option. On the other hand, each judgment has nonergodicity that means the judgment is not necessarily rational and inflexible outcome by the lock-in technology; the gap of returns between choices becomes larger due to innovations. Consequently, the judgment becomes no longer path-efficient.

Through the discussion of path dependence, historical events that are out of knowledge in advance bring the lock-in situation especially in the increasing returns case as we saw in the case of critical mass.

2.1.4 Remarks

In all about network externalities, things we should be taken into consideration most are compatibility and expectations. The compatibility guarantees the value and the size of the network socially shown at the installed base consideration. Policy for encouraging compatibility should be considered, not coercively but promoting competition attractively.

Secondly, the expectations matter for the increase in the value of the network more than that according to the number of customers or the total output. For the competitive circumstances, interconnections between networks are of great importance in practice. For fear of losing share of the market, the dominant firm may make barriers to entry or set some interferences somehow to keep its share. Chapter 3 and 4 considers some factors in practice interfering the competitiveness.

As Economides (1996) implied, the policy for network externalities depends on situations to what extent the industry is matured; unbundling would not work well when the dominant network is not large enough to be preferable industrywide in the existence of critical mass. The practice of unbundling without discretions of the externalities may become the market with the lock-in because the efficient network and technologies could never spread or even exist due to the lock-in.

2.2 Installed Base

2.2.1 Installed Base with an Old Technology and New Adopters with a New Technology

The former section 2.1 followed the existence of the critical mass point characterized by upward sloping at the early stage. Farrell and Saloner (1986) and Farrell and Klemperer (2001) discussed about the installed base with old technology and new adopters with new technology.

Their assumption showed that all users have opportunities to select to adopt new technology. Taking practical sense into account, it is necessary for the size of network to take time to grow. Their models considered the game between users adopted at different times, and they considered the benefits between the installed base with the existing technology and later adopters with newer technologies. Through their models, they analyzed two externalities: the decision of installed base and the effect of available options for later adopters. And the analysis explained further the two externalities through four effects: excess inertia, excess momentum, bandwagon effect and penguin effect.

- Excess inertia is an effect that the benefit of switching new or superior technology cannot be fully obtained unless users of the installed base switch to the new or superior technology.
- Excess momentum is an inefficient technology adoption for those who are willing to adopt the new technology even though a network with the new technology will take long time to be established.
- Bandwagon effect is an effect that once a set of users choose a technology, the same choice is more preferable to other users who choose the same technology.
- Penguin effect is an effect that each user may think that others move first even though users are willing to switch.

One of their models, a game model with new user showed that the adoption is a perfect Nash equilibrium. Any person cannot gain by changing in their strategies under given strategies of others even when the benefit of the network with the new technology is greater than the benefit of users with the existing technology.

Therefore, the difficulty in adopting a new technology arises in the case of excess momentum. The case showed that the loss, for both the installed base and the later adopters by the adoption of the new technology, is too large in spite of the small benefit from it. Farrell and Saloner (1986) also showed the same difficulty because of the existence of the installed base itself, not by the new technology.

As the models implied, the new technology should be compatible so as to encourage its transition from the old technology. During the transition, the benefit of the installed base could start getting smaller as the number of the installed base gets smaller.

Consequently, the decrease of the benefit gained by the installed base is of a great concern if the loss incurred by the early adopters is greater than the benefit of new adopters with the new technology. The penguin effect also needs to be concerned not only to cover the loss and to keep the network attractive by eliminating the hesitation.

Therefore, this section shows that it is important to consider the compatibility between customers with the old and the new technology. A discretion for transition to the new technology by policymaking may well work for the loss of the installed base. Next subsection considers the cost of switching and its effects.

2.2.2 Switching Cost and Lock-in

Subsection 2.2.2 shows the same influence as section 2.2.1 in view of the switching cost. The cost of switching arises when, for example, a technology changes to another technology. The presence of the switching cost may lock those who are willing to switch in the existing group.

An analysis of the switching cost by Klemperer (1988) in the duopoly model showed the effect of the incumbent after an entrant with switching cost came into the market. In the one period model, he assumed the market that the switching cost is the only barrier to entry. The two-period model by Klemperer (1987) showed that the demand with the switching cost is inelastic than that without the switching cost. In assumption of the first period, a firm chooses a price to maximize future profits where the price of another firm is given. Some customers may face the lock-in situation for fear of the switching cost.

The analyses implied that the existence of switching cost expected in the second period makes market in the first period less attractive. Even the firms offer an affordable price in the first period, customers know the rise of the price in the second period. Therefore, competition in the first period may become fierce to lock consumers in in each firm.

The consideration shows that the market share in the second period is less than that of in the first period because the dominant firm is more interested in consumers who choose them again in the second period. This implies that the dominant firm may offer some better offers to stay.

Another case in which the taste change of the switching cost in the second period shows that the more new consumers joins, the less efficiency the preferences of the existing customers have. The analysis showed that switching cost could lock the installed base in. The more customers change their preferences, the more competitive circumstances could be brought into the market.

For policymaking, the analyses implied that policymakers should consider to control or eliminate the switching costs because the irrationality may exist. Therefore, Policymakers should guarantee the easiness in switching firms.

2.2.3 Remarks

The existence of switching cost may attract customers when the operator set a rebate at the same amount as the switching cost. Under the structure that the switching cost exists, the dominant firm may act to eliminate the entrant offering benefit to stay in the dominant firm.

Taking structural aspect into consideration, policymakers should establish a market structure or circumstances controlling or eliminating switching cost, especially when the cost is irrational to be imposed and therefore interferes transition of consumers to other carriers or technologies offering better conditions. This implies that the effective policymaking should consider examinations not only in the structural aspect but also in a behavioral aspect.

In some developed countries, the dominant firms have local loop networks because of historical monopoly ownerships. The dominant firms try to control the market structure to take advantage of the dominant position. However, some countries considers that the local loop is an essential facility that cannot be established by other carriers because of its scale.

Section 2.3 considers how policymakers work for the barriers to introduce competition. Considering the local loop was a major policy issue arising from prospected entrants with new technology and services.

2.3 Entry Deterrence

2.3.1 The Review

This section 2.3.1 reviews the analysis by Klemperer (1987) that the characteristics of switching cost deter entry. We also consider the characteristics through the model and could see the possibility that there are some points needed for policymaking for the market.

He assumed in the two-period duopoly model with switching cost where no differentiation occurs except switching cost and the demand curve shows downward sloping. Customers expect rationally about the future price and the Cournot equilibrium in the second period becomes a market price for the two firms.

Klemperer (1987) considered the behavior of the incumbent that is the firm already entered in the market. He showed that the number of incumbent's sales in the second period is fewer than that in the first period when the entrant's output is high. When the output is within the range between the highest value of the entrant's output and Cournot equilibrium output, the incumbent sells no one but first period consumers. When the output is too low, the sales to new consumers cover the loss caused by the old consumers.

When the switching cost still goes up, a discontinuous figure of the switching cost implies a possibility that the incumbent may stick to the quantity in the first period and try not to increase consumers. The incumbent also may act to reduce the entrant's quantity according to the relationship between the reaction functions. Further rise of the switching cost may show that the new consumers may go to the incumbent. So the entrant may be in a situation where the entrant cannot enter because entrant's expected network value may become too low to cover the cost to build their own network.

Subsection 2.3.2 reviews that the local loop unbundling contributes to eliminate structural barriers and restrictions toward competitive circumstances.

2.3.2 Local Loop Unbundling: the United States

In the United States by the end of 1970s, FCC (Federal Communications Commissions) promoted competition in the long-distance market so that new entrants can enter. This movement was caused by the fear that the regulatory regime does not work enough to eliminate barriers in the market like cross-subsidization where firms offer lower or attractive price to consumers in a competitive market and impose high price in a monopolistic market or a dominant market so as to discourage entrants to enter. The possession of the local exchange enlarges the barrier to entry as the bottleneck facilities and gives a reason for the anticompetitive behavior.

Since divestiture of AT&T in 1984, promoting entries was attempted in the local loop market in the US due to fierce competition in the long-distance market. FCC prohibited the cross-subsidization between competitive services and monopolistic services within local exchange by RBOCs, regional Bell operating companies, or giant AT&T. Therefore, the way of thinking to provide local and long-distance services, pre-divestiture understanding that RBOC would be naturally monopolistic were not suitable to implement it. By implementation of the Telecommunications Act of 1996, the legal barriers to entry in the local loop market had been removed.

The Telecommunications Act of 1996 proposed restructuring of telecommunications industry "so as to make available, as far as possible… at reasonable charges" in the *47 U.S.C. §1*. The Act took consumers into consideration to prevent them from monopolistic tendency and risk that are shown historically.

Considering the telecommunications network in the US, a closest network to consumers is the local network called the local loop that has the bottleneck problem to introduce competition. Without the introduction of competition in the local loop, the local exchange carriers, LECs, may use a monopoly power to eliminate entrants and rivals in its related market by offering high price for the local loop and control the related market like the long-distance market by way of cross-subsidization[14]. In the Act of 1996, the act required the incumbent local loop carriers (ILECs: Incumbent Local Exchange Carriers) to provide the unbundled network elements (*47 U.S.C. §251 [c]*) that consist of seven elements: switching, local loop, interface devices, transmission facilities, signaling network and call-related databases, operation support system, and operator services and directory assistance[15].

The Act also required in the section 251 [c](3) that carriers offer nondiscriminatory access to network elements in certain conditions where are technically feasible and reasonable. This obligation showed that local network becomes unbundled not only hardware like switch or loop but also software like services offered by carriers to enjoy benefits of unbundling. But the structure of telecommunications network still causes structural barriers to encourage

[14] Cross-subsidization is the way to balance between profitable segment and unprofitable segment in a firm. This is applicable to any organizations in business literally to subsidize to the segment in debt and covers the debt from the profit gained from profitable segment internally.

[15] OECD. 1996. Implementation of Local Competition Provisions in the Telecommunications Act of 1996; Interconnection Between Local Exchange Carriers and Commercial Mobile Radio Service Providers, First Report and Order CC Docket No.96-98, 95-185, 11 FCC Red 15499, 15616-775.

competition. To implement unbundling to the network elements, the section 251[d] stated that the commission should determine "minimum" conditions of available network.

In Section 251[d](2),

- [A]ccess to such network elements as are proprietary in nature is necessary.
- [T]he failure to provide access to such network elements would impair the ability of the telecommunications carrier seeking access to provide the services that it seeks to offer.

FCC announced the notice of proposed rulemaking, NPRM, reviewed triennially in December 2001,

- [T]o analyze key issues for establishing general design of unbundling rule
- [T]o preclude impairment
- [T]o encourage competition
- [T]o ensure what elements are "necessary".

Sappington (2003) showed that appropriate requirements might be different through consumer types. And he also insisted that obligations might make the incumbent defensive so as to "limit or delay" access for not only competitors but also customers.

In the Further Notice of Proposed Rulemaking, FNPRM, issued in 2003, the interpretation of section 252 that was about procedure for negotiation, the arbitration and the approval introduced the "all-or-nothing" rule that the agreement reached was adopted in all rates and terms and conditions instead of the "pick-and-chose rule" in 47 CFR 51.809. The pick-and-chose rule requested that the provision agreements are applicable to other carriers under the section 252 by the agreements approved by the commission[16].

Responding in a manner of court decision called USTA II [17], the commission was still under discussion on unbundling rule to clarify the existence of the impairments. The section 251[d](2) clarified the barriers to achieve sustainable competition. Specifically, the commission

[16] FCC. Second Report and Order. FCC 04-164, July.
[17] Department of Justice. 2004. United States Court Appeals. No. 00-1012, March 2.

showed a twelve-month plan with two phases. It is important to note that the plan was for the incumbent consumers, not for new consumers[18].

First phase ordered LECs to keep providing unbundled access in a manner of status quo as interim response under the same rates, terms and conditions until Federal Register published about the obligations or final unbundling rule adopts. Therefore, for fear of a disruption or a confusion caused by implementing short-term interim approach, the commission tried to keep the status even though the interim rule seemed equal to do nothing at all with unbundling.

Second phase ordered that the network elements must be available in any case in pursuit of section 251 [c](3). To achieve the goal, the commission requested LECs to lease a network element at more than a rate that one dollar is added to the rate on June 15, 2004. If the state utility commission created a rate under a certain condition, the commission requested a rate set by the state commission plus one dollar under the condition.

The state commission also required loop and transport to be leased at more than 115% of the rate, and the requesting carriers paid for these elements on June 15, 2004, or a rate set by the state commission. Though they ordered the rate, the state commission allowed negotiations of agreements between carriers in pursuit of better rules during the transition period set by this plan.

Through a policy issue of unbundling, a question still remains as Sappington (2003) and Economides (2003) suggested. The question is whether considerations of unbundling policy are enough to promote competition against structural monopoly power not only in the local loop market but also telecommunications industry as a whole. For example as Sappington showed, ILECs are structurally vertically integrated. This means that the ILECs can provide not only wholesale but also retail.

The cross-subsidization may cause a boundary to encourage competition and be not working effectively even implementing unbundling obligations described above. We reassure that firms' behavior would have an important role for further competition in the market. The room allowed by the legislation to negotiate between operators might be troublesome because their stakes might be the relation of trade-off as explained in the reaction functions.

In March 2010, a National Broadband Plan[19] was released and it ensured that all Americans can access to the broadband at affordable price. In February 2011, the FCC was released a Notice of Proposed Rulemaking that supports the plan to improve the reliability of the universal service. FCC adopted principles to ensure the availability and reasonable rates for the services.

[18] FCC (2004), *Order and Notice of Proposed Rulemaking*, FCC 04-179, August.
[19] FCC (2010), *The National Broadband Plan*, March.

2.3.3 Local Loop Unbundling: the OECD Countries

Based on this consideration and practices in the US, OECD discussed general consideration of local loop unbundling for the purpose of introducing competition into the member countries so that the traditionally regulated telecommunications industry becomes fair and non-discriminatory market structurally. The examination of OECD issued on Sep 10, 2003[20], considered possible options in three alternatives of unbundling: full unbundling, line sharing, and bit stream access.

The full unbundling is an option that entrants can control lines leased from incumbent firm and offer full range of services including voice service. But the ownership of the unbundled loop is still held by incumbent and, therefore, the responsibility of maintenance is under the incumbent. This type of unbundling seems a desirable way of implementing process, but the history of traditionally facilities-based telecommunications industry in the US showed the considerable difficulties such as monopolistic structure and cross subsidizing.

The line sharing is a possible option that entrants are leased some part of spectrum from incumbent to provide services to the subscribers. This type implies that not only the ownership of loop but also the provision of voice service is offered by the incumbent. A benefit of this option is that the entrants are not necessary to invest in facilities. However, a technical problem so called cross talk might become serious because the adjacency of wirelines may cause noises between high-speed data transfer and voice services as the network expands. This problem is inevitable as long as carriers share wirelines and lots of services are offered through the wirelines.

The bit stream access is an option that incumbent owns and control wirelines and allocate spectrum to access, which access services that entrants offer rely on the designation of incumbent, and the services are relatively not competitive enough unlike other options. In this option, the incumbents still have great power to influence entrants. Implementing this type of unbundling is expected to be less competitive than other options.

Through the examination of these types, the difficulty of implementing local loop unbundling is to motivate incumbent firms to implement the unbundling even the incumbents could offer competitive services to eliminate entrants. The examination of OECD insisted that two ways of the collocation, “caged collocation” and “co-mingling”, is an important step for implementing the unbundling.

[20] OECD. 2003 Developments in Local Loop Unbundling. September, Working Party on Telecommunication and Information Services Policies.

The difference between the caged collocation and the co-mingling is how they offer the unbundling. While the caged collocation separates the equipment of the entrants and the incumbents physically, the co-mingling exists altogether in the equipment. This implies that considering the type of collocation becomes also a step for eliminating structural barriers.

In the examination issued on November 3, 2003[21], not only structural separation, OECD proposed other three structural approaches for considering behavioral aspect: LoopCo approach, Netco approach, and ADCo approach. LoopCo approach is a way that access assets and services are run by the established new company called LoopCo, and the rest, non-access assets and services, is provided by incumbent firm. Secondly, the NetCo approach is to separate into two companies; access network company and non-access network company. Finally the ADCo approach is to own loops like club or joint ownership.

There are some questions left whether these approaches are effective and applicable to regulatory framework. The structural separation that OECD proposed could not solve the uncertainty so that the separation becomes an incentive to introduce more competition into the local loop market for now.

2.3.4 Remarks

This section reviewed the movement toward local loop unbundling. However, as the history showed, the incumbent's defensive attitude against entrants is inevitable. Indeed, behavioral barriers are difficult to capture and deal with each case in practice.

The complexity of behavioral barriers makes us difficult to solve all the problems we face. To get rid of practical problems, considering the essential traits in this chapter is of great importance for figuring out influential factors for the market.

The consideration of the local loop unbundling showed that the room allowed by the legislation to negotiate between operators also could not solve the problems. Next chapters figure out and examine influential factors in recent practices, and show how those factors affect price and other influential factors as an incentive.

[21] See OECD (2003) "Benefits and Costs of Structural Separation of the Local Loop", *Working Party on Telecommunication and Information Services Policies*, November.

3 The Incentive of Recent Practices in Telecommunications

This chapter examines the existence of the incentive through factors in empirical data. We consider every possible factors related to the retail price and build a model. The model can estimate the influence to the price and show not only the existence of the incentive in practice and also show how those factors influence to the price indirectly.

The model in this chapter considers the ARPU (Average Revenue per Unit) as the retail price because the ARPU can be taken as an actual payment of homogenous customers. We assume that all those factors are directly unobservable and its effects are included in the price.

In practice, we pay almost the same amount of money regardless of the use of data traffic, or the one of the install base or the one of newer customers. Recent telecommunications technologies change rapidly. The data traffic on the Internet increases exponentially every year. So we evaluate price factors that might affect the ARPU or the payment in reality. The discussion here is taking a stab to figure out what would affect to our payments in the factors we can think of, using empirical methodology.

Now we turn to consider the methodology used in section 3.1. It is not possible to figure out how possible factors affect the price implicitly or directly. It is important that, in reality, the factors are not necessarily pecuniary, but *seem* to affect the price. Therefore, empirical analysis can answer and contribute to analyze the indirect effects.

3.1 Background

As for practices in the market, we consider the year(s) contracts with the early termination fee as incentive compatible debt contracts[22]. And we assume that the fee is also highly related to the effort to cooperate to the contract conditions in practice by the early literature of the incentive compatible contracts. The incentive compatible contracts that we imply that the year(s) term could be highly related to the monthly payment. Therefore, we suggest that there is a possible mechanism in the contracts of this kind and are certain conditions for the optimal contract.

To include qualitative aspects in competition, an incentive should be observed and its criteria (parameters) for efficiency could be critical to analyze. In view of economics,

[22] Incentive-compatible contracts are based on Campbell (2006); Green and Laffont (1992). Limited liability are largely based on Sappington (1983); Harris and Raviv (1979); Poblete and Spulber (2012). They discussed conditions of optimal incentive for efficiency under the debt style contract and shows characteristics of incentive and its perspectives. The concept of early literature is inspired by the insurance contracts.

> "(Q)ualitative policy refers, in our terminology, to changing details of social organization rather than foundations… Changes in social organization, even if they refer to less important aspects only, will, as a rule, be less frequent than quantitative changes in the value of existing instruments of economic policy", Tinbergen (1964).

In the quantitative world, i.e. in neoclassical economics, discussions are not simply the matter of equality between price and marginal cost in virtue of efficiency.

Through the experiences shown in chapter 2, the market introduced competition and becomes more competitive, and now faces severe competitive circumstances. Due to severe competition, telecom operators changed charging schemes to increase revenues.

Furthermore, they introduced differentiated services to meet individual demand. This means that services include many factors enabling differentiation. It is hard to explain or justify the pricing of differentiated services by considering only price and quantity. This is why it is necessary to also take quality into consideration.

To rationale the legitimacy of the practices of this kind, results of this thesis will contribute to real practices of the year(s) contracts implemented by telecom operators. For regulatory agency, oversight of the level of the early termination fee could be a benchmark for not only payment (retail price) level, but also the level of the fee set by the practices and that of the cooperation level that would also suggest that the state of fair odds conditions between contractors and non-contractors except the price customers pay.

3.2 The Model

This subsection considers further on the possible factors taking from business practices cost us or differentiate us to be served.

Recent contractual practices in the market tend to set some constraints on customers' use; the amount of data transferred, the type of data, and/or the duration of our communication. These factors ought to affect the price we pay as the payment.

So the primary purpose of the estimation or benchmarking here should be the one to estimate the indirect influences of the factors to the price in the contractual practices. There are two points to ensure;

- [S]howing a certain rationality in the dependent variables selected
- [E]valuating the relative influences between the factors selected.

The empirical data used here are from financial data of annual reports. The financial data are obtained by major mobile telecom operators in Japan; NTT DoCoMo, KDDI, Softbank, and EMOBILE numbered and classified in the index. We obtained the annual reports as many as possible as long as we can track the recent market status of four major players. As a result, we obtained the annual reports from 2004 to 2011. The data of the TCA (Telecommunications Carriers Association) supports those data.

In the data, the data of "revenuesales" shows the operating revenues in the financial data of their annual report, and the revenues include the sales of handsets or that of other sales. The simple regression model to estimate the influence of the factors is defined as

$$data\ ARPU = \alpha_{it} + \beta_{it} equipment + \gamma_{it} revenuesales + \delta_{it} datacap + \eta_{it} \mathrm{yrcontract} + \varepsilon \tag{2.31}$$

and the independent variables are defined as follows,

data ARPU: data Average Revenue per User
equipment: Investments to the Equipment
revenuesales: Operating Sales
datacap: Dummy for the Existence of the Data Cap
yrcontract: Dummy for the Existence of the Contract Term.

The amount of investments to the equipment is assumed that the amount of money affects the *data ARPU* because of the increase in costs. This might be straightforward when we recall chapter 2. The operating sales is assumed to get the financial situation better by the increase in the revenues, and consequently decline the *ARPU*. On the data cap, the data cap is the cap that the upper threshold of the amount of data used is set in the contract. We assume that the existence of the cap tends to increase the *ARPU* because of, or for fear of, an additional cost for exceeding the limit. The existence of the year(s) term is the condition that customers should continue using the service during the promised term in the contract. The last two factors listed in the model are set as dummies. The dummies are to set to estimate the influences of the existence of the two practices to the retail price and other factors.

In the model, it is natural to use the data of the operating revenues, considering historical backgrounds as discussed in the earlier chapters. Indeed, considering and handling the relationship between the *ARPU* and the operating revenues seem to be meaningless in business, but our statistical approach here can estimate the interrelationship between those factors that affect indirectly.

The model could be effective to consider the actual or real *ARPU* that includes the factors affecting to some degree. First of all, the nominal data of the *ARPU* is simply calculated from the operating revenue, but the data of the *ARPU* is actually interrelated to the qualitative factors in question. That is why, the setting of the model with qualitative factors does not have contradictions in setting itself, and the model could work effectively as a benchmark.

3.3 The Estimation

In the estimation we can get from the model, the correlation between the dependent variable and the independent variables is shown as table III-1, and there is two points to note here; first, the investment of the equipment showed negative against our assumption, and second, a correlation between the *data ARPU* and the term is relatively high.

On the first point, the reason can be explained in a practical sense because the value of the unit data (packets) could decline as the capacity of the network increases. Therefore, when we assume the amount of data used is constant, we can show a possibility that the *ARPU* declines.

On the second point, there is a possibility of multicollinearity. But high correlation does not necessarily mean multicollinearity. Therefore, a high correlation is a necessary condition for the existence, but not necessarily a sufficient condition. For example, neither earlier literature nor textbooks on Econometrics shows that showing the characteristics of multicollinearity does not necessarily means the denial of the validity of the analysis or the model[23].

The multicollinearity exists at the only time when an analysis is impossible. As long as the analysis is possible, the result and its estimation have a certain level of reliability in the analysis. If we deny an analysis because of high correlation, some important analyses in Economics are unanalyzable and unreliable because of it[24].

[23] Goldberger (1968b, pp.80), quoting the definition of Johnson (1963), showed that the problem of multicollinearity is a matter of degree, but not an all-or nothing Problem.

[24] For example, referred by Farrar and Glauber (1967) and attempted by Goldberg (1968a), there is an analysis of Cobb-Douglas function. Kennedy [2008 pp.196] stated that, in the Cobb-Douglas production function, there is no concern about high correlation, and we can take a way not to do anything.

Examining multicollinearity, the result is shown in table III-2. Table III-2 shows eigenvalue, Variance Inflating Factor (*VIF*), control number, and the squares of multiple correlation of other independent variables. As shown in table III-2, considering the *VIF*s and the condition numbers are to discuss correlation between independent variables. The *VIF*s in the table III-2 are below 10, its standard, and the inverse *1/VIF*s are also below 1, the standard, which shows the possibility of multicollinearity is low.

And the control number indicates close to 1, which means variables of the investment of the equipment and the operation revenues. So, we can see good sensitive responses to a small change of data.

The estimation of the pooling regression (OLS: Ordinary Least Squares) shows that the year(s) contract term is the only significant variable in the model. Other independent variables are not significant, but the sign of the variables were almost as assumed. The variable of the term affects significantly to the ARPU.

By the three estimations and tests, the fixed model shows bigger changes in values, but the estimations and results of the fixed model are appropriate. The factor of the operating revenues in the fixed model shows the opposite sign as assumed. In the business practices, setting the year(s) term was significant, though the effect is not that great as that in the pooling model. Therefore, the model shows that the year(s) term affect significantly to other factors and the ARPU.

Table III-1 Correlation

	dataARPU	revenu~s	equipi~t	datacap	yrcont~t
dataARPU	1				
revenuesales	-0.0416	1			
equipinves~t	-0.0903	0.9167	1		
datacap	0.4805	-0.0760	-0.1609	1	
yrcontract	0.7633	0.02533	0.0487	0.3327	1

Table III-2 the Examination of Multicollinearity

Eigenval	C_Number	C_Index	VIF	1/VIF	R2_ xi, X
1.9464	1.0000	1.0000	6.7665	0.1478	0.8522
1.3228	1.4714	1.2130	6.5686	0.1522	0.8478
0.6533	2.9795	1.7261	1.2201	0.8196	0.1804
0.0775	25.1276	5.0127	1.1549	0.8659	0.1341

Table III-3 the Estimation of the Pooling Regression (OLS)

	SS	df	MS		Number of obs	25
Model	3872479.34	4	968119.853		F(4, 24)	10.37
Residual	1867104.66	20	933355.2331		Prob > F	0.0001
					R-squared	0.6747
Total	5739584	24	239149.333		Adj R-squared	0.6096
					Root MSE	305.54
dataARPU	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
equipinves~t	0.728167	0.0562525	1.29	0.210	-0.044524	0.1901574
revenuesales	-0.0129022	0.010921	-1.45	0.163	-0.0384028	0.0069588
datacap	351.8581	248.8079	1.41	0.173	-167.1461	870.8623
yrcontract	685.0905	132.2963	5.18	0	409.1252	961.0557
_cons	1903.351	160.8135	11.84	0	1567.9	2237.802

Table III-4 the Estimation of the Fixed Effect Model

Fixed-effects (within) regression				Number of obs =		25
Group variable: id				Number of groups =		4
R-sq: within =	0.6617			Obs per group: min =		2
between =	0.076			avg =		6.3
overall =	0.3465			max =		8
				F(4,17) =		8.31
corr(u_i, Xb) =	-0.0458			Prob > F =		0.0007
dataARPU	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
equipinves~t	0.0080749	0.0551885	0.15	0.885	-0.1083627	0.1245126
revenuesales	0.0099478	0.019692	0.51	0.62	-0.0315987	0.0514944
datacap	69.00008	171.9779	0.4	0.693	-293.8415	431.8416
yrcontract	475.1588	89.27734	5.32	0	286.8	663.5175
_cons	1522.026	518.5658	2.94	0.009	427.9478	2616.104
sigma_u	654.07226					
sigma_e	187.92701					
rho	0.92374326	(fraction of variance due to u_i)				
F test that all u_i=0		F(3, 17) =	11.96	Prob > F = 0.0002		

Table III-5 the Estimation of the Random Effect Model

Random-effects GLS regression						
Group variable:		*id*		*Number of obs =*		25
R-sq: within =		0.6097		*Obs per group: min =*		2
between =		0.986		*avg =*		6.3
overall =		0.6747		*max =*		8
			Wald chi2(4) =	41.48		
corr(u_i, X) = 0 (assumed)			*Prob > chi2 =*	0		
dataARPU	*Coef.*	*Std. Err.*	*z*	*P>|z|*	*[95% Conf.*	*Interval]*
equipinves~t	0.0728167	0.0562525	1.29	0.196	-0.0374362	0.1830696
revenuesales	-0.015822	0.010921	-1.45	0.147	-0.0372268	0.0055827
datacap	351.8581	248.8079	1.41	0.157	-135.7964	839.5127
yrcontract	685.0905	132.2963	5.18	0	425.7945	944.3864
_cons	1903.351	160.8135	11.84	0	1588.162	2218.539
sigma_u	0					
sigma_e	187.92701					
rho	0	(fraction of variance due to u_i)				

Table III-6 Hausman Test

---- Coefficients ----				
	(b)	*(B)*	*(b-B)*	*sqrt(diag(V_b-V_B))*
	fixed	.	Difference	S.E
equipinves~t	0.0080749	0.072167	-0.0647418	.
revenuesales	0.0099478	-0.015822	0.0257699	0.0163862
datacap	69.00008	351.8581	-282.858	.
yrcontract	475.1588	685.0905	-209.9317	.
b = consistent under Ho and Ha; obtained from xtreg				
B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic				
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)				
= 34.99				
Prob>chi2 = 0.0000				
(*V_b-V_B* is not positive definite)				

Table III-7 Breusch and Pagan Test

Breusch and Pagan Lagrangian multiplier test for random effects			
dataARPU[id,t] = Xb + u[id] + e[id,t]			
Estimated results:			
		Var	*sd = sqrt(Var)*
	dataARPU	239149.3	489.029
	e	35316.56	187.927
	u	0	0
Test: *Var(u) = 0*			
	chibar2(01) = 0.00		
	Prob > chibar2 = 1.0000		

3.4 Remarks

This section considered actual retail price in the case of Japan. The model in section 3.2 showed that available empirical data defined as the factors that affect the retail price indirectly. We can conversely say that the factors not recognizable as a cost or a part of the retail price affect the retail price can be observable its influence to a statistically significant degree.

The estimations show that the existence of the year(s) term was the only significant result that affect ARPU significantly. So we can see that the factors of the practices tend to increase costs and ARPU. This implies that the more discriminations are introduced in business practices or in the contract or service plans, this result shows that those factors affect costs significantly.

4. Bit/Data Cap

The bit/data cap is a conventional way to limit data use and avoid data traffic congestion. A decision on the amount of data might be an arbitrary managerial decision. In virtue of competition, business practices are rarely discussed in the name of freedom of management under competition. This article focuses on the effect of the practice.

We consider the effects of a practice implemented worldwide in the telecommunications industry. The practice sets a “cap”, a quantitative limit on data use, and charges additionally when customers use more than the limit set by operators.

Next we examine the validity of the cap through analysis of empirical data of fixed telephone services under the models, and propose a bridge over the problem in mobile services. The practice of the cap has been implemented over the years in fixed line telecom services, but the practice has been widely implemented recently in the mobile market as the broadband diffuses in the fixed network with a flat-rate charging scheme. Therefore, the models in this chapter examine factors that affect the cap. The models also consider not only the effect of each factor, but also policy issues so that the practice in question can be supervised by the agency. In short, how a cap can be set and rationalized is examined.

Recently, telecom operators have implemented or attempted to implement bit/data caps on telecom data services. The practices are implemented in a process covering enough network capacity or geographical area to provide data services. A concern we point out here is the one when all operators implement the practice uniformly. We also point out that a certain degree of uniform practice could be rational even though the practice tends to be justified in virtue of freedom of business management.

In section 4.1, we review the background of some aspects, especially the methodological background. Section 4.2 explores the models for the bit/data cap. Section 4.3 examines basic statistics and estimations. Section 4.4 considers the newer data and examines its estimations. Section 4.5 concludes the analysis and points out some future extensions.

4.1 The Data

To obtain qualitative data, empirical data in this article are based on OECD data which include detailed data on the cap and periodic data in OECD Communications Outlook. To discuss the characteristics and effects of the cap per se, this chapter focuses on a static model and data. The empirical data cover the most recent data available on the amount of the bit/data cap, downlink and uplink access speed, and minutes to the cap, monthly payments (USDPPP), and price per Mbits/s (USDPPP)[25]. These factors as variables are almost all available from the data source that might be related to the cap. The data cover all service plans offered in OECD member countries that have the bit/data cap.

This chapter shows possible empirical contributions to the incentive using observed data. If the competition needs the bit/data cap, the scheme or model should be simple and easy to capture without observing and listing lots of data and variables. To achieve this goal, assumptions and settings should be carefully defined. These normative considerations are considered in next section.

Table IV-1 shows correlations of the variables in the data. Some relationships indicate relatively high numbers as shown; between downlink speed and Monthly payment, between downlink and the cap, and between monthly payment and the cap. This suggests that the bit/data cap tends to affect downlink speed and monthly payments.

Table IV-1: Correlation of Variables

	Downkb~s	Upkbits	Minute~p	USDpri~P	PMBIT~P	BitcapMB
Downkbits	1.0000					
Upkbits	0.1763	1.0000				
Minutestor~p	-0.2627	-0.1234	1.0000			
USDpricemo~P	0.4176	0.0023	-0.0402	1.0000		
PMBITUSDPPP	-0.3912	-0.1552	0.3501	0.0047	1.0000	
BitcapMB	0.4310	0.0234	0.3229	0.4456	-0.1968	1.0000

Source: OECD Communications Outlook 2011 & OECD Broadband Statistics Sep., 2010

Table IV-2 shows sample statistics of the data used in this article. The basic statistics shows that downlink speed under data cap is about 24Mbits/s, and other variables show that operators in the status quo tend to set lower than standard deviation level. This indicates that customers in status quo using data cap plan use lower level in quality of service. This result shows the need to improve the circumstances of customers using bit/data cap plan.

[25] All data used are shown in the Appendix. The measure of value is in USDPPP for consistency of the data.

Table IV-2: Basic Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Downkbits	185	23345.14	24617.64	512	102400
Upkbits	185	5001.342	10584.42	0	50000
Minutestor~p	185	875.689	1624.719	8.888889	9333.333
USDpricemo~P	185	47.54448	23.48875	0	145.8096
PMBITUSDPPP	185	7.028039	11.90895	0	66.36744
BitcapMB	185	73194.59	89970.25	1000	500000

Source: OECD Communications Outlook 2011 & OECD Broadband Statistics Sep., 2010

4.2 The Model

4.2.1 The Normative Assumptions

For empirical analyses, it is important to describe how we define the characteristics of the cap and market in question. The actual management in the market is not adjustable in real time. This means that management has some "slackness". The discussions of the slackness[26] were treated as an efficiency measure. Berg and Jeong (1991) considered the effectiveness of slackness using probit model, and Abel-khalik, (1988) discussed the setting of a target threshold.

As Villas-Boas (2009) implemented a concept of differentiation in empirical analysis, the decisions may differ according to their preferences. Furthermore, we consider a model setting the mean value as the threshold in subsection 4.2.3[27]. Unlike earlier literature, we introduce the value of the standard deviation, or the ones derived from basic statistics, as the threshold.

To evaluate these complicated services in broader terms, we need to have a certain standard and consider possible options. Therefore, the objective of the agency is to assess competitive circumstances in a qualitatively highly differentiated market.

The following background shows that the standard we expected is statistically testable using empirical data. The background for the methodology is based heavily on an article (Bouissou, Laffont, and Vuong, BLV, 1986), which considers log-likelihood ratio test for

[26] Selten (1986); Abel-khalik (1988); Berg and Jeong (1991).
[27] The model is based on Berry, Levinsohn, and Pakes (1995).

noncausality; noncausality is the abstract or theoretical concept of stochastic process of quality. The definition of noncausality by BLV is as follows,

"(I)f X, Y are two stochastic processes, then Y does not cause X at any instant."

In this definition, *X* involves an infinite number of random variables¸ so conditions need to be set to reduce independence properties of a finite set of variables. BLV defined the probability distribution such that *Y* does not cause *X* if qualitative data are available. The two stochastic processes in BLV are set in time, past and future, but this chapter sets it in relation to a certain threshold of the variable we discuss, under or over a bit/data cap. As BLV sets the value of *X* as null when the time is before a certain defined period of time, we set the value of the cap as null when the cap is over a certain defined threshold. The probability model estimates a stationary process, which identifies the independent restriction, the threshold, to be defined. Details of the model are discussed in section 4.2.3.

4.2.2 The Simple OLS Model

To describe bit/data cap in practice, we build a model of how charges and speeds affect the amount of the cap. We consider a simple mechanism to build a regulatory tool to capture the characteristics of the practice, and obtain better network services, which do not restrict operators' behaviors. The simple OLS model is as follows;

$$DC_i = \alpha_0 + \alpha_1 DL_i + \alpha_2 UP_i + \alpha_3 MIN_i + \alpha_4 MON_i + \alpha_5 PMBIT_i + u \qquad (4.1)$$

where

DC	:	Data Cap (MB)
DL	:	Downlink Speed (kbits/s)
UP	:	Uplink Speed (kbits/s)
MIN	:	Minutes to reach the bit/data cap (min.)
MON	:	Monthly payment (USDPPP)
PMBIT	:	Price per Mbit/s (USDPPP).

Under those conditions, we can hypothetically estimate the quality or market mechanism we faced as we had been discussed. The analysis in this chapter through the model is highly expected that the qualitative factors relate to the price. We estimate through this empirical tools under the competitive circumstances. The estimations in this chapter show the influences of qualitative factors to the market.

4.2.3. The Basic Logit and Probit Models

To consider the cap and its incentive in the service plans, a certain amount of the cap is already determined. In statistical view, we consider the case where the agency sets the amount of the cap level at the mean level, MEAN, and the standard deviation level, STDDEV, obtained from statistical data.

Following the theoretical background in section 2, we set *DC* as a latent variable and assume $DC^* = 1$ if DC becomes more than the standard deviation level, and $DC^* = 0$ if DC is less than the level, shown as follows;

$$DC > MEAN, STDDEV \Leftrightarrow \alpha_1 + DL + \alpha_2 UP + \alpha_3 MIN + \alpha_4 MON + \alpha_5 PBIT + u > 0$$
$$\Leftrightarrow u > -\alpha_0 - \alpha_1 DL - \alpha_2 UP - \alpha_3 MIN - \alpha_4 MON - \alpha_5 PBIT$$

To obtain $DC^* = 1$, we assume its probability, $P(DC^* = 1)$,

$$\begin{aligned} P(DC^* = 1) &= P(DC > STDDEV) \\ &= P(u > -\alpha_0 - \alpha_1 DL - \alpha_2 UP - \alpha_3 MIN - \alpha_4 MON - \alpha_5 PBIT) \\ &= 1 - F(-\alpha_0 - \alpha_1 DL - \alpha_2 UP - \alpha_3 MIN - \alpha_4 MON - \alpha_5 PBIT) \end{aligned} \tag{4.2}$$

$$\begin{aligned} P(DC^* = 0) &= P(DC \leq STDDEV) \\ &= P(u \leq -\alpha_0 - \alpha_1 DL - \alpha_2 UP - \alpha_3 MIN - \alpha_4 MON - \alpha_5 PBIT) \\ &= F(-\alpha_0 - \alpha_1 DL - \alpha_2 UP - \alpha_3 MIN - \alpha_4 MON - \alpha_5 PBIT) \end{aligned} \tag{4.3}$$

where *F(•)* is the cumulative distribution function. Additional variables are considered in the models 2 and 3 that include interaction terms discussed later. Next subsection also considers the status quo at other levels of the cap; 2GB and 5GB. Those levels set instead of *STDDEV* in the models are popular in the US mobile market.

4.3 The Estimations and Results

The estimations and results of the OLS models are shown in table IV-3. The interaction terms work effectively to increase fits in the OLS models. The simplest OLS model listed as model 1 shows a certain fit, the rate of adjusted R-squared being 0.4886, and some interesting results.

Coefficients of the monthly payment and the Price per Mbits/s (PMBIT) show that those variables are highly related, but the opposite direction. This means that a unit change in the monthly payment tends to set about 1.3GB higher cap. In case of charging higher PMBIT, it shows vice versa, setting the cap about 1.9GB lower as the PMBIT increases. The result of the PMBIT shows that a network built by a reckless investment causes higher price and less amount of the cap, which the same result is shown by the Bental and Spigel (1995). The variable MIN shows that the cap increases about 28MB when it takes one minute more to reach the cap.

Tables from IV-4 to IV-7 show the estimation using the logit and the probit model. As assumptions and settings shown in the former subsection, we discuss the level of the cap, and examine statistically for its validity. As shown in previous subsections, we choose a level of the cap from possible thresholds to observe the status quo of the market. The estimations of the logit models set zero as the threshold of *DC* for normalization.

The result shows the uplink speed can never obtain a significant result in any OLS models. The uplink speed can be explained in the following models. In the logit models, we obtain better significance and different characteristics than we expected intuitively.

For further analysis, we create models that have some dummy variables and some interaction variables. The models with those variables are estimated better fits and results shown in table IV-3.

The estimations at the mean level show better estimations and results than those of the OLS. The PMBIT shows the same result as that of the OLS, which the cap is highly influenced negatively by the variables.

The logit model can estimate the marginal effect of the variables. The result of the marginal effect also shows that the PMBIT is the only variable that works negatively.

The probit model, a non-linear estimation, shows that the PMBIT is more sensitive than that in the logit model. This is caused by the distribution and density of the data set. The effect of those terms were discussed and assumed in the models in earlier chapters. In that sense, the difference is acknowledgeable theoretically.

The amount of the cap at the mean level is almost the same amount as Japanese mobile operators set as the upper threshold. At the mean level, the impact on the PMBIT are relatively higher than any other levels.

The following results in the model at the 5GB level shows that the impact of the PMBIT are relatively low. The cap at the 5GB is the major upper limit in the US mobile operators, 2GB for middle range customers.

Table IV-3: Estimations of the OLS Model

	model1	model2	model3
	b/t	b/t	b/t
Downkbits	1.215154	0.0531381	0.0310458
	[25.0697716]***	[2.221978]	[2.13327515]
Upkbits	-0.0988446	-0.3700466	-0.0134667
	[1.7846193]	[.93923229]	[1.9607111]
Minutestoreachbitcap	28.17814	18.29583	16.5731
	[28.9282208]***	[25.8860771]***	[25.2363149]***
USDpricemonthlyPPP	1258.117	413.2687	452.3545
	[25.5337969]***	[22.2004718]**	[22.478916]**
PMBITUSDPPP	-1874.855	-1350.286	-1355.917
	[-2.0794472]***	[-1.5308452]***	[-1.63535]***
dum_mean		38480.74	
		[22.7182777]***	
dwnxmean		2.015292	
		[26.0693785]***	
dum_dev			49404.63
			[23.3170296]***
dwn_dev			1.874077
			[25.6168658]***
_cons	-25994.26	11348.91	11885.31
	[-.21099247]**	[21.1461199]	[21.2220056]
R-squared	0.5025224	0.7184221	0.7266587
Adj-R-squared	0.4886263	0.7072863	0.7158486
N	185	185	185
* p<0.1, ** p<0.05, *** p<0.01			

Table IV-4: The Estimation of the Logit Model under the Cap at the Mean Level

Logistic regression				Number of obs =		185
				LR chi2(5) =		190.92
				Prob > chi2 =		0.0000
Log likelihood =	-25.073447			Pseudo R2 =		0.7920
dum_mean	Coef.	Std. Err	z	P>|z|	[95% Conf.	Interval]
Downkbits	0.0000216	0.000015	1.43	0.152	-7.92e-06	0.000051
Upkbits	0.0000647	0.0000271	2.39	0.017	0.0000115	0.000118
Minutestor~p	0.0135733	0.0028508	4.76	0.000	0.0079858	0.019161
USDpricemo~P	0.1143613	0.0310127	3.69	0.000	0.0535776	0.175145
PMBITUSDPPP	-1.528423	0.3219924	-4.75	0.000	-2.159517	-0.89733
_cons	-9.780121	2.206768	-4.43	0.000	-14.10531	-5.45494
Note: 19 failures and 13 successes completely determined.						

Average marginal effects				Number of obs =		185
Model VCE :	OIM					
Expression :	Pr(dum_mean), predict()					
dy/dx w.r.t. :	Downkbits Upkbits Minutestoreachbitcap USDpricemonthlyPPP					
	PMBITUSDPPP					
		Delta-method				
	dy/dx	Std. Err.	z	P>|z	[95% Conf.	Interval]
Downkbits	8.71E-07	5.88E-07	1.48	0.139	-2.82E-07	2.02E-06
Upkbits	2.61E-06	9.82E-07	2.66	0.008	6.90E-07	4.54E-06
Minutestor~p	0.0005488	0.0000477	11.5	0	0.0004552	0.000642
USDpricemo~P	0.0046237	0.0009148	5.05	0	0.0028308	0.006417
PMBITUSDPPP	-0.061795	0.0052408	-11.79	0	-0.072067	-0.05152

Table IV-5: The Estimation of the Probit Model under the Cap at the Mean Level

Probit regression, reporting marginal effects					Number of obs =		185
					LR chi2(5) =		190.69
					Prob > chi2 =		0.0000
Log likelihood =		-25.18553			Pseudo R2 =		0.7910
dum_mean	dF/dx	Std. Err.	z	P>|z|	x-bar	[95%	C.I.]
Downkb~s	2.08e-06	1.69e-06	1.49	0.137	23345.1	-1.2e-06	5.40e-06
Upkbits	5.25e-06	2.49e-06	2.73	0.006	5001.34	3.70E-07	0.00001
Minute~p	0.0012037	0.0005454	5.32	0.000	875.689	0.000135	0.002273
USDpri~P	0.0105157	0.00429	3.84	0.000	47.5445	0.002107	0.018924
PMBIT~P	-0.135994	0.0555324	-5.31	0.000	7.02804	-0.244835	-0.027152
obs. P	0.3567568						
pred. P	0.0907514	(at x-bar)					
z and P>|z| correspond to the test of the underlying coefficient being 0							

Table IV-6: The Estimation of the Logit Model under the Cap at the STD Dev. Level

Logistic regression				Number of obs =		185
				LR chi2(5) =		173.72
				Prob > chi2 =		0.0000
Log likelihood =		-27.39397		Pseudo R2 =		0.7602
dum_dev	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Downkbits	0.0000332	0.0000158	2.09	0.036	2.12E-06	6.42e-05
Upkbits	0.0000408	0.0000247	1.65	0.099	-7.69E-06	8.93e-05
Minutestor~p	0.0102574	0.0021649	4.74	0.000	0.0060142	0.0145005
USDpricemo~P	0.0982766	0.0270122	3.64	0.000	0.0453337	0.1512195
PMBITUSDPPP	-1.169159	0.2923528	-4.00	0.000	-1.74216	-0.5961576
_cons	-9.631862	2.147876	-4.48	0.000	-13.84162	-5.422102
Note: 16 failures and 13 successes completely determined.						

Average marginal effects					Number of obs =	185
Model VCE :	OIM					
Expression : Pr(dum_dev), predict()						
dy/dx w.r.t. : Downkbits Upkbits Minutestoreachbitcap USDpricemonthlyPPP						
	PMBITUSDPPP					
		Delta-method				
Downkbits	dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Upkbits	1.50e-06	6.57e-07	2.28	0.023	2.11e-07	2.79e-06
Minutestor~p	1.84e-06	1.06e-06	1.73	0.083	-2.40e-07	3.93e-06
USDpricemo~P	0.0004638	0.000036	12.88	0.000	0.0003932	0.0005343
PMBITUSDPPP	0.0044433	0.0008858	5.02	0.000	0.0027072	0.0061794
_cons	-0.0528604	0.008362	-6.32	0.000	-.0692497	-0.0364711

Table IV-7: The Estimation of the Probit Model under the Cap at the STD Dev. Level

Probit regression, reporting marginal effects						Number of obs =	185
						LR chi2(5) =	174.56
						Prob > chi2 =	0.0000
Log likelihood =	-26.969908					Pseudo R2 =	0.7639
dum_dev	dF/dx	Std. Err.	z	P>|z|	x-bar	[95%	C.I.]
Downkb~s	1.49e-06	1.42e-06	2.27	0.023	23345.1	-1.30e-06	4.30e-06
Upkbits	2.03e-06	1.57e-06	2.10	0.036	5001.34	-1.0e-06	5.10e-06
Minute~p	0.000433	0.0003423	5.09	0.000	875.689	-0.000238	0.001104
USDpri~P	0.004264	0.0031684	3.80	0.000	47.5445	-0.001946	0.010474
PMBIT~P	-0.04874	0.034424	-4.62	0.000	7.02804	-0.11621	0.01873
obs. P	0.3081081						
pred. P	0.0333653	(at x-bar)					
z and P>|z| correspond to the test of the underlying coefficient being 0							

Table IV-8: The Estimation of the Logit Model under the Cap at 5GB Level

Logistic regression				Number of obs =		185
				LR chi2(5) =		146.26
				Prob > chi2 =		0.0000
Log likelihood =		-10.492357		Pseudo R2 =		0.8745
dum_5GB	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Downkbits	0.0001256	0.0000578	2.17	0.03	0.0000123	0.000239
Upkbits	0.0001398	0.0002323	0.60	0.547	-0.000316	0.000595
Minutestor~p	0.060894	0.0212253	2.87	0.004	0.0192932	0.1024948
USDpricemo~P	0.1108297	0.0458752	2.42	0.016	0.020916	0.2007434
PMBITUSDPPP	-1.532688	0.5314032	-2.88	0.004	-2.57422	-0.4911573
_cons	-6.299963	2.645653	-2.38	0.017	-11.48535	-1.114578
Note: 5 failures and 99 successes completely determined.						

Average marginal effects				Number of obs =		185
Model VCE :	OIM					
Expression : Pr(dum_5GB), predict()						
dy/dx w.r.t. : Downkbits Upkbits Minutestoreachbitcap USDpricemonthlyPPP						
	PMBITUSDPPP					
		Delta-method				
	dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Downkbits	2.10E-06	7.75e-07	2.71	0.007	5.78e-07	3.62e-06
Upkbits	2.33E-06	3.85e-06	0.61	0.544	-5.21e-06	9.88e-06
Minutestor~p	0.0010164	0.0002192	4.64	0.000	0.0005867	0.0014461
USDpricemo~P	0.0018499	0.0006136	3.01	0.003	0.0006472	0.0030526
PMBITUSDPPP	-.0255829	0.0053537	-4.78	0.000	-.0360759	-0.015089

Table IV-9: The Estimation of the Probit Model under the Cap at 5GB Level

Probit regression, reporting marginal effects					Number of obs =		185
					LR chi2(5) =		146.71
					Prob > chi2 =		0.0000
Log likelihood =		-10.268593			Pseudo R2 =		0.8772
dum_5GB	dF/dx	Std. Err.	z	P>|z|	x-bar	[95%	C.I.]
Downkb~s	9.00e-147	1.90e-144	2.43	0.015	23345.1	-4.00E-144	4.00e-144
Upkbits	8.10e-147	1.70e-144	0.51	0.607	5001.34	-3.e-144	3.00e-144
Minute~p	4.20e-144	8.90e-142	3.09	0.002	875.689	-2.e-141	2.00e-141
USDpri~P	8.00e-144	1.70e-141	2.56	0.011	47.5445	-3.e-141	3.00e-141
PMBIT~P	-1.10e-142	2.20e-140	-3.12	0.002	7.02804	-4.e-140	4.00e-140
obs. P	0.8324324						
pred. P	1	(at x-bar)					
z and P>|z| correspond to the test of the underlying coefficient being 0							

Table IV-10: The Estimation of the Logit Model under the Cap at 2GB Level

Logistic regression					Number of obs =	185
					LR chi2(5) =	115.15
					Prob > chi2 =	0.0000
Log likelihood =	-11.881773				Pseudo R2 =	0.8289
dum_2GB	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Downkbits	0.0001448	0.0000553	2.62	0.009	0.0000365	0.0002531
Upkbits	-.0000408	0.000162	-0.25	0.801	-0.0003583	0.0002766
Minutestor~p	0.0599045	0.0214933	2.79	0.005	0.0177784	0.1020306
USDpricemo~P	0.145727	0.060584	2.41	0.016	0.0269846	0.2644694
PMBITUSDPPP	-.5727106	0.201523	-2.84	0.004	-0.9676884	-0.1777328
_cons	-7.287796	2.718769	-2.68	0.007	-12.61649	-1.959107
Note: 0 failures and 107 successes completely determined.						

Average marginal effects				Number of obs =		185
Model VCE :	OIM					
Expression : Pr(dum_2GB), predict()						
dy/dx w.r.t. :	Downkbits Upkbits Minutestoreachbitcap USDpricemonthlyPPP					
	PMBITUSDPPP					
		Delta-method				
	dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Downkbits	2.78E-06	6.65e-07	4.18	0.000	1.47e-06	4.08e-06
Upkbits	-7.83e-07	3.09e-06	-0.25	0.800	-6.85e-06	5.28e-06
Minutestor~p	0.0011483	0.0002915	3.94	0.000	0.0005769	0.0017198
USDpricemo~P	0.0027935	0.0009041	3.09	0.002	0.0010215	0.0045655
PMBITUSDPPP	-.0109786	0.0026991	-4.07	0.000	-0.0162688	-0.0056884

Table IV-11: The Estimation of the Probit Model under the Cap at 2GB Level

Probit regression, reporting marginal effects					Number of obs =		185
					LR chi2(5) =		115.72
					Prob > chi2 =		0.0000
Log likelihood = -11.599215					Pseudo R2 =		0.8330
dum_2GB	dF/dx	Std. Err.	z	P>|z|	x-bar	[95%	C.I.]
Downkb~s	9.40e-192	0	2.81	0.005	23345.1	9.00e-192	9.00e-192
Upkbits	-2.30e-192	0	-0.24	0.813	5001.34	-2.00e-192	-2.00e-192
Minute~p	3.60e-189	0	3.17	0.002	875.689	4.00e-189	4.00e-189
USDpri~P	9.10e-189	0	2.47	0.013	47.5445	9.00e-189	9.00e-189
PMBIT~P	-3.50e-188	0	-3.30	0.001	7.02804	-3.00e-188	-3.00e-188
obs. P	0.8756757						
pred. P	1	(at x-bar)					
z and P>|z| correspond to the test of the underlying coefficient being 0							

Taking a recent trend especially in the mobile data market into consideration, some mobile operators implement a 5GB cap at its maximum for data use, and avoid congestion of their network. Recent strong demand for mobile data use is not a phenomenon that arose suddenly. Operators have emerged to bundle their services in the name of fixed and mobile convergence. This business strategy benefits both operators and customers, but the operators underestimate the demand for data use. The customers take the bundled service as a seamless service and expect a seamless access without limits on the place of access. Lower charges on each service caused by bundling seem to give an excuse for lower quality of each service.

As shown in the tables, the marginal effect of the PMBIT at 5GB or 2GB showed about 2.5% or 1.1% decline in the probability of setting the cap, respectively. The estimations at 5GB level shown in table IV-8 and IV-9 suggest that setting the cap at 5GB statistically explains better than the case of the cap at standard deviation level. This implies that the cap of 5GB in mobile market may be calculated, justified, and set by the operators. The irrationality of this implication is that most operators set the same amount of the cap even though the capacity, density, and quality of their networks are different. A 5GB cap could be justified as long as their services are offered by bundling, and the PMBIT would have the same level and conditions as those of fixed line services.

4.4 The Newer Data and Its Analysis

Section 4.3 considered the effect of the Bit/Data cap service plans in OECD countries. The latest data in the OECD changed our view. As of 2013, the latest data is the 2011 data[28] shown in Appendix B, a year later of the data used in section 4.3.

The cap we discussed in this chapter is measured in GB scale, though the analysis here changed to MB scale for its consistency. This seems that the telecom market become more generous on the data use, but this does not necessarily mean the generosity. The factor of the minutes to reach the cap is no longer available. The newer data could be falsely seen that the operators eliminate small amount of the cap, but the analysis in this subsection shows that it is more difficult to see the relationships between the factors and the reason why the cap is implemented.

Now we consider the correlations of the variables in the newer data shown in table IV-12. The correlation shows some apparent change comparing to the data used in the former section.

[28] The newer data can be obtained from *http://www.oecd.org/sti/broadband/BB-Portal-ListOfBBOffers_Sep2011_Final.xls*

First, the value of a correlation between downlink and uplink speed arises to a certain higher result, .6248. This result seems to be due to the improvement in overall communications infrastructure for broadband.

Second, the second point is critical for this section that the variable of the cap is rarely correlates to the other variables. To make things worse, the variable of the Bit/Data cap is almost completely independent factor as far as we analyzed. Its effects are more than we can see in the newer data. This may be the reason why we fail to implement the model in the former section. In the newer dataset, almost every possible statistical methods and combinations are tried, but won't work.

The sudden change in the characteristics of the cap in the dataset is very doubtful. Though we focused on the data plans with the cap, it does not make sense that the characteristics suddenly change and there is almost no any kind of statistically significant relationships between any variables directly.

Therefore, we are forced to change the model for the dataset, but we continue to figure out the effect of the cap in a different way. As we can see in table I-12, the correlation shows that the cap is now low correlation with the downlink speed, but the downlink speed now highly correlates to the uplink.

Considering from the basic statistics in table IV-13, the implement of the cap seems to give customers better of higher quality of service by controlling data traffic, but the data of the basic statistics show that the plans implementing the cap are not qualitatively superior to the plans without it. The downlink and uplink speeds of the plans without the cap are faster, though the minimum monthly payment is almost the same.

The monthly price of the plan without the cap is as four to eight times more than that with the cap according to the basic statistics. The comparison of the basic statistics also shows that the operators ask higher charge to the PMBIT though they set the cap to discourage customers' data use.

Table IV-12 the Correlation of Variables

	Downkb~s	Upkbits	USDpri~P	PMBIT~P	BitcapMB
Downkbits	1.0000				
Upkbits	0.6248	1.0000			
USDpricemo~P	0.4695	0.3010	1.0000		
PMBITUSDPPP	-0.2350	-0.1325	-0.1089	1.0000	
BitcapMB	0.1987	0.1399	0.1534	-0.0829	1.0000

Table IV-13 The Basic Statistics of the Plans w/ the Cap

Variable	Obs	Mean	Std. Dev.	Min	Max
Downkbits	161	24638.11	29825.69	256	256000
Upkbits	160	3311.412	7300.184	128	40960
USDpricemo~P	161	55.08035	21.87893	14.0822	120.0971
PMBITUSDPPP	161	8.690088	22.38685	0.381315	188.8516
BitcapMB	161	149516.8	449464.4	1000	5120000

Table IV-14 the Basic Statistics of the Plans w/o the Cap

Variable	Obs	Mean	Std. Dev.	Min	Max
Downkbits	457	46847.72	116205	256	1024000
Upkbits	448	18042.55	91825.16	100	1024000
USDpricemo~P	457	63.67947	94.87938	14.15611	1400.366
PMBITUSDPPP	457	7.79571	16.03671	0.054144	177.7369

4.4.1 The model

The models in the former section consider the effectiveness of the various factors to the Bit/Data cap, and the data eloquently explain some tendencies. After the analysis for the newer data using the model in section 4.2.2, what we found was that the newer data could never be explained by the model in the former sections.

So, going back to the concepts, what we can do is to figure out the relationships and the tendencies between factors listed in the data. In this sense, what the newer data suggests is that the status quo suddenly changes to the one that the cap is not the factor to be explained. Through this analysis, we shows the other function of the cap in the market changes.

Therefore, this subsection considers that the downlink speed is the factor to be explained. The model is expected to figure out how the various factors are related and to what degree each factor affect to the monthly payment. To figure out the role of the cap in the market, the model can be described as follows.

$$DL_i = \alpha_0 + \alpha_1 UP_i + \alpha_2 DC_i + \alpha_3 MON_i + \alpha_4 PMBIT_i + u \tag{4.4}$$

Where

DC	:	Bit/Data Cap (MB)
DL	:	Downlink Speed (kbits/s)
UP	:	Uplink Speed (kbits/s)
MON	:	Monthly payment (USDPPP)
PMBIT	:	Price per Mbit/s (USDPPP).

The model (4.4) is the basic model for section 4.4. As we stated before, the purpose of the analysis is still to figure out the effect of the cap though we changed the model.

To satisfy this purpose, we use the interaction term to figure out indirect effects between the variables as analyzed on earlier sections in this chapter. The interaction terms are defined as the product of the two independent variables. The combinations of the terms are shown in the labels in the table IV-15.

cap_up	:	*DC*UP*
cap_mon	:	*DC*MON*
cap_PMb	:	*DC*PMBIT*
up_mon	:	*UP*MON*
up_PMb	:	*UP*PMBIT*
mon_PMb	:	*MON*PMBIT*

4.4.2 The Estimations and the Results

The estimation and the results are shown in table IV-15. The result shows that the model (4.4) could be captured the characteristics of the cap and its effects between the other variables.

The results of the model 1 shows that the direct effect of the variables are statistically significant except the cap. The variables except the cap can explain the downlink speed statistically. The estimation in the model 1 shows that the unit increase in the monthly payment raises the downlink speed about 397kbit/s and the PMBIT lowers the speed 174kbits/s as shown.

The model 2 in table IV-15 is added the interaction terms regarding the cap, and the model fits better shown in the coefficient of determination than model 1. The estimation of the model 2 suggests that the cap works positively that the unit increase in the cap increases the downlink speed. The model 2 is the only model that can explain the direct effect of the cap statistically. The interaction term between the cap and monthly payment, *cap_mon*, works positively, while the same interactive term shows negative effect in the model 2. So the interaction term *cap_PMb* is the same negative effect to the downlink speed even in the model 3. The model 3 includes all interaction terms available, and the estimation shows a high coefficient of determination.

The result of the interaction term between the cap and the uplink speed works negatively in the model 2, though both variables show positive effect. On the other hand in model 3, the result is almost the same result but the opposite sign. Both results of the *cap_up* show statistically significant. This instability and relatively small effects in this analysis seem to be caused by the change of the cap's characteristics, somehow highly independent, in other words, highly low correlation more than the value shown in the tables in this section.

Table IV-15 the estimations of the OLS model

`	model1	model2	model3
	b/t	b/t	b/t
Upkbits	2.086526	2.074989	8.863436
	[8.507441]***	[7.524869]***	[8.170996]***
BitcapMB	0.0047735	0.0261676	0.0082138
	[1.249298]	[4.614244]***	[1.709545]*
USDpricemonthlyPPP	397.2548	318.4273	469.5663
	[4.8686]***	[3.810405]***	[5.539412]***
PMBITUSDPPP	-174.9044	-26.65073	357.1205
	[-2.291038]**	[-0.4021879]	[1.636908]
cap_up		-3.06E-06	3.97E-06
		[-4.02002]***	[2.940458]***
cap_mon		0.0010379	0.0007221
		[5.898953]***	[4.64676]***
cap_PMb		-0.0238971	-0.0148098
		[-8.32387]5***	[-5.888949]***
up_mon			-0.0758078
			[-4.449805]***
up_PMb			-3.25736
			[-9.760439]***
mon_PMb			0.2863846
			[0.065076]
_cons	-3303.032	110.7287	144.0303
	-0.6990745	0.0247364	0.0312574
R-squared	0.5019078	0.6617021	0.8014435
Adj-R-squared	0.4891362	0.6462244	0.7882064
N	161	161	161
* p<0.1, ** p<0.05, *** p<0.01			

4.5 Remarks

We considerd a case where a regulatory agency takes a qualitative incentive into consideration for competition. As for policymaking, a regulatory agency could use logit and probit models which could set a threshold of Bit/Data cap at the standard deviation level and 5GB level derived from sample basic statistics.

Unlike earlier studies, we applied logit and probit models to the telecommunications market, and modified to a 5GB threshold set by statistical result, standard deviation, and practical market observation. To do this, we organized empirical data available worldwide and considered qualitative factors. We also considered the cap-setting process taking qualitative factors into consideration for the price. With this view, we used the empirical methodology to justify thresholds actually set by operators.

The estimations and results of this article would contribute not only to capturing relationships in the market with the bit/data cap we actually face, but would also give the regulatory agency a regulatory instrument to benchmark. The contribution also showed that this analysis would give some reasons for operators to rationalize thresholds they actually set.

Through our estimations, settings of MON and PMBIT were more likely to be set by the capacity that could be accessed without congestion or other concerns on quality of service. Estimations all in chapter 4 suggested that PMBIT might be one of the effective indicator of bit/data cap because the variable is statistically significant.

According to the estimations in the newer data, the bit/data cap is statistically almost nothing to do with any variables; the speeds, the measured price, the monthly price, or its interactive effect. In other words, the bit/data cap sets arbitrary. However, the down link speed showed high correlation between the factors, and the estimations and results are statistically significant. Therefore, the conditions in the data plans are closely related to the downlink speed.

Conclusion

This thesis analyzed the incentive in the telecommunications market with the traits of the network and we showed that the incentive influences indirectly. We also analyzed to what degree the qualitative factors affect the market. The normative reviews showed the direct effect to the price and the quantity, and we tried to find the influential and additional factors in practices in the market, and we showed the indirect effects as the incentive exists in the practice of the year(s) contract that we strongly are encouraged by the telecom operators.

The incentive described in the empirical model showed that the factors we considered are statistically significant and we got preferable results. The relationship between the factors in the empirical analysis implies that the factors affect the retail price, ARPU, and the Bit/Data cap and the downlink speed. And those factors shown are also influence other factors as independent variables in other models in this thesis.

In 4.3, we considerd logit and probit models which could set a threshold of bit/data cap at different levels derived from sample basic statistics: the standard deviation level, the mean level, the 5GB level, and the 2GB level. The cap set at the mean level showed the most reliable results the logit model. the dispersion of the dataset may influence the reliability. the good results in the logit model may come from the mean value itself because the mean value is a statistically favorable data. The mean level of the Bit/Data cap is almost the same amount of the bit/data cap that is popular in Japan.

The results in the probit model showed that the bit/data cap at 5GB is the most reliable. the the cap at the mean level was the second reliable results. The cause of the most reliable results in the probit model in the 5GB level seem to be the same reason but the different view. The bit/datacap at 5GB level is the level that is popular in the US and other countries. Taking the non-linear characteristics of the probit model into consideration, 5GB is set deliberatelyby operators. Setting the cap at 5GB was not that rational in our analysis, so the dataset may show some dispersion by the arbiterariness of operators.

Furthermore, PMBIT showed negative value in the logit madel, while the factor showed positive in the probit model. This may be caused by the dataset. That is why, the probit model is preferable because the probit model is non-linear estimation.

As shown in 4.4, the estimations and the results in the newer data showed that the downlink speed showed close relationships with the factors we set. In other words, various services could be provided if the conditons were highly related and highly differentiated according to the downlink speed. However, the charging scheme in the wireline optical fiber access services and wireless data services could be possible to differentiate those services according to the generations of its standards, but the differentiation of services is not enough in the market in practice.

As we also showed in section 4.4, customers may choose a technology less than their willingness to pay unless the downlink shows some diversification even though the diversification in the downlink speed corellates the price. In this case, there is no loss for the installed base, but the transition to the newer technology may cause higher switching costs. Consequently, the choice within the willingness to pay may make us difficult to choose a new technology.

As for policymaking, the role of the regulatory agency chaged from rulemaking as a market maker to the monitoring agency after the introduction of competition. The market has been under the cost reduction incentive since the nationalized and monopolistic market conditons in the 1980's becomes competitive and now shows exponentially growing data traffic demand especially in the mobile market. Therefore, more affordable and unconditional mobile data comunications are extremely demanded in the market.

In competition, interferences in any ways in the market are not favorable even though the conditions in practice are seemingly distorting the market indirectly or having the power to restrict customer's freedom in the market. Those conditions are tend to be allowed as long as the conditions are fairly applied, and there is no barriers to terminate or no coersive conditions to customers. Therefore, the change in the role for the regulatory agencies implies that there is no such a mechanism to correct distortions or malpractices implemented marketwide.

Appendix A

Country	Company	Plan	Downkbits	Upkbits	BitcapMB	Minutestor	USDpricem	PMbitsUSD	dum_5GB	dum_mean	dum_dev	dum_2GB	
Australia	Bigpond/Te	BigPond Elite 2GB	30720	1000	2000	8.888889	32.68979	1.63449	0	0	0	0	
Australia	Bigpond/Te	BigPond Elite 2GB	20480	1000	2000	13.33333	32.68979	1.08966	0	0	0	0	
Australia	Bigpond/Te	BigPond Turbo 2GB	8192	256	2000	33.33333	26.14529	3.268161	0	0	0	0	
Australia	Bigpond/Te	BigPond Turbo 2GB	1536	128	2000	177.7778	26.14529	17.43019	0	0	0	0	
Australia	Internode	Home-512-Starter	512	128	5000	1333.333	26.14529	52.29058	0	0	0	1	
Australia	Internode	Home-NakedExtreme-10	24576	1000	10000	55.55556	32.68979	1.362075	1	0	0	1	
Australia	Internode	Home-UltraBundle-10	20480	820	10000	66.66667	39.20157	1.960079	1	0	0	1	
Australia	Internode	Home-NakedUltra-10	20480	820	10000	66.66667	32.68979	1.63449	1	0	0	1	
Australia	Internode	Home-FibreHigh-15	102400	2000	15000	20	52.3233	0.523233	1	0	0	1	
Australia	Internode	Home-FibreMid-15	51200	8000	15000	40	39.23429	0.784686	1	0	0	1	
Australia	Internode	Home-FibreEntry-15 (standard plan)	25600	4000	15000	80	32.68979	1.307592	1	0	0	1	
Australia	Internode	Home-Fast-25	24576	1000	25000	138.8889	65.37958	2.724149	1	0	0	1	
Australia	Internode	Home-Standard-25	1536	256	25000	2222.222	52.29058	34.86038	1	0	0	1	
Australia	Internode	Home-FibreHigh-30	102400	0	30000	40	58.8678	0.588678	1	0	0	1	
Australia	Internode	Home-FibreMid-30	51200	1000	30000	80	45.7788	0.915576	1	0	0	1	
Australia	Internode	Home-FibreEntry-30	25600	2000	30000	160	39.23429	1.569372	1	0	0	1	
Australia	Internode	Home-Extreme-30	24576	8000	30000	166.6667	45.74607	1.906086	1	0	0	1	
Australia	Optus	30GB Broadband + Home Phone	20480	4000	30000	200	45.74607	2.287304	1	0	0	1	
Australia	Bigpond/Te	BigPond Turbo 50GB	30720	1000	50000	222.2222	52.3233	1.74411	1	0	0	1	
Australia	Internode	Easy Broadband	24576	1000	50000	277.7778	52.29058	2.178774	1	0	0	1	
Australia	Internode	Home-Fast-50	24576	1000	50000	277.7778	85.01309	3.542212	1	0	0	1	
Australia	Bigpond/Te	BigPond Turbo 50GB	20480	1000	50000	333.3333	85.01309	3.542212	1	0	0	1	
Australia	Internode	Home-Standard-50	1536	256	50000	4444.444	58.83508	39.22339	1	0	0	1	
Australia	Internode	Home-FibreHigh-60	102400	2000	60000	80	65.4123	0.654123	1	0	0	1	
Australia	Internode	Home-FibreMid-60	51200	8000	60000	160	52.3233	1.046466	1	0	0	1	
Australia	Internode	Home-FibreEntry-60	25600	4000	60000	320	45.7788	1.831152	1	0	0	1	
Australia	Internode	Home-NakedExtreme-60	24576	1000	60000	333.3333	45.7788	1.90745	1	0	0	1	
Australia	Internode	Home-UltraBundle-60	20480	820	60000	400	52.29058	2.614529	1	0	0	1	
Australia	Internode	Home-NakedUltra-60	20480	820	60000	400	45.7788	2.28894	1	0	0	1	
Australia	Internode	Home-FibreHigh-100	102400	1000	100000	133.3333	78.50131	0.785013	1	1	1	1	
Australia	Internode	Home-FibreMid-100	51200	2000	100000	266.6667	65.4123	1.308246	1	1	1	1	
Australia	Internode	Home-FibreEntry-100	25600	8000	100000	533.3333	58.8678	2.354712	1	1	1	1	
Australia	Internode	Home-NakedExtreme-100	24576	4000	100000	555.5556	58.8678	2.452825	1	1	1	1	
Australia	Internode	Home-Fast-100	24576	1000	100000	555.5556	111.1911	4.632963	1	1	1	1	
Australia	Internode	Home-UltraBundle-60	20480	820	100000	666.6667	65.37958	3.268979	1	1	1	1	
Australia	Internode	Home-NakedUltra-100	20480	256	100000	666.6667	58.8678	2.94339	1	1	1	1	
Australia	Internode	Home-Standard-100	1536	820	100000	8888.889	85.01309	56.67539	1	1	1	1	
Australia	Optus	Naked (Standalone) Broadband 14 GB	20480	0	120000	800	39.26047	1.963024	1	1	1	1	
Australia	Optus	Naked (Standalone) Broadband 30 GB	20480	0	150000	1000	45.80497	2.290249	1	1	1	1	
Australia	Optus	Naked (Standalone) Broadband 60 GB	20480	0	170000	1133.333	52.34948	2.617474	1	1	1	1	
Australia	Internode	Home-Fibrehigh-200	102400	1000	200000	266.6667	104.6793	1.046793	1	1	1	1	
Australia	Internode	Home-FibreMid-200	51200	1000	200000	533.3333	87.00916	1.740183	1	1	1	1	
Australia	Bigpond/Te	BigPond Elite 200GB	30720	2000	200000	888.8889	65.4123	3.270615	1	1	1	1	
Australia	Internode	Home-FibreEntry-200	25600	8000	200000	1066.667	85.04581	3.401833	1	1	1	1	
Australia	Bigpond/Te	BigPond Elite 200GB	20480	4000	200000	1333.333	65.4123	3.270615	1	1	1	1	
Australia	Internode	Home-NakedExtreme-240	24576	1000	240000	1333.333	71.95681	2.9982	1	1	1	1	
Belgium	Base	home internet 1	1024	256	1000	133.3333	27.68549	27.68549	0	0	0	0	
Belgium	Telenet	BasicNet	4096	400	15000	500	20.93023	5.232558	1	0	0	1	
Belgium	Belgacom	Internet Start	3072	2115.6	15000	666.6667	35.09136	11.69712	1	0	0	1	
Belgium	Telenet	ComfortNet	15360	1000	50000	444.4444	33.93134	2.262089	1	0	0	1	
Belgium	Belgacom	Internet Comfort	12288	1500	50000	555.5556	31.95367	2.662806	1	0	0	1	
Belgium	Telenet	ExpressNet	30720	1250	80000	355.5556	47.51938	1.583979	1	1	0	1	
Belgium	Belgacom	Internet Favorite	25600	3500	100000	533.3333	41.07143	1.642857	1	1	1	1	
Canada	Bell Canad	Essential Plus	2048	800	2000	133.3333	30.70952	15.35476	0	0	0	0	
Canada	Rogers	Ultra-lite	512	256	2000	533.3333	28.49365	56.98731	0	0	0	0	
Canada	Shaw	High-speed lite	1024	256	13000	1733.333	28.46705	28.46705	1	0	0	1	
Canada	Rogers	Lite	3072	256	15000	666.6667	35.84923	11.94974	1	0	0	1	
Canada	Bell Canad	Performance	6144	1000	25000	555.5556	39.90399	6.650665	1	0	0	1	
Canada	Bell Canad	Fibe12	12288	1000	50000	555.5556	46.79984	3.899986	1	0	0	1	
Canada	Bell Canad	Fibe12 + option 7Mbps upload	12288	7000	50000	555.5556	51.39707	4.283089	1	0	0	1	
Canada	Rogers	Express	10240	512	60000	800	45.96314	4.596314	1	0	0	1	
Canada	Bell Canad	Fibe25	25600	1000	75000	400	55.9943	3.499644	1	1	0	1	
Canada	Bell Canad	Fibe16	16384	7000	75000	625	60.59154	3.786971	1	1	0	1	
Canada	Bell Canad	Fibe16 + option 7Mbps upload	16384	7000	75000	625	64.26933	2.570773	1	1	0	1	
Canada	Shaw	High-speed	7680	512	75000	1333.333	39.7502	5.300027	1	1	0	1	
Canada	Rogers	Extreme	15360	1000	80000	711.1111	61.59374	4.106249	1	1	0	1	
Canada	Rogers	Extreme Plus	25600	1000	125000	666.6667	70.7882	2.831528	1	1	1	1	
Canada	Shaw	High-Speed Extreme	15360	1000	125000	1111.111	48.8633	3.257554	1	1	1	1	
Canada	Rogers	Ultimate	51200	2000	175000	466.6667	98.3716	1.967432	1	1	1	1	
Canada	Shaw	Warp	51200	3000	250000	666.6667	97.51017	1.950203	1	1	1	1	
Canada	Shaw	Nitro	102400	5000	500000	666.6667	145.8096	1.458096	1	1	1	1	
Hungary	T-Home	Kezdo (DSL Kezdo)	5120	2500	1000	26.66667	28.43697	5.687393	0	0	0	0	
Hungary	T-Home	Kezdo (Kabelnet Kezdo)	5120	21838	1000	26.66667	28.43697	5.687393	0	0	0	0	
Hungary	T-Home	Kezdo (Optinet Kezdo)	5120	2918.703	1000	26.66667	28.43697	5.687393	0	0	0	0	
Hungary	T-Home	Maximum (Kabelnet Maximum)	81920	500	350000	583.3333	72.49864	0.906233	1	1	1	1	
Hungary	T-Home	Super (Kabelnet Super)	51200	5000	350000	933.3333	66.24876	1.324975	1	1	1	1	
Hungary	T-Home	Extra (Kabelnet Extra)	25600	5000	350000	1866.667	0	0	1	1	1	1	
Hungary	T-Home	Csaladi (Kabelnet Csaladi)	15360	400	350000	3111.111	0	0	1	1	1	1	*
Hungary	T-Home	Alap (Kabelnet Alap)	5120	400	350000	9333.333	34.99934	6.999869	1	1	1	1	*
Iceland	Siminn	Grunnaskrift	12288	12000	1000	11.11111	26.19063	2.182553	0	0	0	0	*
Iceland	Vodafone	Huggulega 1GB	12288	12000	1000	11.11111	26.19063	2.182553	0	0	0	0	*
Iceland	TAL	DSL 1GB	12288	12000	1000	11.11111	26.19063	2.182553	0	0	0	0	*
Iceland	Vodafone	Huggulega netid - meiri hradi	51200	0	10000	26.66667	0	0	1	0	0	1	*
Iceland	TAL	FTTH 10GB net	51200	0	10000	26.66667	0	0	1	0	0	1	*
Iceland	Siminn	Leid 1	12288	12000	10000	111.1111	21.51373	0.430275	1	0	0	1	*
Iceland	Vodafone	Huggulega 10GB	12288	12000	10000	111.1111	21.51373	0.430275	1	0	0	1	*
Iceland	TAL	DSL 10GB	12288	12000	10000	111.1111	21.51373	0.430275	1	0	0	1	*
Iceland	TAL	DSL 20GB	12288	12000	20000	222.2222	37.703	3.141916	1	0	0	1	*
Iceland	Vodafone	Flotta netid - meiri hradi	51200	50000	30000	80	28.70896	0.574179	1	0	0	1	*
Iceland	TAL	FTTH 30GB net	51200	50000	30000	80	28.70896	0.574179	1	0	0	1	*
Iceland	Vodafone	Flotta netid	12288	50000	30000	333.3333	43.45918	3.621598	1	0	0	1	*
Iceland	TAL	FTTH 60GB net	51200	820	60000	160	33.0261	0.660522	1	0	0	1	*

Iceland	Siminn	Leid 2	12288	12000	60000	666.6667	58.0511	4.837592	1	0	0	1	*
Iceland	TAL	DSL 60GB	12288	12000	60000	666.6667	44.89822	3.741519	1	0	0	1	*
Iceland	Vodafone	Ofurnetid – meiri hradi	51200	50000	70000	186.6667	57.13011	1.142602	1	0	0	1	*
Iceland	Vodafone	Ofurnetid 70GB	12288	50000	70000	777.7778	50.65441	4.221201	1	0	0	1	*
Iceland	TAL	FTTH 80GB net	51200	50000	80000	213.3333	40.22133	0.804427	1	1	0	1	*
Iceland	TAL	DSL 80GB	12288	12000	80000	888.8889	52.09345	4.341121	1	1	0	1	*
Iceland	Vodafone	Enn meira nidurhal	51200	50000	120000	320	59.28868	4.940723	1	1	1	1	*
Iceland	TAL	FTTH 120GB net	51200	50000	120000	320	59.28868	4.940723	1	1	1	1	*
Iceland	Siminn	Leid 3	16384	1024	120000	1000	66.68537	4.167836	1	1	1	1	*
Iceland	Vodafone	Enn meira nidurhal	12288	12000	120000	1333.333	59.28868	4.940723	1	1	1	1	*
Iceland	TAL	DSL 120GB	12288	12000	120000	1333.333	59.28868	4.940723	1	1	1	1	*
Ireland	Eircom	Up to 1Mb home broadband	1024	1000	10000	1333.333	39.7446	39.7446	1	0	0	1	*
Ireland	Irish Broad	Imagine up to 1Mb	1024	1000	10000	1333.333	43.32269	43.32269	1	0	0	1	
Ireland	Irish Broad	Imagine up to 3Mb	3072	3000	20000	888.8889	49.56778	16.52259	1	0	0	1	
Ireland	Irish Broad	Imagine up to 7Mb	7782.4	7600	30000	526.3158	59.39096	7.8146	1	0	0	1	
Ireland	Eircom	Up to 3Mb home broadband	3072	3000	30000	1333.333	48.23428	16.07809	1	0	0	1	
Ireland	Eircom	Up to 7Mb home broadband	7168	7000	50000	952.381	57.15373	8.164819	1	0	0	1	
Ireland	Eircom	Up to 24Mb home broadband	24576	24000	75000	416.6667	65.91601	2.746501	1	1	0	1	
Ireland	UPC Irelan	30Mb Broadband Ultra	30720	15000	120000	533.3333	39.04715	2.603143	1	1	1	1	
Ireland	UPC Irelan	15Mb Broadband Express	15360	30000	120000	1066.667	48.87033	1.629011	1	1	1	1	
Ireland	UPC Irelan	8Mb Broadband Value	8192	8000	120000	2000	32.17092	4.021365	1	1	1	1	
Luxembour	EPT	LuxDSL Junior	5120	512	2000	53.33333	53.4606	10.69212	0	0	0	0	
Luxembour	Numericabl	Internet 3 Mega	3072	256	3000	133.3333	33.3682	11.12273	0	0	0	1	
Luxembour	EPT	LuxDSL Run	10240	640	15000	200	72.28905	7.228905	1	0	0	1	
New Zealar	Telecom	Go	24576	0	3000	16.66667	55.62613	2.317756	0	0	0	1	
New Zealar	Vodafone	Easy Pack	24576	1000	5000	27.77778	42.34725	1.764469	0	0	0	1	
New Zealar	Telecom	Explorer	24576	0	10000	55.55556	61.67574	2.569823	1	0	0	1	
New Zealar	Vodafone	Ideal Pack	24576	1000	10000	55.55556	48.39685	2.016536	1	0	0	1	
New Zealar	Vodafone	Ideal Naked	24576	1000	10000	55.55556	48.39685	2.016536	1	0	0	1	
New Zealar	Telecom	Adventure	24576	0	20000	111.1111	67.72535	2.82189	1	0	0	1	
New Zealar	TelstraClea	LightSpeed 20G	15360	1000	20000	177.7778	33.84755	2.256503	1	0	0	1	
New Zealar	Vodafone	Ultimate Pack	24576	1000	30000	166.6667	67.72535	2.82189	1	0	0	1	
New Zealar	Vodafone	Ultimate Nacked	24576	1000	30000	166.6667	51.42166	2.142569	1	0	0	1	
New Zealar	Telecom	Pro	24576	1000	40000	222.2222	79.82456	3.326023	1	0	0	1	
New Zealar	TelstraClea	LightSpeed 40G	15360	0	40000	355.5556	33.84755	2.256503	1	0	0	1	
New Zealar	TelstraClea	LightSpeed 60G	15360	2000	60000	533.3333	58.04598	3.869732	1	0	0	1	
New Zealar	TelstraClea	LightSpeed 90G	15360	2000	90000	800	84.66425	5.644283	1	1	1	1	
New Zealar	TelstraClea	WarpSpeed 120G	25600	2000	120000	640	127.0115	5.08046	1	1	1	1	
Portugal	Zon	Zon Net SD Net	5120	256	10000	266.6667	42.12079	8.424157	1	0	0	1	
Portugal	Clix	Pack ADSL Net Outras Zonas + Telefone	1024	128	12000	1600	56.61517	56.61517	1	0	0	1	
Portugal	Clix	Pack ADSL Net Outras Zonas + Telefone	8124	512	50000	840.3086	71.9382	9.067543	1	0	0	1	
Portugal	Clix	Pack Fibra Net + Telefone	30720	1024	60000	266.6667	26.90602	1.121084	1	0	0	1	
Portugal	Clix	Pack ADSL Net + Telefone Sem assinatura	24576	3000	60000	333.3333	40.36575	1.345525	1	0	0	1	
Portugal	Clix	Pack ADSL Net Outras Zonas + Telefone	24576	1024	100000	555.5556	98.0618	4.085908	1	1	1	1	
Portugal	Clix	Pack Fibra Net + Telefone	102400	10000	200000	266.6667	53.82549	0	1	1	1	1	
Portugal	Clix	Pack Fibra Net + Telefone	102400	10000	200000	266.6667	67.28523	0	1	1	1	1	
Slovak Rep	T-Com	Optik 1	10240	512	2000	26.66667	14.5	1.45	0	0	0	0	
Slovak Rep	T-Com	Turbo 2 Mini	2048	256	2000	133.3333	14.5	1.45	0	0	0	0	
Slovak Rep	T-Com	Turbo 2 Mini Solo + (faster upload)	2048	256	2000	133.3333	19.33871	9.669355	0	0	0	0	
Slovak Rep	T-Com	Turbo 2 Mini	2048	512	2000	133.3333	14.5	7.25	0	0	0	0	
Slovak Rep	T-Com	Turbo 2 Mini + (faster upload)	2048	512	2000	133.3333	14.5	7.25	0	0	0	0	
Slovak Rep	T-Com	Optik 2	20480	1000	120000	800	25.3871	1.269355	1	1	1	1	
Slovak Rep	T-Com	Turbo 3 Solo	3584	256	120000	4571.429	37.48387	10.70968	1	1	1	1	
Slovak Rep	T-Com	Turbo 3 Solo + (faster upload)	3584	512	120000	4571.429	37.48387	10.70968	1	1	1	1	
Slovak Rep	T-Com	Turbo 3	3584	256	120000	4571.429	35.06452	10.01843	1	1	1	1	
Slovak Rep	T-Com	Turbo 3 + (faster upload)	3584	512	120000	4571.429	35.06452	10.01843	1	1	1	1	
Slovak Rep	T-Com	Turbo 2 Solo	2048	256	120000	8000	27.80645	13.90323	1	1	1	1	
Slovak Rep	T-Com	Turbo 2 Solo + (faster upload)	2048	512	120000	8000	27.80645	13.90323	1	1	1	1	
Slovak Rep	T-Com	Turbo 2	2048	256	120000	8000	25.3871	12.69355	1	1	1	1	
Slovak Rep	T-Com	Turbo 2 + (faster upload)	2048	512	120000	8000	25.3871	12.69355	1	1	1	1	
Slovak Rep	T-Com	Optik 4	81920	2000	240000	400	45.95161	0.574395	1	1	1	1	
Slovak Rep	T-Com	Optik 3	40960	4000	240000	800	36.27419	0.906855	1	1	1	1	
Slovak Rep	T-Com	Turbo 4 Solo	12288	512	240000	2666.667	48.37097	4.030914	1	1	1	1	
Slovak Rep	T-Com	Turbo 4	12288	512	240000	2666.667	45.95161	3.829301	1	1	1	1	
Spain	Telefonica	Movistar kit ADSL Mini	1024	320	2000	266.6667	51.23923	51.23923	0	0	0	0	
Spain	Telefonica	Movistar kit ADSL 1 Mb	1024	256	20000	2666.667	66.36744	66.36744	1	0	0	1	
Turkey	Turksat/Uy	10 Mbps'e kadar limitli	10240	0	1000	13.33333	20.33133	2.033133	0	0	0	0	
Turkey	Turksat/Uy	5 Mbps'e kadar limitli	5120	0	1000	26.66667	0	0	0	0	0	0	
Turkey	Turksat/Uy	1 Mbps'e kadar limitli	1024	0	1000	133.3333	14.30723	14.30723	0	0	0	0	
Turkey	Superonlin	1 Mbps'e kadar limitli	10240	1000	4000	53.33333	20.64445	2.064445	0	0	0	1	
Turkey	Superonlin	8 Mbps' e kadar 4GB	8192	1000	4000	66.66667	38.27466	4.784333	0	0	0	1	
Turkey	Turk Telek	NET4	8192	1000	4000	66.66667	21.83735	2.729669	0	0	0	1	
Turkey	Turk Telek	NET4 (Plus)*	8192	1000	4000	66.66667	23.34337	2.917922	0	0	0	1	
Turkey	Superonlin	8 Mbps' e kadar 6GB	8192	1000	6000	100	38.27466	4.784333	1	0	0	1	
Turkey	Turk Telek	NET6	8192	1000	6000	100	29.36747	3.670934	1	0	0	1	
Turkey	Superonlin	NET6	20480	5000	8000	53.33333	27.54706	1.377353	1	0	0	1	
Turkey	Superonlin	NET6	50480	5000	12000	32.45642	41.35228	0.838842	1	0	0	1	
Turkey	Superonlin	8 Mbps Limitsiz	8192	250	15000	250	84.77316	10.59664	1	0	0	1	
Turkey	Superonlin	8 Mbps' e kadar Limitsiz	8192	512	15000	250	44.86352	5.60794	1	0	0	1	
Turkey	Turk Telek	8 Mbps' e kadar Limitsiz	8192	1000	15000	250	36.89759	4.612199	1	0	0	1	
Turkey	Superonlin	4 Mbps Limitsiz	4096	1000	15000	500	72.83509	18.20877	1	0	0	1	
Turkey	Superonlin	2 Mbps Limitsiz	2048	1000	15000	1000	58.76318	29.38159	1	0	0	1	
Turkey	Superonlin	1 Mbps Limitsiz	1024	1000	15000	2000	44.69785	44.69785	1	0	0	1	
Turkey	Superonlin	1 Mbps Limitsiz	102400	5000	16000	21.33333	62.06012	0.620601	1	0	0	1	
Turkey	Superonlin	1 Mbps Limitsiz	10240	1000	50000	666.6667	34.44967	3.444967	1	0	0	1	
Turkey	Superonlin	1 Mbps Limitsiz	20480	5000	100000	666.6667	48.2549	2.412745	1	1	1	1	
Turkey	Superonlin	1 Mbps Limitsiz	50480	5000	250000	676.1754	68.96273	1.398927	1	1	1	1	
Turkey	Superonlin	1 Mbps Limitsiz	102400	5000	500000	666.6667	137.9888	1.379888	1	1	1	1	
United King	BT	Option 1	20480	0	10000	66.66667	38.14371	1.907186	1	0	0	1	
United King	BT	BT Infinity Option 1	40960	2000	40000	133.3333	44.13174	1.103293	1	0	0	1	
United King	BT	Option 2	20480	0	40000	266.6667	45.62874	2.281437	1	0	0	1	
United King	Sky	Sky Broadband Unlimited with Sky Talk	20480	1300	40000	266.6667	31.43713	1.571856	1	0	0	1	
United King	Sky	Sky Broadband Unlimited without Sky Talk	20480	1300	40000	266.6667	22.45509	1.122755	1	0	0	1	

* information are added from telecom operators' websites

Source: OECD Communications Outlook 2011, OECD Broadband Statistics Sep. 2010, and Telecom Operators' Websites

Appendix B

Country	Company	Type	Plan	Downkbits	Upkbits	BitcapMB	MON	PMBIT	cap_up	cap_PMb	cap_mon	up_mon	up_PMb	mon_PMb
Australia	Internode	A	Easy Naked 1000	24576	2048	1000000	96.19	3.91	2.05E+09	3914155	9.62E+07	197005.8	8016.188	376.5192
Australia	Internode	F	NBNTP Bronze 1000	12288	1024	1000000	94.81	7.72	1.02E+09	7715398	9.48E+07	97082.17	7900.567	731.4723
Australia	Internode	F	NBNTP Silver 1000	25600	5120	1000000	101.13	3.95	5.12E+09	3950366	1.01E+08	517782.4	20225.88	399.498
Australia	Internode	F	NBNTP Gold 1000	51200	20480	1000000	107.45	2.1	2.05E+10	2098671	1.07E+08	2200616	42980.77	225.5062
Australia	Internode	F	NBNTP Platinum 1000	102400	40960	1000000	120.1	1.17	4.10E+10	1172823	1.20E+08	4919176	48038.82	140.8526
Australia	Optus	A	500GB Naked	20480	640	500000	69.46	3.39	3.20E+08	1695741	3.47E+07	44452.84	2170.549	235.5641
Australia	BigPond/T	A	Elite Liberty 500GB Standalone (without Telstra	20480	1024	500000	98.27	4.8	5.12E+08	2399153	4.91E+07	100627.8	4913.464	471.5261
Australia	BigPond/T	C	Elite Liberty 500GB Standalone (without Telstra	30720	1024	500000	98.27	3.2	5.12E+08	1599435	4.91E+07	100627.8	3275.643	314.3507
Australia	Internode	A	Easy Naked 300	24576	2048	300000	64.58	2.63	6.14E+08	788347.8	1.94E+07	132262.8	5381.788	169.7088
Australia	Internode	F	NBNTP Bronze 300	12288	1024	300000	63.19	5.14	3.07E+08	1542822	1.90E+07	64710.66	5266.167	324.9904
Australia	Internode	F	NBNTP Silver 300	25600	5120	300000	69.52	2.72	1.54E+09	814647.3	2.09E+07	355924.8	13903.31	188.7716
Australia	Internode	F	NBNTP Gold 300	51200	20480	300000	75.84	1.48	6.14E+09	444369.9	2.28E+07	1553185	30335.65	112.3354
Australia	Internode	F	NBNTP Platinum 300	102400	40960	300000	88.48	0.86	1.23E+10	259231.2	2.65E+07	3624315	35393.7	76.45959
Australia	Internode	A	Easy Reach 250	20480	1024	250000	104.38	5.1	2.56E+08	1274194	2.61E+07	106887.1	5219.099	532.0116
Australia	BigPond/T	A	Elite Liberty 200GB Standalone (without Telstra	20480	1024	200000	85.62	4.18	2.05E+08	836173.5	1.71E+07	87679.15	4281.208	357.9833
Australia	BigPond/T	C	Elite Liberty 200GB Standalone (without Telstra	30720	1024	200000	85.62	2.79	2.05E+08	557449	1.71E+07	87679.15	2854.139	238.6555
Australia	Internode	A	Easy Naked 200	24576	2048	200000	51.94	2.11	4.10E+08	422658.9	1.04E+07	106365.6	4328.027	109.7568
Australia	Internode	F	NBNTP Bronze 200	12288	1024	200000	50.55	4.11	2.05E+08	822735.7	1.01E+07	51762.05	4212.407	207.9418
Australia	Internode	F	NBNTP Silver 200	25600	5120	200000	56.87	2.22	1.02E+09	444308.1	1.14E+07	291181.8	11374.29	126.3422
Australia	Internode	F	NBNTP Gold 200	51200	20480	200000	63.19	1.23	4.10E+09	246851.6	1.26E+07	1294213	25277.6	77.9977
Australia	Internode	F	NBNTP Platinum 200	102400	40960	200000	75.84	0.74	8.19E+09	148123.3	1.52E+07	3106371	30335.65	56.16771
Australia	Optus	A	150GB Naked	20480	640	150000	63.13	3.08	9.60E+07	462414.5	9470249	40406.39	1972.969	194.6302
Australia	Optus	A	120GB Naked	20480	640	120000	56.81	2.77	7.68E+07	332885.3	6817492	36359.96	1775.388	157.6002
Australia	Internode	A	Easy Reach 100	20480	1024	100000	72.77	3.55	1.02E+08	355318.2	7276917	74515.63	3638.458	258.5621
Australia	Internode	A	Easy Reach 60	20480	1024	60000	60.12	2.94	6.14E+07	176144.7	3607443	61567.02	3006.202	176.5089
Australia	BigPond/T	A	Elite Liberty 50GB Standalone (without Telstra	20480	1024	50000	72.98	3.56	5.12E+07	178171.5	3648952	74730.54	3648.952	260.0557
Australia	BigPond/T	C	Elite Liberty 50GB Standalone (without Telstra	30720	1024	50000	72.98	2.38	5.12E+07	118781	3648952	74730.54	2432.635	173.3705
Australia	Internode	A	Easy Naked 30	24576	2048	30000	39.29	1.6	6.14E+07	47962.9	1178736	80468.39	3274.267	62.81734
Australia	Internode	F	NBNTP Bronze 30	12288	1024	30000	37.9	3.08	3.07E+07	92538.47	1137113	38813.45	3158.646	116.9185
Australia	Internode	F	NBNTP Silver 30	25600	5120	30000	44.23	1.73	1.54E+08	51827.72	1326790	226438.8	8845.264	76.40497
Australia	Internode	F	NBNTP Gold 30	51200	20480	30000	50.55	0.99	6.14E+08	29618.48	1516466	1035241	20219.55	49.90604
Australia	Internode	F	NBNTP Platinum 30	102400	40960	30000	63.19	0.62	1.23E+09	18513.87	1895820	2588426	25277.6	38.99885
Australia	BigPond/T	A	Elite Liberty 5GB Standalone (without Telstra phone	20480	1024	5000	60.33	2.95	5120000	14729.96	301669.6	61781.94	3016.696	177.7433
Australia	BigPond/T	C	Elite Liberty 5GB Standalone (without Telstra phone	30720	1024	5000	60.33	1.96	5120000	9819.975	301669.6	61781.94	2011.131	118.4955
Australia	Internode	A	Easy Reach 5	20480	1024	5000	53.8	2.63	5120000	13135.13	269007.4	55092.72	2690.074	141.3379
Austria	Tele2	A	ADSL 3GB	2048	384	3000	44.52	21.74	1152000	65214.82	133560	17095.67	8347.497	967.7875
Belgium	Belgacom	A	Internet Comfort	15360	2560	100000	37.21	2.42	2.56E+08	242238.2	3720779	95251.93	6201.297	90.13146
Belgium	Telenet	F	Fibernet	50000	2048	100000	50.25	1.01	2.05E+08	100508.5	5025425	102920.7	2058.414	50.50979
Belgium	Belgacom	A	Internet Start	3072	400	50000	28.56	9.3	2.00E+07	464914.8	1428218	11425.75	3719.319	265.6
Belgium	Telenet	C	Basicnet	20480	1280	50000	28.56	1.39	6.40E+07	69737.23	1428218	36562.39	1785.273	39.83999
Belgium	Base	A	Home Internet 1	1024	0	1000	37.15	36.28	0	36278.77	37149.46	0	0	1347.737
Canada	Shaw	C	Broadband 250	256000	15360	1000000	97.62	0.38	1.54E+10	381314.6	9.76E+07	1499390	5856.991	37.2226
Canada	Shaw	C	Broadband 100+	102400	5120	750000	80.62	0.79	3.84E+09	590514.9	6.05E+07	412799.8	4031.248	63.48032
Canada	Shaw	C	Broadband 100	102400	5120	500000	72.13	0.7	2.56E+09	352193.3	3.61E+07	369301.4	3606.459	50.80682
Canada	Shaw	C	Broadband 50	51200	3072	400000	63.63	1.24	1.23E+09	497135.9	2.55E+07	195481.8	3818.004	79.08613
Canada	Shaw	C	Extreme	25600	1024	250000	50.13	1.96	2.56E+08	489503	1.25E+07	51328.11	2005.004	98.14557
Canada	Rogers	C	Ultimate	51200	2048	250000	87.66	1.71	5.12E+08	428031.7	2.19E+07	179529.5	3506.435	150.0865
Canada	Rogers	C	Extreme Plus	32768	1024	150000	62.17	1.9	1.54E+08	284607.9	9326031	63665.71	1942.923	117.9672
Canada	Shaw	C	High Speed	7680	512	125000	41.63	5.42	6.40E+07	677560.7	5203666	21314.21	2775.289	225.6512
Canada	Rogers	C	Extreme	24576	1024	100000	53.68	2.18	1.02E+08	218415.4	5367776	54966.03	2236.573	117.2405
Canada	Bell	A	Fibe 16	16384	1024	75000	53.34	3.26	7.68E+07	244162.8	4000363	54618.28	3333.635	173.6426
Canada	Bell	A	Fibe 25	25600	7168	75000	61.83	2.42	5.38E+08	181154.1	4637546	443225.7	17313.51	149.353
Canada	Rogers	C	Express	12288	512	60000	42.63	3.47	3.07E+07	208170.1	2557995	21828.22	1776.385	147.9162
Canada	Bell	A	Fibe 12	12288	1024	50000	44.84	3.65	5.12E+07	182464.1	2242119	45918.6	3736.865	163.6425
Canada	Shaw	C	High Speed Lite	1024	256	30000	31.43	30.7	7680000	920929.4	943031.7	8047.204	7858.598	964.9618
Canada	Bell	A	Performance	6144	1024	25000	37.76	6.15	2.56E+07	153656.3	944064.2	38668.87	6293.761	232.0982
Canada	Rogers	C	Lite	3072	256	15000	33.29	10.84	3840000	162538.5	499318.3	8521.699	2773.99	360.7042
Canada	Bell	A	Essential Plus	2048	800	2000	29.27	14.29	1600000	28580.85	58533.57	23413.43	11432.34	418.2347
Canada	Rogers	C	Ultra Ligt	512	256	2000	26.49	51.74	512000	103481.5	52982.52	6781.763	13245.63	1370.678
Chile	VTR	C	Banda Ancha Mega 1	1024	512	3000	30.74	30.01	1536000	90044.15	92205.21	15736.36	15367.53	922.5043
Denmark	Stofa.dk	C	FlatRate 110000/11000	110000	11000	500000	51.24	0.47	5.50E+09	232901.5	2.56E+07	563621.6	5123.833	23.86696
Hungary	UPC	F	Fiber Power 10	10240	1024	5120000	15.87	1.55	5.24E+09	7935725	8.13E+07	16252.37	1587.145	24.5999
Hungary	T-Home	C	DSL Kezdo	5120	512	1000	23.88	4.66	512000	4664.119	23880.29	12226.71	2388.029	111.3805
Hungary	T-Home	A	DSL Kezdo	5120	512	1000	23.88	4.66	512000	4664.119	23880.29	12226.71	2388.029	111.3805
Hungary	T-Home	F	DSL Kezdo	5120	2560	1000	23.88	4.66	2560000	4664.119	23880.29	61133.54	11940.15	111.3805
Iceland	Siminn	A	Leid 4 - 4 - without	51200	15360	140000	62.17	1.21	2.15E+09	169994	8703694	954919.6	18650.77	75.48858
Iceland	Vodafone	A	Internet 140 without	12288	1024	140000	59.8	4.87	1.43E+08	681313.3	8371977	61235.03	4983.32	291.0173
Iceland	Siminn	A	Leid 4 - 4 - without	16384	1024	120000	65.65	4.01	1.23E+08	480832.7	7877963	67225.28	4103.105	263.0543
Iceland	Hringidan	A	ADSL 18Mb/120GB without	18432	1024	120000	63.44	3.44	1.23E+08	413000.7	7612428	64959.39	3524.272	218.329
Iceland	Siminn	A	Leid 3 - 3 - without	51200	15360	80000	53.82	1.05	1.23E+09	84087.78	4305295	826616.5	16144.85	56.56604
Iceland	Vodafone	A	Internet 80 without	12288	1024	80000	52.14	4.24	8.19E+07	339471.7	4171429	53394.29	4345.238	221.2628
Iceland	Hringidan	A	ADSL 12Mb/80GB without	12288	1024	80000	54.7	4.45	8.19E+07	356126.2	4376079	56013.81	4558.416	243.5057
Iceland	Siminn	A	Leid 3 - 3 - without	12288	820	60000	57.3	4.66	4.92E+07	279768.7	3437798	46983.23	3823.505	267.1633
Iceland	Siminn	A	Leid 2 - 2 - without	51200	15360	50000	46.86	0.92	7.68E+08	45757.12	2342765	719697.3	14056.59	42.87926
Iceland	Siminn	A	Leid 2 - 2 - without	12288	820	40000	50.34	4.1	3.28E+07	163853.3	2013429	41275.3	3358.993	206.1919
Iceland	Vodafone	A	Internet 40 without	12288	1024	40000	44.49	3.62	4.10E+07	144810.8	1779435	45553.54	3707.157	161.0509
Iceland	Hringidan	A	ADSL 12Mb/40GB without	12288	1024	40000	45.97	3.74	4.10E+07	149625.9	1838603	47068.23	3830.422	171.9391
Iceland	Hringidan	A	ADSL 12Mb/20GB without	12288	1024	20000	42.28	3.44	2.05E+07	68808.27	845515.9	43290.42	3522.983	145.4462
Iceland	Siminn	A	Leid 1 - 1 - without	12288	640	10000	43.37	3.53	6400000	35298.54	433748.5	27759.9	2259.106	153.1069
Iceland	Siminn	A	Leid 1 - 1 - without	51200	15360	10000	39.89	0.78	1.54E+08	7791.875	398944	612778	11968.32	31.08522

Iceland	Vodafone	A	Internet 10 without	12288	1024	10000	36.83	3	1.02E+07	29971.44	368289	37712.8	3069.075	110.3815
Iceland	Vodafone	A	Internet 0 without	6000	1024	4000	21.51	3.59	4096000	14343.3	86059.79	22031.31	3671.884	77.14883
Iceland	Siminn	A	Grunnaskrift - Basic - without homephone	12288	382	1000	79.57	6.48	382000	6475.542	79571.47	30396.3	2473.657	515.2684
Ireland	Vodafone	A	Ultimate Broadband	24576	512	350000	56.32	2.29	1.79E+08	802034.7	1.97E+07	28834.09	1173.262	129.051
Ireland	Vodafone	A	Ideal Broadband	8192	512	300000	49.26	6.01	1.54E+08	1803809	1.48E+07	25219.07	3078.5	296.1613
Ireland	Eircom	A	7MB	7168	384	50000	66.56	9.29	1.92E+07	464262.5	3327834	25557.76	3565.536	617.9955
Ireland	Vodafone	A	Value Broadband	8192	512	40000	41.19	5.03	2.05E+07	201107.2	1647470	21087.62	2574.172	207.0739
Ireland	Eircom	A	3MB	3072	384	30000	56.64	18.44	1.15E+07	553140.6	1699248	21750.37	7080.2	1044.359
Ireland	Eircom	A	1MB	1024	128	10000	51.6	50.39	1280000	503889.8	515983.2	6604.585	6449.79	2599.987
Ireland	Eircom	A	Next Generation Broadband	8192	512	10000	26.02	3.18	5120000	31761.26	260188.2	13321.64	1626.176	82.63905
Luxembour	Visual Onli	A	Vodsl Starter	5120	512	500000	46.31	9.05	2.56E+08	4522635	2.32E+07	23711.63	4631.178	418.9026
Luxembour	P&T	A	SpeedSurf Run - LuxDSL	10240	640	15000	48.08	4.7	9600000	70428.56	721188.5	30770.71	3004.952	225.7434
Luxembour	Numericabl	A	Internet 10 Mega	10240	256	10000	43.76	4.27	2560000	42734.43	437600.6	11202.58	1094.001	187.0061
Luxembour	P&T	A	SpeedSurf Junior - LuxDSL	5120	512	2000	29.67	5.79	1024000	11588.25	59331.82	15188.95	2966.591	171.8879
New Zealar	TelstraClea	A	WarpSpeed 120G	25600	2048	120000	90.67	3.54	2.46E+08	425004.6	1.09E+07	185687.3	7253.411	321.118
New Zealar	NZ Telecor	A	Total Home Broadband 100GB (with speed	24576	1024	100000	91.68	3.73	1.02E+08	373058.4	9168283	93883.21	3820.118	342.0305
New Zealar	NZ Telecor	A	Total Home Broadband 100GB (without speed	24576	1024	100000	91.68	3.73	1.02E+08	373058.4	9168283	93883.21	3820.118	342.0305
New Zealar	TelstraClea	A	LightSpeed 90G	15360	2048	90000	65.38	4.26	1.84E+08	383061.5	5883825	133889.7	8716.777	278.2551
New Zealar	Vodafone	A	Ultimate pack (Double Your	24576	1024	90000	82.58	3.36	9.22E+07	302408.8	7432000	84559.64	3440.74	277.4694
New Zealar	NZ Telecor	A	Total Home Broadband 80GB (with speed reduction)	24576	1024	80000	79.04	3.22	8.19E+07	257281.6	6322954	80933.8	3293.205	254.1844
New Zealar	NZ Telecor	A	Total Home Broadband 80GB (without speed reduction)	24576	1024	80000	79.04	3.22	8.19E+07	257281.6	6322954	80933.8	3293.205	254.1844
New Zealar	NZ Telecor	A	Total Home Broadband (without speed reduction)	24576	1024	60000	66.39	2.7	6.14E+07	162087.4	3983461	67984.4	2766.292	179.3525
New Zealar	TelstraClea	A	LightSpeed 60G	15360	2048	60000	52.73	3.43	1.23E+08	205976.3	3163795	107990.9	7030.656	181.0185
New Zealar	Vodafone	A	Ultimate pack	24576	1024	45000	63.23	2.57	4.61E+07	115776.7	2845329	64747.04	2634.564	162.678
New Zealar	NZ Telecor	A	Adventure	24576	1024	40000	80.68	3.28	4.10E+07	131316.5	3227236	82617.23	3361.704	264.8684
New Zealar	TelstraClea	A	LightSpeed 40G	15360	2048	40000	46.41	3.02	8.19E+07	120851.5	1856279	95041.47	6187.596	140.2088
New Zealar	Vodafone	A	Ideal pack (Double Your	24576	1024	30000	69.81	2.84	3.07E+07	85211.68	2094162	71480.73	2908.559	198.2745
New Zealar	TelstraClea	A	Call Local with Broadband with 25GB usage pack	24576	256	25000	69.36	2.82	6400000	70555.02	1733960	17755.75	722.4835	195.7434
New Zealar	NZ Telecor	A	Total Home Mobile (with speed reduction)	24576	1024	20000	62.6	2.55	2.05E+07	50941.77	1251945	64099.57	2608.218	159.4407
New Zealar	NZ Telecor	A	Total Home (without speed	24576	1024	20000	64.49	2.62	2.05E+07	52485.45	1289883	66041.98	2687.255	169.2502
New Zealar	TelstraClea	A	LightSpeed 20G	15360	2048	20000	40.08	2.61	4.10E+07	52192.73	801680.3	82092.05	5344.535	104.6047
New Zealar	Vodafone	A	Easy pack (Double Your	24576	1024	16000	57.03	2.32	1.64E+07	37130.89	912528.7	58401.84	2376.377	132.3555
New Zealar	Vodafone	A	Ideal pack	24576	1024	15000	56.91	2.32	1.54E+07	34733.02	853598.8	58272.34	2371.108	131.7692
New Zealar	NZ Telecor	A	Total Home Lite (with speed	24576	1024	10000	52.48	2.14	1.02E+07	21354.38	524805.1	53740.05	2186.688	112.0689
New Zealar	NZ Telecor	A	Total Home Lite (without speed reduction)	24576	1024	10000	52.48	2.14	1.02E+07	21354.38	524805.1	53740.05	2186.688	112.0689
New Zealar	TelstraClea	A	Call Local with Broadband with 10GB usage pack	24576	256	10000	59.87	2.44	2560000	24362.79	598739.8	15327.74	623.6873	145.8697
New Zealar	Vodafone	A	Easy pack	24576	1024	8000	50.58	2.06	8192000	16466.03	404669	51797.64	2107.651	104.1139
New Zealar	Vodafone	A	Basic pack (Double Your	256	128	6000	48.35	188.85	768000	1133110	290076	6188.289	24173	9130.22
New Zealar	NZ Telecor	A	Go	24576	1024	5000	68.03	2.77	5120000	13841.75	340174.9	69667.82	2834.791	188.3447
New Zealar	TelstraClea	A	Call Local with Broadband with 3GB usage pack	24576	256	3000	54.82	2.23	768000	6691.359	164446.8	14032.8	570.996	122.2637
New Zealar	Vodafone	A	Basic pack	256	128	3000	45.12	176.26	384000	528765.3	135363.9	5775.526	22560.65	7952.858
New Zealar	NZ Telecor	A	Total Starter Plan (with	24576	1024	2000	47.9	1.95	2048000	3897.817	95792.75	49045.89	1995.682	93.34564
New Zealar	TelstraClea	A	Maximum Speed Broadband +	24576	256	1000	55.51	2.26	256000	2258.651	55508.61	14210.21	578.2147	125.3746
Portugal	PT	A	SAPO ADSL 24Mb - Zonas	24000	1024	50000	32.08	1.34	5.12E+07	66824.84	1603796	32845.75	1368.573	42.86937
Portugal	PT	A	SAPO ADSL 12Mb - Zonas	12000	1024	30000	25.58	2.13	3.07E+07	63946.82	767361.9	26192.62	2182.718	54.52262
Slovak Rep	T-Com	A	Turbo 1 Solo	2048	384	2000	24.26	11.85	768000	23690.93	48519.03	9315.653	4548.659	287.3653
Slovak Rep	T-Com	F	Optik 1	10240	1024	2000	33.37	3.26	2048000	6518.009	66744.41	34173.14	3337.221	108.7602
Turkey	Superonlin	A	Superonline ADSL 8Mbps unlimited (100GB)	8192	1024	100000	114.07	13.92	1.02E+08	1392406	1.14E+07	116803.5	14258.24	1588.26
Turkey	Superonlin	A	Superonline ADSL 8Mbps unlimited (25GB)	8192	1024	25000	83.62	10.21	2.56E+07	255177.5	2090414	85623.34	10452.07	853.4824
Turkey	TTNet	F	FiberNET 100 Mb 20GB	102400	1024	20000	89	0.87	2.05E+07	17382.15	1779932	91132.51	889.9659	77.34758
Turkey	Superonlin	F	Fiber 100 mbps 16GB	102400	5120	16000	97.24	0.95	8.19E+07	15193.97	1555863	497876.1	4862.071	92.34271
Turkey	TTNet	A	Daily internet 1Mbps/500 mb	1024	256	15208.33	84.76	82.77	3893333	1258773	1288984	21697.31	21188.78	7015.067
Turkey	TTNet	F	FiberNET 50 Mb 15GB	51200	1024	15000	62.21	1.22	1.54E+07	18225.09	933124.8	63701.32	1244.166	75.58349
Turkey	Superonlin	F	Fiber 50 mbps 12GB	51200	5120	12000	70.45	1.38	6.14E+07	16512.46	845437.8	360720.1	7045.315	96.94622
Turkey	TTNet	F	FiberNET 32 Mb 10GB	32768	1024	10000	38.99	1.19	1.02E+07	11899.36	389918.2	39927.62	1218.494	46.39775
Turkey	Superonlin	F	Fiber 20 mbps 8GB	20480	5120	8000	52.59	2.57	4.10E+07	20544.65	420754.4	269282.8	13148.58	135.0665
Turkey	Superonlin	A	Superonline ADSL 8 Mbps	8192	1024	6000	46.34	5.66	6144000	33943.14	278062.3	47455.96	5792.963	262.1752
Turkey	TTNet	A	Net 6 / 6GB	8192	1024	6000	29.17	3.56	6144000	21364.34	175016.7	29869.52	3646.181	103.8644
Turkey	TTNet	A	1 Mbps / 6 GB	1024	256	6000	32.8	32.03	1536000	192209.3	196822.3	8397.754	8200.932	1050.864
Turkey	TTNet	A	2 Mbps / 6 GB	2048	512	6000	41.05	20.05	3072000	120276.9	246327.1	21019.91	10263.63	822.9849
Turkey	Superonlin	A	Superonline ADSL 16 Mbps	16384	1024	5000	47.24	2.88	5120000	14415.48	236183.3	48370.33	2952.291	136.1878
Turkey	TTNet	A	16 Mbps/ 5GB	16384	4096	5000	30.06	1.83	2.05E+07	9174.314	150312	123135.6	7515.598	55.16037
Turkey	Superonlin	F	Fiber 10 mbps 4GB	10240	1024	4000	43.66	4.26	4096000	17056.59	174659.5	44712.84	4366.488	186.1935
Turkey	Superonlin	F	Fiber 20 mbps 4GB	20480	5120	4000	48.13	2.35	2.05E+07	9400.311	192518.4	246423.5	12032.4	113.1083
Turkey	Superonlin	A	Superonline ADSL 8 Mbps	8192	1024	4000	43.66	5.33	4096000	21320.74	174659.5	44712.84	5458.11	232.7419
Turkey	TTNet	A	Net 4 / 4GB	8192	1024	4000	26.49	3.23	4096000	12934.87	105962.5	27126.4	3311.328	85.66322
Turkey	TTNet	A	1 Mbps to / 4 GB	1024	256	4000	24.54	23.96	1024000	95840.15	98140.31	6280.98	6133.77	587.8615
Turkey	TTNet	A	2 Mbps / 4 GB	2048	512	4000	29.17	14.24	2048000	56971.58	116677.8	14934.76	7292.362	415.4574
Turkey	Superonlin	F	Fiber 20 mbps 2GB	20480	5120	2000	40	1.95	1.02E+07	3906.623	80007.63	204819.5	10000.95	78.13991
Turkey	Superonlin	A	Superonline ADSL 1 Mbps	1024	256	2000	40	39.07	512000	78132.45	80007.63	10240.98	10000.95	1562.798
Turkey	TTNet	A	1 Mbps / 2 GB	1024	256	2000	22.83	22.29	512000	44588.98	45659.12	5844.367	5707.39	508.9734
Turkey	Superonlin	F	Fiber 20 mbps 1GB	20480	5120	1000	44.84	2.19	5120000	2189.662	44844.28	229602.7	11211.07	98.19382
Turkey	Superonlin	A	Superonline ADSL 1 Mbps	1024	256	1000	44.84	43.79	256000	43793.24	44844.28	11480.14	11211.07	1963.876
Turkey	TTNet	A	1 Mbps / 1 GB	1024	256	1000	29.97	29.27	256000	29270.83	29973.33	7673.171	7493.332	877.3441
Turkey	Turksat/Uy	C	1Mbps'e kadar	1024	256	1000	14.08	13.75	256000	13752.15	14082.2	3605.042	3520.549	193.6604
Turkey	Turksat/Uy	C	5Mbps'e kadar	5120	1024	1000	17.65	3.45	1024000	3448.04	17653.97	18077.66	3530.793	60.87159
Turkey	Turksat/Uy	C	10Mbps'e kadar	10240	1024	1000	21.23	2.07	1024000	2072.826	21225.74	21735.15	2122.573	43.99725
United King	BT	A	More Broadband and Calls	20480	256	40000	40.44	1.97	1.02E+07	78990.3	1617721	10353.42	505.5379	79.86517
United King	BT	F	More Broadband and Calls with superfast BT Infinity	40960	2048	40000	40.44	0.99	8.19E+07	39495.15	1617721	82827.33	2022.152	39.93259
United King	BT	A	Broadband and Evening &	20480	256	10000	33.18	1.62	2560000	16202.59	331829.1	8494.825	414.7864	53.76492
United King	Sky	A	Everyday Lite + TV	20480	1300	2000	51.79	2.53	2600000	5058.095	103589.8	67333.36	3287.761	130.9917

Source: OECD Broadband Statistics Sep. 2011

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