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A counterfactual analysis of the Korean telecommunication service market

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Abstract

This paper predicts the prices of cell phone plans under two hypothetical situations in Korea: abolishing the current governmental regulation on a leading company and introducing a government-initiated new cell phone plan. I first estimate a structural individual level demand system for cell phone plans, controlling for unobserved characteristics of each plan. Furthermore, given that the plan prices have a lot of variations even with almost zero marginal costs I assume several cases of marginal costs that a service provider can impose. The predicted prices based on the marginal costs and demand estimates imply that, after the abolition of the governmental regulation, the plan prices may go down in general, and the decline may be more salient for the middle and high type plans (according to the data volume). The counterfactual analysis on the introduction of the government-led cell phone plan indicates that, although the prices of the low type plans may decrease considerably, the prices of other higher type plans may go up.

Keyword : Mobile telecommunication service, BLP model, Demand estimation, Policy simulation, Regulation
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Chapter 1. Introduction

Since when a national telecommunication service company began to provide cell phone service in 1988, the Korea telecommunication service industry has made extraordinary progress for 30 years. In 2010, the percentage of opening a mobile phone reached 100.6%, and in 2019, the Korean telecommunication providers launched the world's first 5G technology-based services.

Along with the incredibly rapid development of the industry, high-priced monthly phone bill charged to customers has been a long-debated topic in Korea. According to the Rewheel[1]'s report about the 4G technology-based services in 2018, Korean customers paid the second highest phone bill among 41 countries, £13.9 per gigabyte. Although the three major service providers in Korea explained that their service quality is different from that of other countries, most of the customers perceived that their monthly phone bill is too expensive. Thus, the former and current governments and legislators have put a lot of efforts to lower the service charges.

In this paper, I provide direct estimates of possible prices applying two proposed policy changes to lower the prices of cell phone plan. The first change is easing the current governmental regulation on a market-dominating service provider. The regulation has been blamed for allegedly hindering the service providers' price competition. The other change is introducing a new government-led cell phone plan which offers similar services of the current low type plans in a lower price. The study is conducted in the following three steps. First, I estimate own- and cross- price elasticities for cell phone plans. Second, I assume possible cases of marginal costs. Unlike regular products, services have almost zero marginal costs. However, the prices of cell phone plans vary widely. Thus, I examine how service providers set plan prices and probable cases of marginal costs. Third, given the marginal costs, I suggest possible outcomes

[1] Rewheel is a Finland-based boutique telecom management consultancy.

of applying each of policy change.

To estimate the demand system, I use individual-level data on mobile plan choices. Based on the nature of telecommunication service industry where a person chooses a plan per cell phone, I use discrete choice model to identify demands. Specifically, I use a mixed logit model. Also, to control endogeneity between unobserved plan quality and plan prices, I use alternative-specific fixed effects method suggested by Berry, Levinsohn, and Pakes (1995).

With the demand estimates and assumed marginal costs, I predict the plan prices and outcomes of two policy changes. To predict the plan prices when the regulation on a market-dominating service provider is repealed, I assume that service providers set the profit-maximizing prices for price competition. The results show that, although the overall plan prices are likely to go down, the decline may be more substantial for the middle and higher type plans.

Furthermore, I analyze the price changes in response to the adoption of the new government-led cell phone plan. Given that it is impossible to predict plan prices under the current regulation system which may distort service providers profit-maximizing behaviors by impeding the price competition, I use implied marginal costs obtained with the assumption that the observed prices are the profit-maximizing prices. The results show that the prices of the lower type plans may decline, however, the service providers are likely to raise the prices of other types of plans.

The paper has seven chapters. In chapter 2, I briefly summarize the historical contexts of the Korean telecommunication service industry and explain two policies under study. In chapter 3, I describe data and variables being used. In chapter 4, I explain model specification and estimation strategies. In chapter 5, I present estimation results. In chapter 6, I present possible marginal costs and the corresponding counterfactual outcomes. In section 7, I summarize and conclude the study.

Chapter 2. Literature Review

Although most countries introduced regulations on telecommunication industry to lower market concentration or to facilitate innovation, these regulations vary by countries. Especially, the regulation in Korea, which requires a market-dominating service provider to win approval before selling any new cell phone plan is unique. With respect to the regulation, Choi (2002) claimed that, although the asymmetric regulation allows the Korean government to easily control service prices, it stiffens the prices and does not protects service competition itself but late movers. Cheong (2002) also claimed that the regulation is not market-oriented because of its disproportionate protection for non-market dominating service providers. Furthermore, he questioned the effectiveness of the regulation in increasing the market shares of the late movers. Park (2003) acknowledged the necessity of asymmetric regulations, however, he called for careful consideration to the specific way of control.

Although several studies have discussed the validity of the regulation on the market-dominating service provider, there have been very few studies estimating the possible price changes. Lee (2013) predicted prices without the regulation, using the Tirole (1988) model and the provider-level data. His analysis revealed that, although the service prices may go down without the regulation, the market-dominating provider's share may increase considerably.

The studies estimating the demands for telecommunication services in Korea mostly focused on the overall telecommunication service demands and calculated consumer surplus difference after a market change. For example, Lee and Lee (2006) estimated the Korean demands for the telecommunication services and estimated consumer surplus from the increased competition from 1997 when the industry shifted from monopoly to oligopoly.

In my knowledge, there have been two papers estimating telecommunication service demands by using structural estimation. Kim (2005) estimated the demands for a total of 32 IMT

(International Mobile Telecommunications)－2000 services in Korea using the random coefficient discrete choice model to identify consumer preferences. Kim(2006) also developed empirical model to analyze consumer's dynamic decisions on plan and firm subscription. However, the telecommunication industry has undergone tremendous changes from 2006. In particular, the introduction of the smartphone and advanced technology (3G and 4G) based services are commercialized. Considered these significant changes in the market and technology, their results can not sufficiently represent the current demands. Therefore, with the latest available data, I estimate the demands for 4G technology－based services. Furthermore, given the estimation, I predict the consequential outcomes applying two major market changes at a cell phone plan level. As far as know, this is the first paper which evaluates the two proposed polices with structural estimation.

Chapter 3. The telecommunication service market in Korea

In 1994, SKT took over control of a national telecommunication service provider in Korea. KT and LG started telecommunication business since 1996. To protect the late movers from KT's aggressive pricing, the Korean government introduced a regulation which requires a leading company among these three service providers to win approval from the government before selling any new cell phone plan. Although the government specified that the regulation would apply to any leading service provider among the three companies, SKT has been the only subject of the regulation because it has retained the industry's first position. In this paper, I refer to the regulation as "the approval system".

Figure 1. The trend of households' expenditure on telecommunication service fee and equipment

Note: The data is from the household trend survey of the Korea statistical office.

Figure 1Figure 1 shows that the prices of cell phone plans increased a lot when the number of 3G technology-based service users increased rapidly in 2010. The plan prices kept on rising till 2013. During this period, the three service providers competed by offering cellphone subsidies for new customers. They attracted the new customers by combining an expensive cell phone plan with a subsidized cellphone device. The exact amount of subsidies varied widely by sellers. I refer to the competition as "the subsidy competition" in the study. Under the intensive subsidy competition, there were a variety of sales deceptions and customers' complaints. As a solution, in 2014, the Korean government introduced a law that regulated the maximum amount of subsidy and had the service providers subsidize any customers regardless of plan types. After the new law enacted, customers' monthly phone bill decreased in accordance with their actual service use. However, their expenditure for cellphone devices increased because of the lower amount of subsidies.

Although the overall monthly phone bill went down, some customers argue that the plan prices are still high compared to other countries, pointing out the existing approval system as one of the reasons. They claim that the approval system deterred the price competition, which resulted in the price collusion that SKT had set.

They insist on repealing the approval system and allowing the leading service provider to sell new plans simply with a report. I refer to this eased system as "the reporting system". As mentioned in the Literature Review, abolition of the approval system has been constantly discussed and even proposed as a bill in the previous and current National Assembly. In particular, recently, as the Ministry of Science and ICT refused to approve the expensive 5G technology based services, the validity of the approval system increased sharply. According to the bill information system, the proposed bills are pending in the Assembly. In this paper, I examine the possible outcomes if the reporting system is applied to the leading service provider.

As another measure of reducing telecommunication costs, the current government proposed a bill forcing the market dominating provider to additionally sell plans that the government ask. The current government suggested a new plan which costs $20~$30 for 1 GB of mobile data. Although telecommunication service providers showed their disapproval of this new government-led services, the proposal passed the screening process from the Regulatory Reform Committee and the Ministry of Government Legislation in Korea. To be implemented, only parliament passage of the bill remains. This bill also is pending in the Assembly. I also conduct a counterfactual analysis of applying the new plan.

Chapter 4. Data

I use two data on individual choices and characteristics of each plan. The information of individual level choices on cell phone plans is based on the Korea Media Panel collected and offered by the Korea Information Society Development Institute (KISDI). Since 2010, the panel data on media environments and media use behaviors has been gathered on an annual basis. In the 2015 survey, the next year after the subsidy regulation, respondents were asked to select the exact cell phone plan they were using among the 4G technology-

based telecommunication services. Therefore, I am able to infer the individuals' unbiased preferences on cell phone plans irrespective of the previous subsidy competition. This data is highly important in that none of the three service providers have revealed the actual numbers of their customers using a certain plan.

To be specific, the survey presents 68 service options in total: "don't know" (1)[2], "using a MVNO[3] plan" (1), "using another plan of a service provider" (3), "the 3G technology-based plan of SKT" (1) and "the 4G technology-based plan of the three service providers" (62). Instead of estimating demand for the entire range of possible plans, I estimate the demand for the 4G technology-based plans. It is a valid scope to represent the pattern of the population because, as shown in Table 1, customers using the 4G technology-based plans of the three major service providers accounted for approximately 70 percent of the total cell phone users in 2015.

Table 1. The percentage of people by service technology and firms

	Service Technology	N. of individuals	Percentage
Three major firms	2G	4,236,906	7.19
	3G	7,958,658	13.50
	4G	40,818,639	69.26
MVNO	MVNO	5,920,878	10.05
	TOTAL	58,935,081	100.00

Note : Note: This data is from the Ministry of Science and ICT's monthly report on the telecommunication service markets in Korea. I used the December 2015 report.

Furthermore, I aggregate the 4G technology-based plans of

[2] The number in the parenthesis indicates the number of relevant options. Thus, the sum of numbers in the parenthesis is 68, the total number of service options.

[3] A mobile virtual network operator (MVNO) is a wireless communication service provider that does not own their own wireless network infrastructure.

the three major service providers to 9 categories considering the service provider (SKT, KT, LG) and data volume (high type (H), middle type (M), low type (L)) of each plan. Therefore, by aggregating them, I am able to estimate the overall demands of high type, middle type and low type plans per service provider. The aggregation not only helped to understand the overall pattern of customers but also improved the estimation precision by increasing the number of observations per category. Understanding the general choices of customers is important since plans belonging to the same type are not very different in price and the data volume which are the two most important conditions that consumers consider. Table 2 shows the aggregated nine categories from the entire range of the 4G technology-based plans and their market shares.

Table 2. Aggregation of 62 services to 9 services

	DATA(GB[4])	N. of relevant services	Market shares
SKT_L	~3	6	0.383
SKT_M	4~11	5	0.086
SKT_H	12~	5	0.021
KT_L	~3	6	0.194
KT_M	4~11	5	0.030
KT_H	12~	14	0.024
LG_L	~3	9	0.192
LG_M	4~11	4	0.035
LG_H	12~	8	0.011

Note : The prices and data volume (GB) of each plan were collected from the service providers' websites

Among the 2015 survey respondents, the sample of my study includes only those who changed their cell phone devices in 2015. A total of 2,455 respondents were used for the estimation. The shares of each aggregated categories are shown in Table 2. For individual

[4] gigabytes

demographics, I include the age variable, income variable, dummy variable for the employment status and dummy variable for whether the respondent actually pays his or her phone bill. Table 3 provides detailed descriptions of these variables.

Table 3. Demographic variables

Income (10$/month)	1	No income
	2	50~200
	3	200~400
	4	400~
Age	1	~25
	2	26~40
	3	41~65
	4	66~
Job status	1	working
	0	not working
payer	1	pay service fee by oneself
	0	others pay one's service fee

Chapter 5. Model and Estimation

Each individual chooses one cell phone plan. Due to the nature of this discrete demand, I use a discrete choice model for demand specification. I use index (i) for individuals and (j) for plans. The prices and attributes of plans were denoted as p_j and X_j, respectively. Along with these plans' characteristics, each consumer's demographic characteristics, Z_i, may affect individual choices. Moreover, in addition to these observed characteristics, some unobserved factors also may affect individual decisions. Therefore, the utility that a consumer i gets from having a plan j is presented as a function of the observed and unobserved attributes.

$$U_{ij} = V(p_j, X_j, Z_i) + \mathrm{e}_{ij} \qquad (1)$$

Especially, the function $V(\cdot)$ indicates the part comprised of the observable variables and their parameters, and e_{ij} indicates the part that makes the identity equation.

The specification of function $V(\cdot)$ and e_{ij} is given as

$$U_{ij} = \alpha_0 p_j + \sum_{g=2}^{4} \alpha_g income_{ig} payer_i\, p_j + X_j\beta + \sum_{l=1}^{2} \beta_l Z_l data_j + (\xi_j + \epsilon_{ij}) \quad (2)$$

This specification is based on demand specification from Goolsbee and Petrin (2004). α_0 indicates the common price effect to all individuals, the basic price sensitivity of all income. In addition to the basic price effect, by controlling for income of individuals, I aim to examine the impact of wealth on individual decisions. However, controlling for only the income variable has a limit. For example, in most cases, young people with little or no income ask for parents to pay their own monthly phone bill even though they are likely to have an expensive plan that provides a large volume of mobile data. To address this issue, I use a dummy variable of whether the individual pays their own phone bill, as shown in the second term of the equation above. As described in Table 2, income is categorized into four classes. Setting the group with 'no income' as a base group, the variable $income_{ig}$ is a dummy variable that takes the value 1 if the individual i's income belongs to the income class g, and 0 otherwise. The variable $payer_i$ is a dummy variable that takes the value 1 if the individual i pays his or her own phone bill.

The third term indicates a plan's attributes affecting the utility. In terms of a plan's characteristics, I use data volume measured in gigabytes, a dummy variable of the service providers. Individuals' demographic characteristics may affect their monthly data usage. I use a dummy variable of the employment status (1 if the person has a job, and 0 otherwise) and age variable for the demographic control. These two variables were respectively interacted with the data volume of the plan offered by j. The error term e_{ij} in the equation

(1) is decomposed into ξ_j and ϵ_{ij}. ξ_j represents the unobserved factor of each plan. ϵ_{ij} is the unobserved idiosyncratic taste that the individual i has for the plan j. The individual i chooses the service provider j with a probability

$$s_{ij} = \int_{A_{ij}} dF(\boldsymbol{e}_i) \tag{3}$$

where $A_{ij} = \{\boldsymbol{e}_i \,|U_{ij} > U_{ik}\ \forall k \neq j\}$ and $dF(e_i)$ is the density of the composite error.

However, ξ_j, the unobserved factor of each plan, is correlated with p_j for all plan j. Therefore, the choice probability obtained based on the composite error distribution would be biased. To address this enogeneity problem, following Goolsbee and Petrin (2004), I use a method suggested by Berry, Levinsohn and Pakes (1995). They included alternative−specific constants, the plan fixed effects, to incorporate all observed and unobserved attributes of the plan j into a value. Denoting this as δ_j, the utility specification above was rewritten as follows.

$$U_{ij} = \delta_j + \sum_{g=2}^{4} \alpha_g income_{ig} payer_i\, p_j + \sum_{l=1}^{2} \beta_l Z_l data_j + \epsilon_{ij} \tag{4}$$

$$\delta_j = \alpha_0 p_j + X_j \beta + \xi_j \tag{5}$$

The left error term, ϵ_{ij} is not correlated with the plan's price. Then, the choice probability of the individual i choosing the plan j is rewritten

$$s_{ij} = \int_{A'_{ij}} dF(\boldsymbol{\epsilon}_i) \tag{6}$$

where $A'_{ij} = \{\boldsymbol{\epsilon}_i \,|U_{ij} > U_{ik}\ \forall k \neq j\}$. I assume that ϵ_{ij} is distributed as an extreme value, thus, after normalization to the outside good, the error term is distributed logit that allows us to obtain logit choice probability.

Here, I consider the 3G users of SKT as an outside good. Although it would be better to include 3G users from all service providers, the information was not available. The reason why I do not include the respondents using other plans by the three service providers was to eliminate measurement errors. Among the 3G plan users in 2015, more than half of them used plans of SKT. Therefore, it is not restrictive to use 3G plan users of SKT as the outside good.

The estimation consists of the following two steps. First, I write the likelihood function with the individual choice data and the choice probability calculated from the model. By maximizing the likelihood function, all parameters except for those absorbed in the fixed effects are identified. The likelihood function is given by

$$L = \prod_{i=1}^{R} \prod_{j=1}^{J} s_{ij}^{j(i)} \tag{7}$$

where $j(i)$ is the indicator function

$$j(i) = \begin{cases} 1, & if \ \ individual\ i\ choose\ product\ j \\ 0, & otherwise \end{cases}$$

In the second stage estimates, the parameters α_0 and β are estimated by regressing the fixed effect δ_j on the price and characteristics of each plan *j*. Here, the plan prices are instrumented to control the correlation with the error term ξ_j. I use the phone bill in 2014 as an instrument.

As shown in the equation (6), computing the choice probability s_{ij} requires conditioning on $\boldsymbol{\theta} = \{\boldsymbol{\alpha}, \boldsymbol{\beta_j}\}$ of all plans j and the vector of fixed effects $\boldsymbol{\delta}$. However, for the first stage where the choice probability s_{ij} is used, I do not directly maximize over the entire space of $\{\boldsymbol{\theta}, \boldsymbol{\delta}\}$. I use the BLP contraction to concentrate out and make the likelihood function as the function of $\boldsymbol{\theta}$. To do this, for any given $\boldsymbol{\theta}$, I compute $\delta_j(\boldsymbol{\theta})$ which equates the observed share for plan j with the predicted share of plan j. Then, the likelihood function

is a function of $\{\boldsymbol{\theta}, \boldsymbol{\delta}(\boldsymbol{\theta})\}$, and searching only over the $\boldsymbol{\theta}$ space is sufficient for the maximization.

Chapter 6. Estimation Results

I present the first stage estimations based on two different models. The first model controls for only the income variable in the first stage. The second model, like the model in chapter 4, controls for both the income variable and the demographic characteristics interacted with data volume.

Table 4. First stage parameter estimates

	Model 1		Model 2	
Explanatory Variable	Coefficient	Standard Error	Coefficient	Standard Error
Price for income group 2	0.191	0.036	0.145	0.041
Price for income group 3	0.401	0.031	0.345	0.041
Price for income group 4	0.517	0.055	0.499	0.063
Interaction with data				
age	–	–	−0.154	0.021
dummy of having job	–	–	0.216	0.059

Note : Inverse of the information matrix is used to calculate the standard errors. (Train (2009))

Table 4 shows that every variable has a statistically significant impact on the utility under the given specification. The three price coefficients are generally similar between Model 1 and Model 2, and all of them have positive signs which means that, compared to the base zero income group, income earners are less price−sensitive.

Besides the signs, the size of coefficients becomes bigger as income is higher. It means that the price sensitivity is lower for the higher income group. The interaction term between data volume and age indicates that older individuals are less likely to demand larger data volume. Also, employed individuals are likely to have higher utility from larger data volume.

To estimate the price elasticity, the second stage results are required. The second stage estimation equation is given

$$\delta_j = \alpha_0 p_j + X_j\beta + \xi_j$$

As mentioned earlier, in the second stage, parameters α_0 and β are obtained by regressing δ_j on the price of plan j, p_j, and the attributes of plan j, X_j. However, simple OLS estimation may cause bias since the plan-specific unobservable, ξ_j, is correlated with the price of the plan, p_j. To address the endogeneity issue, 2SLS estimation is used.

For the instrument, the monthly phone bill payment in 2014 is used. To be specific, I use the mean of the monthly phone bill of consumers who chose a cell phone plan as the instrument for that plan. In the panel data, the instrument variable is observed at an individual level. How is the instrument related to the plan price? In most cases, individuals change their cell phone device at a 2-year interval. Although consumers might have chosen expensive plan for first several months to receive subsidy on the cell phone, they were able to change the plan after the contracted months. Since I restrict the sample for estimation to the respondents who changed their cell phone device in 2015, they were likely to have used another cell phone in 2014. Table 5 shows that they had been using the cell phone of 2014 for 1.5 year on average. With the assumption that individuals had already adjusted their cell phone plan to their actual use pattern in 2014, monthly phone bill in 2014 was correlated with the price of the cell phone plan they chose in 2015. In other words, the two variables revealed their actual service use pattern and were not biased by the subsidy competition. Furthermore, the previous

monthly phone bill was not affected by the plan-specific unobservable factors, ξ_j, in 2015.

Table 5. The using period of phone in 2014 among the samples

The length of using the phone in 2014	Percentage
more than 3 years	14.73
2 years	34.34
1 years	35.66
0 (bought the phone in 2014)	15.27
Total	100
The weighted mean of the length :1.49	

Table 6 shows the second stage estimation results from Model 1 and Model 2.

Table 6. The second stage parameter estimates

	Model 1		Model 2	
Explanatory Variable	Coefficient	Standard Error	Coefficient	Standard Error
Price	−1.035	0.095	−0.992	0.097
Data	0.095	0.077	0.296	0.079
Firm SKT	0.637	0.196	0.627	0.200
Firm KT	0.131	0.196	0.121	0.200
Constant	5.395	0.472	5.306	0.482

Except for the KT dummy variable, all variables enter in the demand specification with statistical significance. All coefficient signs and sizes are sensible. While the price coefficients per income class from the first stage of Model 2 is (0.145, 0.345, 0.499), the base price coefficient is −0.992. Therefore, it is inferred that, while individuals prefer a low-price cell phone plan if other things are equal, the price sensitivity is lower if income is higher. The estimates from

the two models are generally similar to each other excepting the coefficient on data volume. Although these two have positive signs, when data volume is controlled in terms of the demographic effect in the first stage, the second stage coefficient on data volume becomes larger compared to the results of Model 1, possibly because the negative impact of age on data volume demand is included in the Model 1 estimate while the effect is already reflected in the first stage and extracted in the second stage estimate of Model 2. Also, considering that LG has the lowest market share compared to other firms, it is appropriate for the SKT and KT firm dummy variables to have positive signs.

With the estimates from the first and second stages, I compute the own- and cross-price elasticities for each cell phone plan, which is shown in Table 7.

Table 7. Estimated demand elasticities

share change	Price change of the service...								
	SKT_L	SKT_M	SKT_H	KT_L	KT_M	KT_H	LG_L	LG_M	LG_H
SKT_L	-1.87	0.38	0.10	0.64	0.14	0.12	0.58	0.15	0.06
SKT_M	1.10	-4.06	0.13	0.58	0.14	0.14	0.52	0.16	0.07
SKT_H	0.94	0.40	-5.19	0.51	0.15	0.21	0.44	0.16	0.10
KT_L	1.20	0.38	0.11	-2.58	0.14	0.12	0.58	0.15	0.06
KT_M	1.08	0.39	0.13	0.58	-4.50	0.14	0.51	0.16	0.07
KT_H	0.96	0.39	0.19	0.52	0.15	-4.93	0.45	0.16	0.10
LG_L	1.22	0.38	0.10	0.64	0.14	0.12	-2.35	0.15	0.06
LG_M	1.10	0.39	0.13	0.58	0.14	0.14	0.52	-4.29	0.07
LG_H	0.94	0.39	0.18	0.51	0.15	0.19	0.44	0.16	-5.56

The SKT_L type has the lowest own-price elasticity, -1.873. Although the data volume offered by each of low type cell phone plan is almost the same, the other two firms' (KT and LG) own-price elasticities of the low type are -2.583 and -2.353, much lower than that of SKT_L. The magnitude of own-price elasticities is bigger for

the higher type of cell phone plans. This may seem unusual because individuals who purchase an expensive high-type cell phone plan are not likely to change their high type cell phone plan to a lower type cell phone plan when the price of the high type cell phone plan slightly increases. Although the derivative part, $\Delta share/\Delta price$, of elasticity is smaller for the higher types, since the prices of high types are higher than lower types while the shares of high types are much smaller than low types, $price/share$ part reversed the trend observed in $\Delta share/\Delta price$.

In terms of substitutability, a low type's closest substitute is a low type cell phone plan of other firms. For example, raising the price of SKT_L leads to a larger increase in the price of low types of other firms. A middle type's closest substitute can be a high type cell phone plan. A high type cell phone plan is likely to be substituted with another firm's high type cell phone plan.

Chapter 7. Counterfactual policy changes

It has been pointed out that prices of cell phone plans in Korea are unnecessarily expensive, which resulted in several policy changes. Here, with the demand estimates, I conduct counterfactual analyses on two of those policy changes. The first change was that the Korean government shifted the regulation on pricing from the approval system to the reporting system. Second, I analyze the impact of introducing a new cell phone plan, which was one of the current president's promises. The detailed explanations of each policy are covered in chapter 2.

To briefly summarize, "the approval system" indicates the current pricing system that a leading firm among the major three service providers must obtain a governmental permission for prices of new cell phone plans before selling them. It has been argued that the approval system deters market competition and paradoxically keeps the prices of cell phone plans high. If the current approval system is shifted to "the reporting system", the Korean government

leaves service providers to set prices freely in the market; the government intervenes only in case of unfair market outcomes. The new cell phone plan introduced by the government costs $20–$30 for 2GB data.

7.1. Change in the government regulation

In this section, I compute possible prices under the report system with the assumption that, under the report system, the three major service providers simultaneously set profit–maximizing prices considering the price competition. This assumption may seem too restrictive, since the biggest concern of not abolishing the regulation is the possibility predatory pricing of the market–dominating service provider. Although this counterfactual analysis may be limited to infer the market–dominating service provider's incentive to set aggressive prices, it can predict prices under the fiercest competition and recognize factors affecting the cell phone plan prices in the pricing system. Therefore, the analysis can consider the ways of compensating the new system and controlling for variables other than the policy change.

The process can be explained by the following equations. When J_f denotes the set of cell phone plans of a service provider f, the profit of the service provider f is

$$\Pi_f = \sum_{j \in J_f} q_j(p_j - mc_j) - C_f = \sum_{j \in J_f} M * s_j(p_j - mc_j) - C_f \qquad (8)$$

where mc_j is marginal cost, M is the total number of individuals in the market, s_j is the market share of plan j, and C_f is the fixed cost of the service provider. The service provider's profit–maximizing prices satisfy the first order conditions

$$0 = \frac{1}{M}\frac{\partial \Pi_f(\boldsymbol{p})}{\partial p_k} = \sum_{j \in J_f} \frac{\partial s_j(\boldsymbol{p})}{\partial p_k}(p_j - mc_j) + s_k, \qquad k \in J_f \qquad (9)$$

The market share of a cell phone plan is a function of the vector of all prices, $\boldsymbol{p}$. The share was computed based on the model specification presented in chapter 4 and its parameter estimates. If one of the cell phone plans price changes, then the predicted share of the plan also changes. The prices satisfying the first order equations for all service providers and plans are the profit-maximizing prices. I use them as prices under the reporting system.

The direct use of the equations above is problematic because of the marginal cost. While the industry requires huge amount of cost to establish the initial infrastructure and start a business, marginal cost per person is virtually almost zero regardless of service types. I assume four possible cases of marginal costs and computed optimal prices for each case. By exploring all possible cases, the counter factual prices under various situations can be estimated.

First, I analyze the simplest and fiercest competition case where marginal costs of all cell phone plans are zero. Second, as another extreme case, I assume that the observed prices are the results of profit-maximizing in the price competition. In other words, the second argument presumed the current system does not hinder market competition, so the abolition of the approval regulation has no consequences. Based on the profit-maximizing FOC equations above, the marginal costs of cell phone plans are implied. With these implied marginal costs, I approximately infer the costs a service provider charges their customers.

For the other two cases, I aim to assume more realistic marginal costs. Then, how does each of service providers set prices of their cell phone plans? Although there is no perfect answer for this question, approximately, service providers set prices in proportion to data volume. The proportion, however, is not necessarily linear. The example of pricing is shown in Table 8. The table shows data volume of cell phone plans and their prices that a customer can buy after consuming all pre-paid data.

Table 8. The optional services' prices and the amount of data they offer.

DATA (GB)	Price (about 1$)		
	SKT	KT	LG
0.05			1
0.1	2	18	2
0.25			5
0.3			
0.5	10	8	10
1	15	13	15
2	19	18	19
5	33	33	33
8	45		
12	60		
16	70		

Note : The optional service only offers the data up to 5GB. For the service prices above 5GB, I refer the SKT reports submitted to the Ministry of Science and ICT.

While 0.5GB data costs about $10, 1GB data costs about $15. 5GB data costs almost $33. The prices vary a lot, and the price of unit data (1GB) becomes lower when purchasing larger volume of data.

Like mentioned, this analysis significantly depends on the assumption on the marginal costs.

Moreover, according to the reports that SKT submitted to the Ministry of Science and ICT (MSIT) for the pricing approvals, the average-per-person cost computed by dividing the total costs by the number of total customers were used to set prices. In the reports, the company explicitly mentioned that it is impossible to accurately figure out costs of offering different cell phone services since the services are based on the existing infrastructure of wire networks. Thus, the average individual costs were taken into account to set prices for different cell phone services. Unfortunately, the MSIT released the reports to the public after erasing the value of the average-per-person costs so I could not apply the actual value in this analysis. However, as mentioned earlier, I roughly guessed the value based on the second assumption on the marginal costs.

Considered this situation, for the third assumption, I use the values in Table 8 to assume marginal costs. Especially, I divide the prices of optional services by two and regarded the values as the marginal costs of cell phone plans offering the similar volume of data. For the fourth case, considering that service providers took the individual costs into account, I assumed that they set marginal costs for each cell phone plan so that the weighted average of those allocated costs is equal to the average individual cost.

To be specific, if a service provider allocates different marginal cost to different cell phone plans, then the profit-maximizing prices considering those different marginal costs are calculated. With these profit-maximizing prices, the predicted market shares are obtained. Using these market shares, I am able to compute the probability of a cell phone plan being chosen at a service provider level. Using the predicted share of a cell phone plan at a service provider level as weights of the allocated marginal costs, a service provider can successfully divide costs if the weighted mean of marginal cost equals to the average individual costs of the service provider.

My analysis below is based on the estimation results of Model 2 in chapter 5, which controls for data volume and demographic interaction terms in the first stage of estimation.

7.1.1. Prices when marginal costs are equal to zero

To put it simply, the actual marginal cost of any telecommunication service is close to zero. Although it is unlikely for the providers to set zero marginal costs for all plans, if the price competition between providers become intense, zero marginal costs could happen. Based on this assumption, I computed the profit-maximizing optimal prices.

Table 9. The profit maximizing prices when marginal costs are equal to zero

	Optimal Price (about 10$)	Predicted Share	Observed prices (about 10$)	Observed market share
SKT_L	1.991	0.133	3.654	0.383
SKT_M	1.996	0.148	5.632	0.086
SKT_H	2.025	0.123	7.458	0.021
KT_L	1.707	0.099	3.830	0.194
KT_M	1.715	0.083	5.942	0.030
KT_H	1.763	0.129	7.016	0.024
LG_L	1.645	0.076	3.465	0.192
LG_M	1.650	0.081	5.638	0.035
LG_H	1.666	0.126	7.883	0.011

We can see that prices decreased a lot to about $20. The price gap between different types of cell phone plans is noteworthy. While approximately $20 gap between different types of cell phone plans is recognized in the prices, there is no huge difference from the counterfactual prices, which is possibly associated with the assumption that the marginal costs of each cell phone plan are zero and individual preferences in data volume. If marginal costs are zero, service providers are indifferent to providing any cell phone plan in terms of cost. To attract customers who want to use a higher type cell phone plan but do not want to pay the accompanying expensive phone bill, the service providers lower the prices of high and middle type cell phone plan to be competitive. Furthermore, it seems market become less concentrated when the providers set zero marginal costs. However, since the providers' supply sides are not considered here, it is uncertain that these prices can be persisted.

7.1.2. When the observed prices are profit maximizing prices.

In this section, I examine marginal costs under the assumption that the observed prices are profit-maximizing prices considering the marginal costs. As mentioned above, this assumption might be unrealistic. However, based on the results, we can approximately infer the average individual cost of each service provider from the weighted average of marginal costs by using the shares at a service provider level as weights. Table 10 shows the results.

Table 10. Implied marginal costs when the observed prices are profit maximizing prices

	Implied MC (about 10$)	Implied Markup	Market Share	Share in a firm level
SKT_L	1.343	0.632	0.383	0.783
SKT_M	3.227	0.427	0.086	0.175
SKT_H	4.936	0.338	0.021	0.042
KT_L	2.263	0.409	0.194	0.782
KT_M	4.267	0.282	0.030	0.120
KT_H	5.254	0.251	0.024	0.099
LG_L	1.928	0.444	0.192	0.808
LG_M	4.005	0.290	0.035	0.146
LG_H	6.119	0.224	0.011	0.046

The column 4 of Table 10 shows the shares of each cell phone plan at a service provider level calculated by dividing a cell phone plans market share by a sum of market shares of cell phone plans offered by the same service provider. For example, SKT_L's firm level share is

$$\text{Firm level share of SKT\_L} = \frac{\text{the observed share of SKT\_L}}{\text{the sum of observed shares of services from SKT}} = \frac{s_{SKT_L}}{s_{SKT_L} + s_{SKT_M} + s_{SKT_H}}$$

where s indicates the market share.

Table 11. Inferred total costs and individual cost per firm from the results in Table 7

	Total cost(10$) in 2,455 size market	Pct. of customers	Individual cost(10$)
SKT	2,191.5	0.4895	1.8
KT	1,703.1	0.2476	2.8
LG	1,416.3	0.2380	2.4

The weighted averages of marginal costs are about $18.25, $27.98 and $24.24 for SKT, KT and LG, respectively. Although SKT spends more costs in total, due to the larger number of total customers, it has the lowest individual cost. The size of the total cost in order seems reasonable since SKT invests more in R&D and marketing, and KT invests more than LG. Assuming that the current system hinders the price competition, we can also assume that the estimated total cost above is the maximum cost imposed on customers by each service provider. In other words, under the report system, the providers are likely to lower total costs from the above estimated total costs while price competing.

7.1.3. Prices using proxy marginal costs

In this section, I predict prices under the changed system with proxies for marginal costs. I use the data volume for optional purchase in Table 8 for calculating the proxy marginal costs. First, I match the low type, middle type and high type cell phone plans of each service provider with the data volume for optional purchase. Then, I divide the prices of the data volume for optional purchase by two and regard them as costs of offering corresponding data volume. Unit data costs can be computed by dividing the costs by their data volume. Marginal cost of each cell phone plan is assumed by multiplying the corresponding unit data cost with the data volume the plan offers. The process is presented in Table 12.

Table 12. Calculating proxy marginal cost for each service.

Optional service				Services of analysis		
Price (10$)	Cost (10$)	Data (GB)	unit MC (10$/GB)	Name	Data (GB)	MC(10$) =unit MC*Data
1.5	0.75	1	0.75	SKT_L	1.44	1.08
3.3	1.65	5	0.33	SKT_M	6.40	2.11
7	3.5	50	0.07	SKT_H	49.40	3.46
1.3	0.65	1	0.65	KT_L	1.58	1.03
3.3	1.65	5	0.33	KT_M	7.00	2.31
7	3.5	50	0.07	KT_H	49.70	3.48
1.5	0.75	1	0.75	LG_L	1.48	1.11
3.3	1.65	5	0.33	LG_M	7.25	2.39
7	3.5	30	0.12	LG_H	31.00	3.62

Table 13. Profit maximizing prices under proxy marginal costs.

	Marginal cost (10$)	Price (10$)	Predicted Share
SKT_L	1.08	3.12	0.26
SKT_M	2.11	4.20	0.12
SKT_H	3.46	5.65	0.04
KT_L	1.03	2.74	0.21
KT_M	2.31	4.07	0.06
KT_H	3.48	5.33	0.04
LG_L	1.11	2.68	0.16
LG_M	2.39	4.02	0.06
LG_H	3.62	5.32	0.03

Table 13 shows the predicted prices and shares considering the proxy marginal costs. While the marginal costs are similar for each of the types among service providers, the leading company SKT sets the highest prices for each type. In addition, with the proxy

marginal costs, prices of high and middle types go down substantially. Thus, the shares of these two types increased compared to the observed shares.

To this point in this paper, I presented possible counterfactual outcomes which critically depends on the assumptions of marginal costs. What can be inferred through these analyses? Particularly, can any lower or upper bounds be said with these results? As shown, the lower the marginal costs, the cheaper counterfactual prices are. Among the three assumptions, the assumption that marginal cost equals to zero gives the lowest outcome and another assumption that current prices are profit maximizing prices give the highest marginal cost. However, it cannot be said that the zero marginal costs are the minimum and the current prices are the maximum prices in the changed system since the marginal costs can go up in the changed system. Also, it seems rather very unrealistic to assume a marginal cost as zero. Therefore, in the following section, I assume a pricing method of the service providers and calculate counterfactual prices under two cases : all the providers' total costs decreased or increased. Although the following analysis does not guarantee any precise lower or upper bound either, providers' pricing tendency in the changed system can be observed more realistically.

7.1.4. Prices considering the individual costs.

In this section, I first explain how to set service prices considering the average individual cost. Assuming that all three major service providers in Korea would follow this pricing rule, I estimate possible total costs of the service providers under the report system and calculated the service prices.

First, I identify marginal costs that each service providers sets for cell phone plans and corresponding profit-maximizing cell phone plan prices. What does "identifying marginal costs" means? I explained earlier that SKT, the leading company, set prices

considering the average individual cost as actual marginal costs are almost zero. I assume that other service providers have a similar rule for pricing. In other words, there is a certain amount of expenditure that a service provider aims to impose on a customer in proportion to the total cost. Furthermore, the three service providers set nonlinear prices for data volume.

To summarize, I find marginal costs satisfying

$$\frac{\text{Total cost of the firm f}}{\left(s\left(p(\boldsymbol{mc})\right)_{Lf} + s\left(p(\boldsymbol{mc})\right)_{Mf} + s\left(p(\boldsymbol{mc})\right)_{Hf}\right) * M}$$

$$= mc_{Lf} * s\left(p(\boldsymbol{mc})\right)_{Lf} + mc_{Mf} * s\left(p(\boldsymbol{mc})\right)_{Mf} + mc_{Hf} * s\left(p(\boldsymbol{mc})\right)_{Hf}$$

$$\text{where f} = \text{SKT, KT, LG}$$

where $\boldsymbol{mc}$ is a vector of marginal costs of a cell phone plan offered by all three service providers, M is the total number of consumers in the market, f denotes each service provider, s means the market share and L, M, H indicate the types of cell phone plans.

The problem of this equation is that, while there is a total of 9 unknown variables, only three equations were used for the marginal costs of cell phone plans. To address this problem, I use a cost of unit data per service provider and two scaling factors to describe the nonlinear data pricing. With the unit cost, I am able to calculate the marginal costs of each cell phone plan by simply multiplying the unit data cost with the data volume of each cell phone plan and adjust the linear marginal costs to the nonlinear pricing by applying the different scaling rates on the M type and H type. Then, by applying the scaling rates on M and H types and the total cost of each service provider, the equations changes to the three unknown variables with three equations. I assume that it is optimal for all of the three service providers to set the same rates on the M and H types, respectively. In other words, the three firms adopt the uniform rates.

Are these assumptions acceptable? Unlike the optional purchase presented in Table 8, here I predict the prices of basic cell

phone plans which contain provider-specific services such as free calls . Therefore, the unit data cost can vary among service providers. For the scaling factors, it is hard to verify the assumption that the providers set the same price percentage gap difference between plan types. However, since they offer similar services, it is unlikely to set much different price percentage gap between plans. For the scaling factors, I use [0.6,0.9] which are the observed unit data price's percentage gap between the low and middle type and the low and high type in Table 8.

Although the best case was using the actual total costs that each service provider passes on to customers, obtaining the actual data was not feasible during the period of study. Thus, I assume the total costs of the service providers based on the implied total costs estimated in the section 6.1.2, the section calculates the implied marginal costs assuming that the observed prices are profit maximizing prices. I assume that the gap between the service providers remains while the implied total costs of each service provider can decrease or increase.

Table 14. Assumed total costs: decreased by 3,000$ for each firm from the total costs in Table 8

	Total Cost (10$)
SKT	1,800
KT	1,400
LG	1,100

Table 15. Predicted marginal costs and corresponding prices and market shares when total costs are like the Table 11.

	Marginal cost(10$)	Price (10$)	Predicted Share	Observed prices
SKT_L	1.27	3.32	0.27	3.65
SKT_M	2.26	4.35	0.13	5.63
SKT_H	4.36	6.58	0.02	7.46
KT_L	0.96	2.89	0.23	3.83
KT_M	1.69	3.65	0.10	5.94
KT_H	3.00	5.06	0.06	7.02
LG_L	1.92	3.34	0.11	3.47
LG_M	3.76	5.28	0.03	5.64
LG_H	4.02	5.57	0.03	7.88

Although the decline in the total costs per service providers seems small, considering that all of the service providers' total costs decreased by $3,000 per provider in the 2,455-size market, it is not a small change. However, the predicted prices are not very different from the observed prices of the lower type cell phone plans. For the middle and high types, noticeable decreases are observed, which may imply that, the changed system and service providers' attempts to reduce the total costs are not likely to decrease the prices of the low type plans. Considering almost 61 percent of customers use a low-type cell phone plan even in the counterfactual situation, most customers are not likely to recognize the price change significantly.

I also analyze the case where all of the service providers have increased by $3,000 per provider in the 2,455-size market. Table 16 shows the assumed total costs of the service providers, each provider's total costs increased by almost $3,000 compared to the implied total costs in the first column of Table 11.

Table 16. Assumed total costs: all firms total costs increased by 3,000$

	Total Cost (10$)
SKT	2,500
KT	2,000
LG	1,700

Table 17. Predicted marginal costs and corresponding prices and market shares when total costs are like the Table 16

	Marginal cost(10$)	Price (10$)	Share	Observed Prices
SKT_L	2.260	4.174	0.302	3.654
SKT_M	4.013	6.024	0.076	5.632
SKT_H	7.744	10.002	0.004	7.458
KT_L	1.854	3.674	0.271	3.830
KT_M	3.279	5.160	0.067	5.942
KT_H	5.820	7.851	0.016	7.016
LG_L	2.315	3.846	0.170	3.465
LG_M	4.526	6.173	0.027	5.638
LG_H	4.839	6.524	0.036	7.883

Like the previous case, compared to the low type plans, larger change in the prices of middle and high type plans were observed. Although the direction of changes can be different across providers and services, the size of the change in the prices of low type is smaller than that of the prices of middle and high type.

If the total costs of all three providers decrease, provider decrease the prices of middle and high type plan more. While customers who buy the middle and high type plans may choose a low-type plan, there is almost no option for customers who already use a low type plan. Thus, the service providers do not have an incentive to lower the prices substantially while they may lower the prices of higher type plans to attract customers.

If the total costs of all three providers increase, to cover the

total costs, providers increase prices. Considered that people who choose higher type plans are less sensitive to price, providers may increase middle and high type prices more compared to low types. LG's changes to the opposite direction observed in Table 17 may be resulted from the volume of data that the LG's high type plan offer, which is smaller than the volume of the other high-types (See Table 12).

This analysis is limited due to a lack of information on the actual total costs a service provider imposes on customers. However, I can conclude that if the system changes, the size of price change is larger for the middle and high type plans compared to that of low type plans.

Unfortunately, it is uncertain that the service providers would actually lower the total costs or reflect the decreased total costs on the plan prices. Because an individual generally maintains a cell phone plan and pays monthly bills for approximately 2 years, the service providers are likely to collude on keeping high monthly bill prices and compete in marketing to attract new customers. Therefore, even if the regulation is abolished to encourage the price competition, in order to decrease the prices, it is important to monitor wasteful spending of the service providers and their pricing.

7.2. Introducing new cell phone plans

As a way of lowering the prices of cell phone plans, the present government promised to introduce a new cell phone plan which offers 1GB data for the price between $20 and $30. The service providers oppose the policy, claiming the government intervenes too much. Here, I examine how the service providers and consumers would react to the newly initiated cell phone plan.

First, I analyze how the new cell phone plan would affect the existing market shares. The results are shown in Table 18.

Table 18. The change in market shares when new goods are introduced and service prices remain the same

	Market Share with NG		The market share of 2015
	NG = 25$	NG = 30$	
SKT_L	0.126	0.164	0.302
SKT_M	0.030	0.038	0.113
SKT_H	0.008	0.010	0.012
KT_L	0.064	0.083	0.245
KT_M	0.011	0.013	0.075
KT_H	0.009	0.011	0.024
LG_L	0.063	0.082	0.144
LG_M	0.012	0.015	0.028
LG_H	0.004	0.005	0.037
SKT_NG	0.311	0.266	_
KT_NG	0.187	0.160	_
LG_NG	0.166	0.142	_

If the new plan is introduced and the service providers keep the same prices, the market shares of the existing plans would decrease a lot. Even customers using a high type plan would choose another plan.

Although the service providers would not keep the same prices, it is hard to predict the adjusted prices under the current system, since the price competition is deterred by the regulation on the leading service provider and then the profit-maximizing FOCs to calculate new prices would not be directly used. Thus, I use both implied marginal costs from Table 10 and proxy marginal costs from Table 13.

Furthermore, I assume that introducing a new low type plan would ultimately replace the existing low types plans, since the data volume of the new plan, 1GB, is almost same with the data volume the low that plans offer. Table 19 shows the data volume that the low type plans offer as of 2015.

Table 19. The amount of data that the low type services offer

Name	DATA (GB)
SKT_L	1.44
KT_L	1.58
LG_L	1.48

Table 20. Predicted prices when new services replaced low type service and KT and marginal costs are implied marginal costs

Implied marginal costs				
	L type prices are fixed to $25		L type prices are not fixed	
	Prices (10$)	Markup	Prices (10$)	Markup
SKT_L	2.500	0.6272	3.137	0.7029
SKT_M	5.724	0.4362	5.559	0.4195
SKT_H	7.547	0.3460	7.395	0.3325
KT_L	2.500	0.4283	3.060	0.5329
KT_M	6.100	0.3005	6.045	0.2942
KT_H	7.160	0.2663	7.110	0.2611
LG_L	2.500	0.4802	2.848	0.5437
LG_M	5.658	0.2923	5.681	0.2951
LG_H	7.912	0.2266	7.928	0.2281

Table 21. Predicted prices when new services replaced low type service and KT and marginal costs are proxy marginal costs

Proxy marginal costs				
	L type prices are fixed to $25		L type prices are not fixed	
	Prices (10$)	Markup	Prices (10$)	Markup
SKT_L	2.500	0.7000	2.772	0.7294
SKT_M	4.412	0.5213	4.208	0.4981
SKT_H	5.843	0.4082	5.659	0.3889
KT_L	2.500	0.7400	2.369	0.7256
KT_M	4.041	0.4283	4.102	0.4369
KT_H	5.301	0.3437	5.355	0.3503
LG_L	2.500	0.7000	2.319	0.6766
LG_M	3.981	0.3991	4.034	0.4070
LG_H	5.289	0.3162	5.337	0.3223

As explained, the low type plans from the three providers in both Table 20 and Table 21 provide 1GB of data. The Table 20 and Table 21 are different in terms of marginal costs used in prices calculation. For Table 20, implied marginal costs obtained from the assumption that the observed prices are profit maximizing prices are used and for Table 21, the proxy marginal costs are used. The first column of Table 20 and Table 21 is the profit maximizing prices of plans when the replaced low plans' prices are fixed to 25$. The second column is corresponding percentage markups of the plan prices in the first column. Third column shows the profit maximizing prices without the $25 constraint on the low type plan. That is, firms set profit maximizing prices considering the marginal cost and the changed data volume of the low type plans. Markups for these plan prices are shown in the fourth column. In this analyzing process, I assume that, even though the prices and the data volume of the low type plans change, the unobserved characteristics of the low type plans remain the same.

Then, how would the service providers change their prices in response to the introduction of the new government-driven plan? The middle and high type plan prices of LG and KT (the first column) declined compared to the profit maximizing prices with the same proxy marginal cost (the third column), while the middle and high type plans prices of SKT went up. With the implied marginal costs, compared to the profit maximizing prices without price constraints on the low type plans, all the middle and high type plan prices increased. In other words, even the market system changed to the report system, the prices of the middle and high type plans may go up with the introduction of the new plan. Therefore, introducing the new government-driven plan may not work for the governmental goal of lowering the overall prices of cell phone plans.

Chapter 8. Conclusion

The telecommunication service is a necessary good in any modern society. Thus, factors affecting telecommunication prices need to be carefully analyzed. This paper examined the impacts of two proposed policy changes based on the demand estimates. I estimate an individual level disscrete choice demand system for cell phone plans aggregated to nine categories. Based on the structural framework, I control for the unobserved characteristics of cell phone plans.

The results indicated that, unlike the existing findings on commodities, own-price elasticities of low type cell phone plans were lower than other higher type of cell phone plans. The middle type plan users may switch over to a high type plan rather than switching over to another provider's middle type plan, whereas the low and high type plan users may switch over to the same plan type of another provider.

To compute the prices after the change in the current system, I divide possible cases of the marginal costs. For the counterfactual analysis in case of abolishing the regulation on a leading service

provider, I use the profit-maximizing first order conditions given the marginal costs. In addition, I take the actual pricing system into account and calculated how each service provider sets nonlinear prices given the possible total costs under the reporting system. Furthermore, I approximately estimate the current average individual cost of each service provider. The results showed that the prices may decrease due to the price competition that lowers the total costs under the changed system. Especially, noticeable decreases in the middle and high type plans appeared compared to the low type plans.

The other hypothetical change in the current market was an introduction of a government-initiated cell phone plan. The proposed plan would offer similar services of the current low type plans. Therefore, after replacing the low type plans' characteristics and the prices to the new plan, I predict profit maximizing prices. The results revealed that, when the new plan is introduced, the service providers are likely to raise the prices of other type plans. Thus, adopting the government-driven cell phone plan would not be effective if the target of the government policy is not only the low type plans but also the general types of plans.

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Abstract

이 논문은 두 가상적인 상황에서 한국의 이동통신요금이 어떻게 변화할 것인가를 추정한다. 구체적으로, 현재 시장지배적 사업자가 정부에게 요금을 인가 받아야 하는 제도를 폐지하여 이동통신 사업자간 자유로운 가격경쟁이 있을 때의 가격과 현 정부에서 도입하려 하는 보편요금제가 도입되었을 때의 가격을 예측하였다. 이 연구에서는 4G 휴대폰 요금제 수요를 추정하기 위해 BLP 모델을 사용하였다. 더불어 다양한 이동통신회사의 가격 설정 모형을 가정하고, 이를 바탕으로 인가제 폐지와 보편요금제 도입 시 가격 변화를 추정하였다. 분석 결과, 인가제가 폐지되어 이동통신사들이 가격을 낮출 경우, 상대적으로 비싼 요금제에서 가격하락이 클 것으로 추정된다. 반면에 보편요금제 도입 시, 이동통신사가 고가요금제의 가격을 더 높일 수 있다는 것을 확인하였다.