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**Conference Paper**

## Empirical analysis of mobile broadband adoption in major six countries from the view of competition policy

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# **Empirical Analysis of Mobile Broadband Adoption in Major Six Countries from the View of Competition Policy**

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## **Abstract**

The purpose of this paper is to study competition policy on mobile broadband, consisting of 3G and 4G (LTE). Currently mobile broadband has been developing rapidly and its access speed amounts to 150Mbps for the latest 4G, which is similar to fixed broadband. This paper analyzes the factors affect the mobile broadband adoption in major six countries, such as the U.S., UK, France, Germany, Japan, and Korea, those cover more than fifty percent of total population and adoption ratio of OECD 34 member countries. The factors examined here include HHI and frequency auction as completion policy, FTTH adoption, FMC (Fixed mobile convergence), and launching Android and iPhone, in addition to economic variables such as price and income. Panel data analysis showed that smartphone, competition among telecommunication carriers observed by HHI and FTTH affect mobile broadband adoption. This result provides important basis for competition policy on mobile

broadband in each country.

Keywords: Mobile Broadband, Competition Policy, Smartphone, iPhone, Android, Feature Phone, 3G, 4G, FTTH, Panel Data Analysis.

## **1. Introduction**

In accordance with development of broadband, whether wired or wireless, promoting further nationwide deployment of broadband services has become an important national agenda for many countries, including Japan, Korea, the U.S. and the EU, for example. Japan has implemented a scheme aimed at providing broadband connections to every household by 2015 under the name of New Broadband Super Highway (*Hikari-no-michi*) Plan, while the U.S. has been pressing ahead with a National Broadband Plan, the objective of which is to provide 100Mbps broadband services to 100 million households by 2020. A Digital Agenda for Europe promotes 30Mbps broadband access in whole EU population and 100Mbps broadband access in 50% population in EU by 2020.

Broadband consist of (i) fixed broadband such as FTTH (Fiber To The Home, by fiber subscriber line), DSL (Digital Subscriber Line, by copper subscriber line) and cable modem (CATV broadband, by coaxial subscriber line), and (ii) mobile broadband provided by wireless. Fixed broadband, particular FTTH, boosts very high speed such as more than 100 Mbps up to several Gbps. On the other hand, mobile broadband had provided relatively low speed than fixed broadband. But due to technological development upon mobile broadband in recent years, 4G (LTE) has enabled it boosts more than 100 Mbps up to 150

Mbps.

The purpose of this paper is to conduct an empirical analysis to identify factors promoting mobile broadband services adoption, in particular on competition policy. In many countries, the mobile phone market has been developed in the framework of market competition, while in the fixed broadband the market completion has been secured by competition policy such as LLU (local loop unbundling) and connection charge, for example. In the mobile market, although similar competition policy such as MNP (Mobile number portability), frequency auction, and so on have been implemented, they were found less relevant to its adoption (e.g., Akematsu, Shinohara, and Tsuji, 2012). Other various regulations to check the SMP of dominant mobile carriers were implemented one another. The deployment of broadband throughout a nation requires a large amount of funds and many years just similar to the wired phone, which took much investment and around 100 years even in developed countries. Mobile broadband uses fiber lines in nationwide to connecting signal among mobile base stations, and those fibers costs high which causes they are essential facilities. Identifying the factors of promoting broadband services adoption can contribute to reduce costs and time for mobile broadband adoption. This is one of the objectives of this paper.

In what follows, this paper first examines previous studies on the smartphone in Section 2. In Section 3, current status of mobile phones and smartphones in six major countries are examined, and Section 4 analyzes to extract factors promoting the mobile phone adoption by using a panel data model which includes not only 3G but also other generations of smartphones. Discussions and conclusions are presented in Section 5 and 6.

## **2 Previous Studies**

Papers conducting a research on “smartphone” employing statistical analysis were few, but among them Gerpott, Thomas, and Weichert [2013] studied the characteristics and intensity of mobile internet use among consumers with different types of advanced handsets considering iPhone and Android in Germany. Gerpott [2010] analyzes the impact of the intensity of mobile Internet use on the demand for SMS and voice services of mobile network operators in Germany by the method of cross sectional analysis. Yamakawa et al. [2013] examines the diffusion of mobile telephones in Peru by the method of time series analysis. Ward and Zheng [2012] studies mobile and fixed substitution for telephone service in China, while Akematsu, Shinohara, and Tsuji [2012] analyzes the diffusion factors promoting the Japanese 3G mobile phone. Both employ panel data analysis.

## **3. Current status of mobile phone and smartphone in six major countries**

Here the contemporary status of mobile phone and smartphone in six major countries are presented including the U.S., European (UK, Germany and France) and Asian countries (Korea and Japan).

### ***3.1. U.S.***

The service penetration ratio of mobile phone in population in the U.S. is 108% (as of 1Q of 2013). Verizon wireless, AT&T, Sprint, and T-Mobile USA own the market share of 34 %, 31%, 16% and 10%, respectively. Total share of those four mobile carriers is more than 90%.

The generations of the mobile network in the U.S. is as follows: (i) 1G mobile phone:

0.1%; (ii) 2G mobile phone: 47.4%; and (iii) 3G mobile phone: 52.5%, as of the 2Q of 2007, when iPhone was launched, while Android was also launched in the same year. Thus the 2Q of 2007 is designated as the benchmark period in this paper for launching major smartphone in all countries; notwithstanding the dates of launching smartphone are different up to one year over the countries, as shown in Figure 3.1. After smartphone was launched, 2G decreased and 3G increased rapidly, respectively. The shares of 2G, 3G and 4G mobile phones are 6.7%, 79.6% and 13.6%, respectively, in the 1Q of 2013.

Verizon launched LTE service as 4G mobile phone, firstly in the U.S. in December, 2010. Verizon 4G's service coverage ratio in population attains to 99% so far. AT&T, Sprint and T-Mobile launched their 4G services in September 2011, July 2012, and March 2013, respectively.

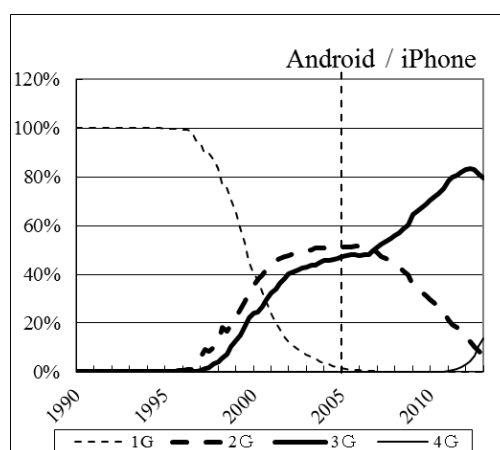


Figure 3.1 The Ratio of Cellular Services by Generation (U.S.).

Source: National Regulatory Authority, International Organizations.

The shares of handset vendors are as follows, Apple: 39.9%, Samsung: 23.7%, HTC: 8.5%, Motorola: 7.2% and LG: 6.6%, respectively, in the average of three months to Jun of 2013 (Source: ComScore.). As those figures changed +0.9, +2.0, -0.5 -1.3 and -0.2 from the

average in the previous month, top two vendors won and other three vendors lost the shares.

The shares of smartphone platforms are as follows, Android: 52.0%, Apple (iOS): 39.9%, and three other platforms such as BlackBerry, Microsoft, Symbian are less than 5%, respectively. These figures mean top two platforms such as Android and Apple hold 90% of the market share.

As Android is an open platform, each mobile carrier provides smartphones powered by Android after it was launched in 2007. On the other hand, Apple provides iPhones to the selected mobile carriers. In the U.S., AT&T firstly launched iPhone in the 2Q of 2007. AT&T also launched iPhone4 in the 2Q of 2010. Before Verizon launched iPhone4 in the 1Q of 2011, only AT&T provided iPhones. After iPhone4S started in the 4Q of 2011, in addition to AT&T, Sprint and Verizon launched iPhone5.

### *3.2. European countries*

#### *3.2.1. UK*

The service penetration ratio of mobile phone in population in the UK is 126% (as of the 1Q of 2013). Everything Everywhere, Telefónica O2 UK and Vodafone UK own the shares of 36.8%, 31.1% and 22.5%, respectively. Total share of those three mobile carriers is more than 90%.

The generations of the mobile network in the UK are as follows: (i) 1G mobile phone: 0% (its services ceased in the 1Q of 2001); (ii) 2G mobile phone: 86.7%; and (iii) 3G mobile phone: 13.3%, as of the 2Q of 2007, the times of the major smartphones launched are as shown in Figure 3.2. After smartphone was launched, 2G mobile phone

decreased and 3G increased rapidly. The shares of 2G, 3G and 4G mobile phone are 43.5%, 56.1% and 0.4%, respectively, in the 1Q of 2013.

Telefónica O2 UK launched LTE service as 4G mobile phone as a trial, firstly in the UK in December, 2011. Everything Everywhere launched its 4G service in October, 2012.

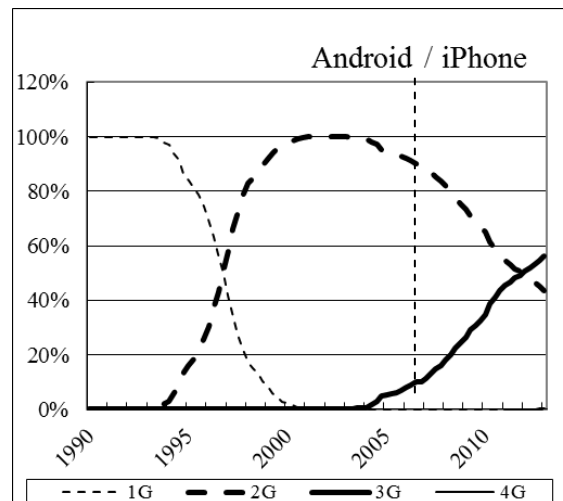


Figure 3.2 The Ratio of Cellular Services by Generation (UK)

Source: National Regulatory Authority, International Organizations.

### 3.3.2. Germany

The service penetration ratio of mobile phone in population in Germany is 132% (as of the 1Q of 2013). T-Mobile, Vodafone D2, E-Plus and Telefonica Germany (O2) own the shares of 34.2%, 28.0%, 19.7% and 18.1%, respectively. Total share of those four mobile carriers is 100%.

The generations of the mobile network in Germany are as follows: (i) 1G: 0% (services ceased in the 4Q of 2000); (ii) 2G: 90.8%; and (iii) 3G: 10.2% in the 2Q of 2007, when the major smartphones were launched. After smartphone launched, 2G mobile phone was decreased, while 3G increased rapidly. The shares of 2G, 3G and 4G mobile phone are



58.2%, 41.3% and 0.5%, respectively, in the 1Q of 2013.

T-Mobile, Telefonica Germany (O2) and Vodafone D2 launched LTE services as 4G in Germany in June 2011, July 2011 and October 2011, respectively. T-Mobile and Telefonica Germany (O2) agreed with the joint ownership for their facilities.

### *3.3.3 France*

The service penetration ratio of mobile phone in population in France is 106% (as of 1Q of 2013). Orange (considered as in FT group), SFR, Bouygues Telecom and Free Mobile hold the shares of 40.2%, 33.8%, 17.1% and 8.9%, respectively. Total share of those four mobile carriers is more than 90%.

The generations of the mobile network in France are as follows; (i) 1G: 0% (service ceased in the 2Q of 1999); (ii) 2G: 89.8%; and (iii) 3G: 10.2% in the 2Q of 2007, when the major smartphones were launched. After smartphone was launched, 2G decreased and 3G increased rapidly here in France. The shares of 2G, 3G and 4G are 40.0%, 60.0% and 0.0% (8600 subscribers), respectively, in the 1Q of 2013.

Orange launched LTE service as 4G, firstly, in France in June, 2012 as a trial. SFR launched it November 2012.

## *3.3. Asian countries*

### *3.3.1. Korea*

The service penetration ratio of mobile phone in population in Korea is 111% (as of the 1Q of 2013). SK Telecom, KT and LG U+ own the shares of 49.9%, 30.3% and 19.1%, respectively. Total share of those four mobile carriers is close to 100%.

The generations of the mobile network in Korea are greatly advanced, that is, 2G almost ceased around the 2Q of 1999, while 3G dominated almost all. 4G was launched in the 3Q of 2011. The latest shares of 3G and 4G mobile phone are 63.1% and 36.1% (as of the 1Q of 2013), as shown in Figure 3.3. SK Telecom and LG U+ launched LTE service as 4G mobile, firstly, in Korea in July 2011. KT launched it January 2012.

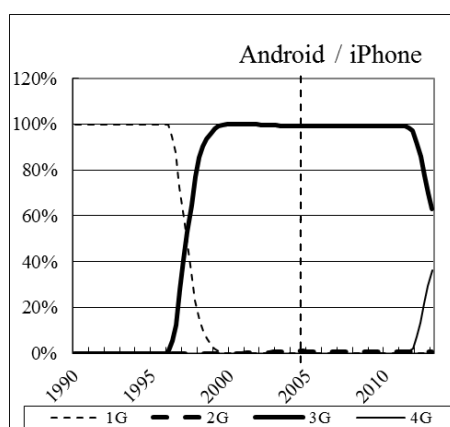


Figure 3.3 The Ratio of Cellular Services by Generation (Korea)

Source: National Regulatory Authority, International Organizations.

### 3.3.2. Japan

The service penetration ratio of mobile phone in population in Japan is 108% (as of the 1Q of 2013). NTT DoCoMo, KDDI, Softbank Mobile and e-Access (Softbank bought in 2012 and now it is in the Softbank group) own the shares of 45.2%, 27.7% 23.9 and 3.2%, respectively. Total share of those four mobile carriers is 100%.

The generations of the mobile network in Japan are as follows: (i) 2G: 23.3%; and (ii) 3G: 76.7% in the 2Q of 2007, when the major smartphones were launched, as shown in Figure 3.4. After smartphone was launched, 2G decreased, while 3G increased rapidly. The shares of 3G and 4G mobile are 89.8% and 10.2%, respectively, in the 1Q of 2013. NTT

DoCoMo, KDDI and Softbank Mobile launched LTE service as 4G mobile in the 3Q of 2010, 3Q of 2012 and 1Q of 2012, respectively.

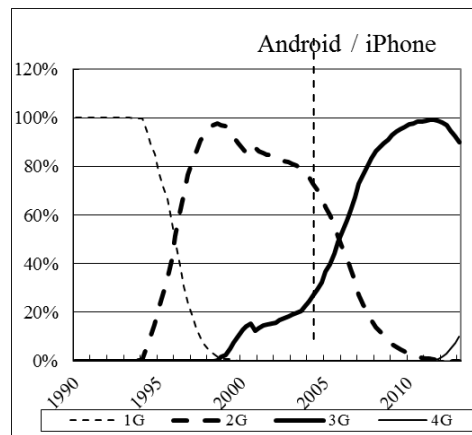


Figure 3.4 Ratios of Cellular Services by Generation (Japan)  
Source: National Regulatory Authority, International Organizations.

### 3.4. Examining the status in six countries

In this section, the status for mobile phone and smartphone in six countries are examined considering the discussions mentioned above.

#### 3.4.1 Latest status (as of the 1Q of 2013))

##### (1) The penetration ratio

The penetration ratios in population of mobile phone are more than 100% and still growing in all six countries.

##### (2) Generations

2G mobile still occupies around from 40% to 60% in European countries, while 2G occupies only 7% in the U.S. but it was already ceased in Korea and Japan. Mobile

handsets in the U.S, and Japan and Korea have almost migrated into 3G or later, as shown in Figure 3.1-3.4.

### *3.4.2. Smartphone*

#### **(1) Migration in generations**

2G peaked out and 3G increased rapidly in the U.S., UK, Korea and Japan since major smartphones launched since the 2Q of 2007 as shown in Figure 3.1-3.4. Germany and France are similar to the UK. In addition, 4G increased and 3G peaked out after the launch of 4G particularly in the U.S., Korea and Japan.

#### **(2) Platform (OS)**

The shares of platforms (OSs) in the U.S. and Japan are presented here. Android occupies 64% in Japan (as of June, 2012), while 52% in the U.S. (as of June, 2013). iOS including iPhone occupies 32% (June, 2012) and 39.9% (June, 2013). In both countries, Android occupies more than half and iOS occupies around 30 to 40%, and those two platforms occupy more than 90% in two countries.

As mentioned in section 3.3, including from Figures 3.1 to 3.4, and in this section 3.4.2, this paper postulates smartphone such as Android and iPhone affects mobile broadband adoption as Hypothesis I.

### *3.4.3 Market and Competition Policy*

#### **(1) Incumbent dominant carrier and competition**

Telecommunications Markets had been dominated by government or incumbent dominant carrier(s) and competition was introduced by policy.

“Incumbent dominant carrier(s)”, described above is defined as the carrier(s) which has been dominating the fixed local loop and providing fixed services such as PSTN (legacy phone) and broadband. They are carriers such as Verizon, AT&T and CenturyLink in the U.S., BT in the UK, Telekom Deutschland in Germany, FT in France, KT in Korea, and NTT-East and NTT-West in Japan. They occupy almost all of subscriber lines in each country, except for KT in Korea which occupies around 78%.

In the mobile market, on the other hand, the incumbent dominant carriers occupy less than half of subscribers by themselves or their group carriers. The highest occupancy ratio is 45.2% by NTT DoCoMo in Japan. Those statuses indicate that there are intra-competition inside the mobile market as well as inter-competition both the mobile and fixed market.

## **(2) Incumbent dominant carriers and MNO**

The incumbent dominant carriers provide mobile services by themselves or their group carriers as MNO in five countries except the UK, where BT separated and sold its mobile services (MNO, currently O2) in 2001, and BT provides mobile services as an MVNO of O2. They occupy the largest market share in four countries, such as U.S., Germany, France and Japan. The carrier which owns the largest share among these four is NTT DoCoMo in Japan at the share of 45.2%. Orange in France and T-Mobile follow at the share of 42.7% and 34.2%, respectively. But these shares are decreasing, after the 2Q of 2007, when major smartphones launched as mentioned earlier.

Korea is an exceptional case, where SK, which is not incumbent dominant carrier, occupies the largest share at 49.9%, whereas KT of incumbent dominant carrier owns 30.3%.

### (3) Competition Policy and HHI

There are consolidation issues in the mobile market. In each of EU member country, there are some consolidated cases, namely the number of mobile carriers consolidated from 4 to 3, such as Austria, Ireland and Germany. In EU, there is also cross-country consolidation issue at EU level as one market. And it is not a EU member but in Switzerland, regulator (anti-monopoly authorities) prohibited the consolidation from 3 to 2. In U.S., Sprint tried to acquire T-Mobile but prohibited by regulator, and in result the number of major mobile carriers stays 4. In Japan, Softbank acquired (and later on affiliated) e-access, and in result the number of mobile carriers became 4 to 3. As competition policy is important for mobile broadband market, this paper considers HHI. The “Inter-platform HHI” is defined as the total market shares by carriers throughout all generations (summing up from 1G to 4G), which of six countries are shown in Figure 3.5, and they are in general decreasing at the range of from 4080 (Japan, in the 2Q of 2007) to 2669 (Germany, in the 1Q of 2013). But the U.S. is exceptional, since its HHI is the lowest among five countries and it is increasing from 1980 (2Q of 2007) to 2478 (1Q of 2013).

#### *3.4.4. FTTH Adoption*

Mobile broadband network consists of huge amount of base stations in nationwide in each country. For instance, there are up to around two hundreds thousands base stations in each mobile carrier in Japan. As mobile broadband serves high speed internet, backhauls, which link each base station and center station, consist of fiber lines. From the viewpoint of telecom carriers, in another word, from the viewpoint of supply side, those fiber lines can also be used for FTTH of fixed broadband service. In fact, as there are also huge amount of

households in nationwide, for instance, there are around fifty millions households, telecom carriers intend the efficient usage of fiber lines in nationwide. On the other side, from the viewpoint of broadband user, in other word, from the viewpoint of demand side, heavy users of high speed fixed broadband would like to use FTTH in household and those heavy users intend to use mobile broadband in outdoor.

This paper postulates FTTH adoption affects mobile broadband adoption as Hypothesis III.

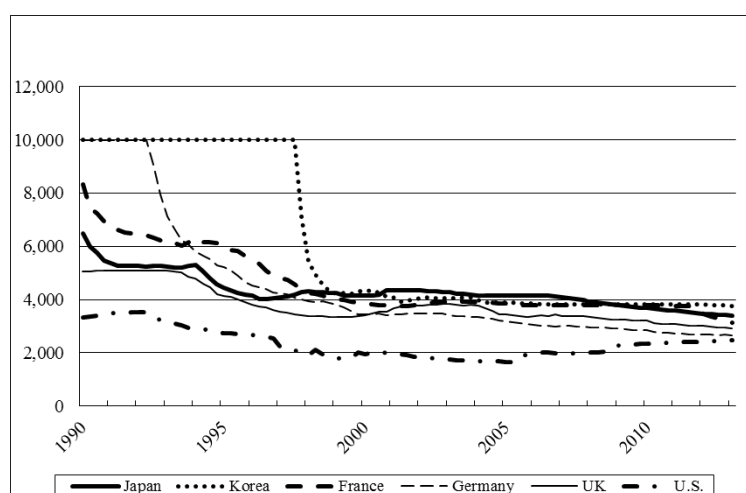


Figure 3.5 Inter-platform HHIs in major countries

Source: National Regulatory Authorities, International Organizations.

### 3.5 Summary of this section

Let us summarize the discussions in the previous sections from the viewpoint of what smartphone led the transformation of the mobile market. These are as follows: (i) it accelerated the technological progress of upgrading generations. The most countries upgraded to newer generations; and (ii) it promoted competition in the market, as seen in decreasing in HHI. Then a natural question comes out; why smartphone causes these

transformations. In order to search answers, this study takes the Japanese mobile market as an example and conducts analysis.

#### 4. Analysis the factors promoting mobile broadband in six major countries

This section verifies hypotheses by analyzing the factors promoting mobile broadband (=3G+4G) in six major countries, including the U.S., European countries (UK, Germany and France) and Asian countries (Korea and Japan), by panel data analysis.

##### 4.1. Methodology

This Section postulates the estimation equation such that the number of mobile subscribers can be explained as follows,

$$\begin{aligned} Subscriber_{it} = & \alpha_1 Subscriber_{it-1} + \alpha_2 Price(Voice)_{it} + \alpha_3 Price(Data)/Speed_{it} + \alpha_4 Income_{it} \\ & + \alpha_5 HHI_{it} + \alpha_6 FTTx_{it} + \sum_j \alpha_7^j Factor_{it}^j + \alpha_8 Z, \end{aligned}$$

where  $Subscriber_{it}$  denotes the mobile broadband adoption rate in country  $i$  at  $t$  (quarter in 2000 to 2012),  $Subscriber_{t-1}$  one period lag for examining network effect,  $Price(Voice)_{it}$  monthly charge of voice services calculated by (Voice ARPU)/MOU,  $Price(Data)$  calculated by (Data ARPU)/MOU for country  $i$  (the Price variable is divided into two parts, voice and data, which is due to the fact that monthly data price is fixed and its speed increases rapidly),  $Speed$  download speed of mobile broadband,  $HHI$  the Herfindahl-Hirschman Index of mobile broadband market,  $Income$  GDP per capita.  $Factor$  denotes dummy variables including the launch of Android, iPhone, and FMC (whether



carriers providing fixed and mobile services together or not). In this equation, we add  $Z$  which consists of instruments such as  $Price (Voice)_{it-1}$ ,  $Price (Data)/Speed_{it-1}$ ,  $HHI_{it-1}$  and  $Subscribers_{it-2}$ . MNP (Mobile Number Portability) is excluded, since it was not significant. The data were obtained from National Regulatory Authorities, telecom carriers' homepages or IR documents, and international organizations such as OECD and ITU.

#### 4.2. Results and further issues

The summary of statistics is described in Table 4.1. In the estimation, adding the one lag of the number of subscribers improved the R-squared coefficient of determination from within = 0.7932, between = 0.1019 and overall = 0.3678 to 0.9973, 0.9890 and 0.9923, respectively. In the third term of right side, normalizing by speed improved the sign condition of the price of data from plus to minus. The fixed-effect model, not random-effect model was selected by Hausman test and F test.

Table 4.1 Summary of statistics

Variables	No. of Obser.	Mean	Std. Dev.	Max	Min
Mobile Broadband Adoption Ratio (one lag, Log)	249	3.216682	1.540417	4.696976	-4.78088
Price (Voice, Log)	312	-1.82361	0.614531	-0.5773	-3.04236
Price/Speed (Data, Log)	256	0.654528	1.61142	6.083785	-2.5008
Income (GDP/Capita, Log)	312	10.3582	2300295	10.85863	9.69237
HHI (Log)	249	8.278625	0.361672	9.21034	7.641016
FTTx (Adoption Ratio, Log)	197	3943072	2.68979	4.192044	-8.28205
Android	312	0.298077	0.458148	1	0
iPhone	312	0.375	0.484901	1	0
FMC	312	0.048077	0.048077	1	0
Frequency Auction	312	0.519231	0.500433	1	0

And the results obtained are as described in Table 4.2 and summarizes as follows: (i) launch of Android is positively significant, while the launch of iPhone is not, which

partially verifies Hypothesis I; (ii) competition among carriers in terms of HHI is negatively significant, which verifies Hypothesis II; (iii) voice price is negatively significant, while data price adjusted by speed is not significant; (iv) FMC is negatively significant, that is carriers which provide both of fixed and mobile tend to have more subscribers; (v) iPhone is not significant, because it was initially provided to a single mobile carrier in each country; and (vi) FTTH is positively significant, which verifies Hypothesis III. These results demonstrate that competition among carriers promotes mobile broadband diffusion.

This study provides an important suggestion to the backhaul issue of mobile broadband, since the variable FTTH also can be thought as a proxy of the backhaul network. The related estimation result shows that carriers own larger backhaul have more mobile subscribers.

## **5. Discussions**

This paper studied competition policy and the factors of mobile broadband adoption, but mobile broadband services were just started. The result of estimation described obtained above are influenced by the data collected. The data of six major countries, which covers 56.0% in population, 63.7% in the number of terminals of mobile broadband and 68.1% (as of 4<sup>th</sup> quarter in 2012, respectively) in GDP of OECD 34 member countries, which seems to captures the nature of the whole OECD member countries to some extent. But country biases, for example, still remain, and further effort to revise and collect data are required.

Table 4.2 Estimation Result

Dependent variable: mobile broadband subscribers (Log)		
Mobile Broadband Adoption Ratio (one lag, Log)	0.769 *** (0.00789)	
Price (Voice, Log)	-0.0736 *** (0.0244)	
Price/Speed (Data, Log)	-0.0000145 (0.00474)	
Income (GDP/Capita, Log)	0.0505 (0.0927)	
HHI (Log)	-0.305 *** (0.0265)	
FTTx (Adoption Ratio, Log)	0.0273 *** (0.00682)	
Android (Dummy)	0.032 *** (0.0113)	
iPhone (Dummy)	0.00485 (0.0115)	
FMC (Dummy)	-0.0518 *** (0.0195)	
Frequency Auction (Dummy)	-0.0193 (0.0160)	
Constant	2.739 *** (0.911)	
Observations	190	
R-squared (within)	0.9973	
R-squared (between)	0.9890	
R-squared (overall)	0.9923	
Wald test (model)	1.90E+06	
Prob. > $\chi^2$	0.00000	
Test of overidentifying restrictions (Sargan-Hansen statistic)	0.027	
Prob. > $\chi^2$	0.8686	
Note: Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

The effect of Android and iPhone is expressed in terms of the dummy of the initial launching of those smartphone due to the data constraint, and continuous effort to collect the data on the date of launching the types of iPhones. In this context, care should be taken to the number of mobile carriers which start serving those iPhones, namely iPhone 3 was provided by only one carrier, iPhone 4S was by two carriers, and iPhone 5S and 5c were by three carriers in Japan, for example. The importance of smartphones and the launch of iPhone lies in the fact such that they influenced largely to the changes in the shares of

mobile carriers in six countries as shown in Figures 3.1-3.4.

Mobile broadband in this paper includes 3G + 4G, there are other kinds of wireless systems such as WiFi and WiMAX, which are excluded from the analysis here since this paper focuses on the demand side of the market, but those belong to the supply side. Similarly, services provided by OTTs such as Google and LINE are also excluded here due to the limitation of related data. Continuously effort is required to collect the data to improve the result of estimation.

Regarding the effect of FTTH to mobile broadband adoption, it has dual effects to the supply and demand sides of the market, that is, it contributes to the mobile broadband as backhaul shown in the paper, but it also affects the demand side through the substitution or complementarity to mobile broadband. Current speed of 4G is more than 100 Mbps, which is almost similar to fixed broadband which seems to increase the substitutability between these two broadband categories. A further increase in the substitutability may require new completion policy toward the new broadband era. These dual characteristics should be considered in the further study.

## **6. Conclusion**

This paper thus analyzed the factors mobile broadband adoption in OECD major six countries and its relevance to competition policy. Empirical analysis extracted the following factors: (i) Launching smartphone affect mobile broadband adoption, but regarding two categories of smartphone, the result shows only Android of open OS affected the mobile broadband adoption, while iPhone did not because of its sales strategy, that is, it was firstly provided by only one mobile carrier; (ii) The development of FTTH affected

significantly through two channels such as contributing to the construction of the mobile broadband network as supply side and an increase in the usage of mobile broadband as demand side, although this paper could not separate these two effects; and (iii) HHI negatively affects mobile broadband adoption.

This paper suggests to competition policy on mobile broadband in EU and the US, where the consolidations are currently discussed as principal issues.

\*) The views expressed in this paper represent the personal opinions of the authors. They do not necessarily represent the views of the KDDI Group.

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