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Revisiting Number Portability and Switching Cost from the Experience of South Korean Mobile Operator

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Abstracts

Many mobile phone subscribers have their own experience of switching from one network to the other. Introduction of Mobile Number Portability (MNP) in the Korean mobile market back in 2004 was believed to lower the switching costs of subscribers. This study reveals that subscribers perceive the switching cost still high, discouraging them from switching carriers. While MNP lowered switching costs considerably, a significant level of switching costs still remains despite MNP. Carriers develop new lock-in strategies that make them stay with current carriers. In addition, there are hidden costs other than MNP that should burden subscribers with.

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Ⅰ. Introduction

A product has switching costs if a buyer would purchase it repeatedly and find it costly to switch from one brand or product

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to another. Large switching costs lock in a buyer once he makes an initial purchase. The economics of switching costs and network effects have received a great deal of attention in recent decades. Their importance has been growing as information technology industries dominate a larger share of our economies.

This paper examines the consequences of introducing mobile number portability (MNP) in Korea back in 2004 and the firms' strategies under MNP, which is believed to reduce consumer-switching costs. Although a much larger part of the switching costs would be the handset, contracts or many other reasons, this paper's focus is on the effect of number portability on the switching costs and identifying the determinants of the switching costs. The objective of this chapter is to identify the factors that cause switching costs in mobile telecom service (what would stop them from switching the carriers, and what would make them choose one carrier over another?), estimate the relative switching costs in the Korean mobile market using easily available market data, and analyze each carrier's switching cost after the introduction of number portability.

Any type of switching cost can be a factor that differentiates one product from another when they were homogeneous ex ante. This is a good reason that consumers with high switching cost hesitate switching their service providers even when other service providers can offer a seemingly identical service at a lower price. This lock-in effect can be considered as one of the anti-competitive factors in a subscriber-based industry such as telecommunication services.

The structure of wireless telecommunications in Korea has been a hot issue for the last decade especially after SK Telecom merged with Shinsegi Telecom in 2000. Some 87% of new mobile subscribers in year 2003 chose SK Telecom, which raises the

question of a 'tipping effect'[1] in the mobile telecom market. This brings out the effective competition issue, and one of the new mechanisms introduced to the market was Mobile Number Portability (MNP) to lower the switching cost with an intention of unlocking locked-in consumers. Mobile number portability was introduced in the sequence as follow:

【Table 1】 Mobile number portability implementation sequence

Timing	Allowed direction of mobile number portability		
	SKT -〉 other carriers	KTF -〉 other carriers	LGT -〉 other carriers
Jan.~Jun. 2004	Allowed	Not allowed	Not allowed
July~Dec. 2004	Allowed	Allowed	Not allowed
After Jan 2005	Allowed	Allowed	Allowed

Although number portability is not exactly a regulatory measure per se, it acted as an asymmetric regulation in Korea due to the nature of its introduction in sequence. It only offers mobile subscribers of SKT to churn out from their current service to other service providers for the initial six months. It is applied for the next 6 months to subscribers of KTF, the second largest mobile service provider. After January 2005 it was adopted fully across the service providers including LGT, the smallest of the three. This asymmetric regulatory measure was to protect the weakest network service provider, LGT, but it wouldn't have made too much of a negative impact on LGT's subscriber base even if MNP has been implemented all at the same time. Sequential implementation of MNP ignored the foregone consumer benefits of KTF and LGT subscribers who couldn't enjoy number portability while subscribers with SKT were free to move to other network

1) It has been widely used term in Korea referring to the accumulating market power of SKT.

providers. This is one of the critical oversights of Korean Ministry of Information and Communication (MIC).[2] If there needs to be any regulation, its justification is to protect the consumer benefits rather than protecting incompetent firms, which very well could be a free rider on unfair government protection.

Ⅱ. Literature Review

This study attempts to estimate switching cost using all three mobile operators' monthly data from 2001 to 2005.[3] I develop the method introduced by Shy (2002), modifying his model to the multiple firm case with additional variables. He demonstrated that under price competition between firms producing differentiated brands, a Nash Bertrand equilibrium in pure actions never exists. An Undercut-Proof equilibrium (UPE) was introduced by Morgan and Shy (2000) to avoid such a problem. Although the UPE is questioned by some such as Peeters and Strobel (2005), the comparative analysis between the two equilibria is out of the scope of this study although the disadvantages are considered. Shy (2002) developed a model to estimate switching cost for two different industries: the Israeli mobile telecommunication market, and the Finnish market for bank deposits. He showed that his model can be applied in industries ranging from health care services to telecommunication industry and beyond. Shy's model can give us a glimpse of switching costs change and its application can be insightful in identifying the change of switching costs in a given industry. Before MNP was introduced, consumers

2) MIC is now Korean Communications Commission.
3) The reason why I will use data from 2001 is that's when the current three mobile service providers have been operating since the merger and acquisition.

would have to get a new number when they switched operators. This can cause a nuisance as consumers have to inform the change to friends and relatives,[4] incur the cost of changing stationeries, receive wrong-numbered incoming calls,[5] and miss important calls. Introducing MNP is expected to have considerable benefits to the mobile telephone consumer. When the mobile penetration rate in Korea is a few points shy of 80%, the consumer benefit is shared by virtually everyone. However, Aoki and Small (1999,2005) showed theoretically that number portability cannot guarantee social benefit under specific cost and demand environments although they assumed that number portability reduced switching costs. Buehler and Haucap (2004) examined the consequence of mobile number portability and refined the conclusion of Aoki and Small (1999). Identifying switching cost is very important for any customer-based business. As stated by Shapiro and Varian (1998), "*You just cannot compete effectively in the information economy unless you know how to identify, measure, and understand switching costs and map strategy accordingly*."

In modeling switching costs, studies by Klemperer (1995) and Shy (2002) are closely related to this paper. The switching cost literature is mostly concerned with dynamic aspects. Klemperer (1987, 1995) analyzes dynamic price competition when consumers are to some degree locked in with their supplier due to switching costs. Klemperer (1995) argued there are several factors comprise switching costs. Compatibility with existing product is an important component of switching costs;[6] Transaction cost of

4) This may not be a big deal anymore due to group SMS: You can send SMS notifying the change of numbers to the contacts much easier than before.

5) This also benefits service providers since they have fewer numbers to recycle before distribute the numbers again for consumers to use so that consumers have wider number selection pools to choose from when they first activate the phone, which increases customer satisfaction level.

switching suppliers, the cost of learning new products-which is high for IT products, uncertainty about the quality of unproven products, discount coupons and similar devices like frequent flyer programs,[7] and finally, the psychological costs of switching such as brand loyalty. If there is an industry where multiple suppliers with similar production cost and quality exist, profit will be positively related with switching cost.[8] Therefore, measuring the size of switching cost can be a guideline for estimating the competitiveness of an industry.

The concept of switching costs has been dealt with in detail by Klemperer (1987) and Jones *et al*. (2002), among others. Despite the vast theoretical literature on consumer switching cost, empirical work is hard to find. Greenstein (1993) studies switching costs in mainframe computer purchases using data on U.S. federal government procurement. Sharpe (1997) analyzed the effects of switching costs on fees in the bank deposit market. Kim *et al*. (2003), Shy (2002), Chen and Hitt (2001), and Lee *et al*. (2006) also empirically analyze switching costs. The latter two studies use conjoint analysis and discrete choice modeling to estimate switching costs. Lee *et al*. (2006) used stated preference data acquired from a survey,[9] which is fundamentally different from this study. Lee *et al*. (2006) tried to estimate subjective switching cost by using a discrete choice model, but neglected to determine

6) The easiest example of this will be IBM compatible PC users' reluctance in purchasing Apple power book.

7) Korean mobile operators have been competing with each other by this type of indirect price competition in the form of strategic alliances with many consumer related services such as restaurants, theme parks, cinemas, and even some hair dressing shops for customer retention and lock in. All these benefits became switching costs for consumers.

8) Shapiro, C. and Varian, H., 1999, Information Rules, Harvard Business School Press, Boston Massachusetts.

9) Size of this survey population is 500 and limited to residents of Seoul Metropolitan area only. The survey participants had to choose from 16 conjoint cards.

the switching cost of each firm, which is related to market share of each firm analyzing the switching cost of each firm can provide a basis for evaluating competition policy. The advantage of Shy (2002)'s method is that it enables us to estimate switching cost by using market share and price data that can easily be obtained.

Ⅲ. Modeling switching costs.

Tight price regulation has somewhat discouraged price competition in the Korean mobile telephony market. Official regulation and unofficial intervention on pricing has discouraged carriers from attempting any direct price reduction for standard calling plans and introducing further optional calling plans.[10] Carriers have accepted the price regulation with little resistance, since it has significantly reduced the possibility of secret and sudden price cuts by rivals, thus facilitating collusion. The regulated price level of a market leader is thought to have served as a good focal point for this tacit collusion.

Although price competition on airtime usage was non-existent, substantial rivalry emerged on lowering the initial subscription price. With a very limited possibility of price competition, Korean mobile carriers also exerted efforts on non-price competition such as advertising, new services, and quality enhancement. In this paper, I consider price competition, which includes the initial subscription price and non-price factors.

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10) This restriction on price competition in the market induced Korean mobile carriers to devise different market segmentation than that of other countries'. SKT's TTL™ is the first attempt of age segmentation among the carriers. It was targeted age segment between high teens and early twenties with membership benefits such as discounted movie tickets, discount on TGI Fridays, and many more.

Consider a simple model to analyze the effect of switching cost on firm decision making. For this purpose, let's assume there exist switching costs, and the price competing mobile service providers are aware of the switching cost. My objective is to estimate the switching cost of mobile service providers by using market data.

Consider a market with three firms A, B *and* C. Each firm already has subscribers of S_A, S_B, S_C respectively. For the sake of simplicity of the model let's assume $S_A > S_B > S_C$.[11] Consumers are distributed among the firms so that initially S_A consumers have already purchased service from A (type α subscribers), S_B consumers have already purchased service from B (type β subscribers), and S_C consumers have purchased service from company C (type γ subscribers), and assume that consumers who are in the same subscription group are homogeneous. Let P_A, P_B, and P_C represent prices charged by the firms. Then assume when each type of consumer tries to move from one service to the other, there be a switching cost of $sc_i > 0$, and we assume this switching cost to be uniformly distributed. Let U_α denote the utility of a consumer who has purchased service A, U_β the utility of a consumer who has purchased service B, and U_γ the utility of a consumer who has purchased service C. As mentioned earlier, there could be many different factors involved in switching costs including some that are purely subjective. Therefore, the assumption that all consumers would have the same switching cost is strong. But it will be extremely difficult for anyone to relax that assumption and assume each heterogeneous consumer bears different switching cost in order to estimate it.

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11) It also represents the reality for the case of Korean mobile telecom industry that SKT with market share of 50.3%, KTF has 31.4%, and LGT with 18.3% of market share(as of end of 2009).

The utility function of each consumer type derived from the next purchase is given by

$$U = \begin{cases} b_i - p_i & continue\ \ to\ consume\ i \\ b_j - p_j - sc_i & switching\ \ to\ \ service\ j \end{cases}, \qquad (1)$$

where $i, j = A, B, C$ and $i \neq j$, b_i is benefit from consuming the service i. p is the price for the consuming service, SC is switching cost occurring by switching one's service from one to the other. All other things being equal, the size of the benefit b_i is related to the firm's marketing expenses and quality of services.

If there exist large switching costs for any price-competing telecom operators, there is no guarantee of attracting more subscribers than the competitor even after lowering one's price compared to competitors. The model indicates that in the presence of switching costs, it may not be desirable for a firm to lower its service price. This is also not inconsistent with tacit price collusion due to the price regulation.

Now let s_A, s_B, and s_C be the endogenously determined subscribers of services A, B and C on their next purchase, respectively. Then the utility function (1) implies when we assume $s_i(p_A, p_B, p_C)$ is the number of company i's subscribers at the given price set. The benefits from alternative services can differ from the benefit from the current service. When $p_j < (p_i - sc_i) + (b_j - b_i)$, then consumers will switch services only when the cost of switching to service j is cheaper than continuing to consume service i. Furthermore, it also depends on the size of the benefit that the consumer would receive from each service. This implies that in order for any consumer subscribing to service A to change its service to either B or C, the price difference between A and other service has to be large enough to offset the

switching cost and any differences in benefits. When we assume that the benefits among carriers are the same, switching the services would depend solely on the size of switching costs.

Now let's define the following,

$$A(i,p) \equiv \{j \in 1,2,3 | p_j < p_i - sc_i, p_j = \min_{k=1,2,3} p_k\}, \quad (2)$$

where $A(i,p)$ is a group of firms who are applying an undercut pricing strategy against firm i. Since there are three service-providing firms, it is clear to see that $0 \leq \#A(i,p) \leq 2$, where $\#A(i,p)$, is number of firms that belongs to the set $A(i,p)$.[12] Now using $A(i,p)$, we can define the following.

$$D(i,p) \equiv \{j \in \{1,2,3\} \setminus \{i\} | i \in A(j,p)\}, \quad (3)$$

where $D(i,p)$ is a group of firms that are attacked by firm i that apply an undercut pricing strategy.

Now we can express $s_i(p_A, p_B, p_C)$ as follow,

$$s_i(p_A, p_B, p_C) = \begin{cases} 0 & if \ A(i,p) \neq 0 \\ S_i + \sum_{j \in D(i,p)} \frac{S_j}{\#A(j,p)} & if \ A(i,p) = 0 \end{cases}, \quad (4)$$

For better understanding, when two firms are competing, it could be represented as follow

$$s_A(p_A, p_B) = \begin{cases} 0 & if \quad p_B < p_A - sc_A \\ S_A & if \quad p_B - sc_B \leq p_A \leq p_B + sc_A \\ S_A + S_B & if \quad p_A < p_B - sc_B \end{cases}, \quad (5)$$

12) Refer to the definition by Shy(2002).

Now, assume the marginal cost of service is zero, and that mobile service operator i is choosing price p_i where it can maximize $p_i s_i(p_A, p_B, p_C)$.

Nash-Bertrand equilibrium is the most often used tool in analyzing price competition between firms. However, when non-negative switching costs exist, Nash-Bertrand equilibrium doesn't exist.[13)]

Suppose (p_A^b, p_B^b, p_C^b) is the Nash-Bertrand equilibrium price, if we assume $p_i^b - sc_i > \min_{-i} p_{-i}^b$ then firm i will earn zero profit at equilibrium. Then firm i can lower its price to $sc_i + \min_{-i} p_{-i}^b$ in order to get positive profit. Therefore, in equilibrium, $p_i^b - sc_i = \min_{-i} p_{-i}^b$ has to be satisfied for all i. But this does not exist. For example, consider $p_B = \min_{-A} p_{-A}^b$, $p_C = \min_{-B} p_{-B}^b$, $p_A = \min_{-C} p_{-C}^b$ then $p_A > p_B > p_C > p_A$ has to be satisfied, but it cannot be true. This proves that the pure strategy Bertrand equilibrium doesn't exist.

Definition 1 (Undercut-proof equilibrium)

In our given three firm situation, UPE is a price vector $p^U = (p_A^U, p_B^U, p_C^U)$ such that,

A) For each $i (i = A, B)$, given $p_{-1}^U, S_c^U = p_i^U$ maximizes p_i subject to the following,
$p_C^U S_C \geq (p_i - sc_i)(S_C + S_i)$;

B) For the given $(p_A^U, p_B^U, p_C^U), p_C^U = p_C$ maximizes p_C subject to $p_i^U S_i^U \geq (p_c - sc_c)(S_C + S_i)$; and

C) for all $j = A, B, C, s_j$ will satisfy the equation (4).

Undercut proof equilibrium can be applied for the matured

13) Proof from Shy (2002).

market such that each competitive firm in the market already has its own subscribers and they are locked-in with positive switching costs. Subscribers of each firm realize that they have to bear the switching cost when switching from the current subscribing firm to a new firm. Knowing this, it is difficult to apply UPE to a new market. The Korean mobile market is well matured with a total market penetration rate of 78% so we can usefully apply UPE.

From definition 1, the first condition means that firm A and B would set their prices so that firm C, would not easily undercut to gain market share. The second condition of definition 1 means that the smallest firm C is setting its price in order to protect its current market share from getting even smaller when firm A or B would try to undercut.

An undercut proof equilibrium according to the definition 1 is a price vector (p_A^U, p_B^U, p_C^U), which satisfy the following equations.

$$p_C^U S_C = (p_A^U - sc_A)(S_C + S_A) \tag{6}$$

$$p_C^U S_C = (p_B^U - sc_B)(S_C + S_B) \tag{7}$$

$$p_A^U S_A = (p_C^U - sc_C)(S_C + S_A) \tag{8}$$

Solving the above equations, we get the solutions as follow;

$$p_A^U = (sc_A + \frac{sc_C S_C}{S_A + S_C})(\frac{(S_A + S_C)^2}{S_A^2 + S_A S_C + S_C^2}),$$

$$p_C^U = sc_C + \frac{p_A^U S_A}{S_A + S_C}, \text{ and}$$

$$p_B^U = sc_B + \frac{p_C^U S_C}{S_B + S_C}.$$

If we assume that there is zero switching cost, then each firm cannot easily lock-in its subscribers, and consumers would simply

switch their services to a lower price tag. This is the case when all mobile services are perfectly identical and non-differentiated.

Now we can calculate the switching cost for the each firm as follow

$$sc_A = p_A^U - \frac{p_C^U S_C}{S_A + S_C} \quad (9)$$

$$sc_B = p_B^U - \frac{p_C^U S_C}{S_B + S_C} \quad (10)$$

$$sc_C = p_C^U - \frac{p_A^U S_A}{S_A + S_C} \quad (11)$$

Using equations (9), (10), and (11) we can calculate the monthly switching cost trend of SKT, KTF and LGT and determine how introducing MNP influences the switching cost of each firm.

Ⅳ. Estimating switching cost by fitting the actual data

To calculate switching cost using the above equations (9), (10) and (11), total number of subscribers, revenue, and ARPU[14] for each network provider are needed. The data used here to estimate switching cost is monthly data of each network operators since 2001. Monthly data is collected from Jan 2001 to Sep. 2005 for all three Korean mobile network operators. The data collection initiates from Jan. 2001 since this was when the current three company oligopoly market structure started.

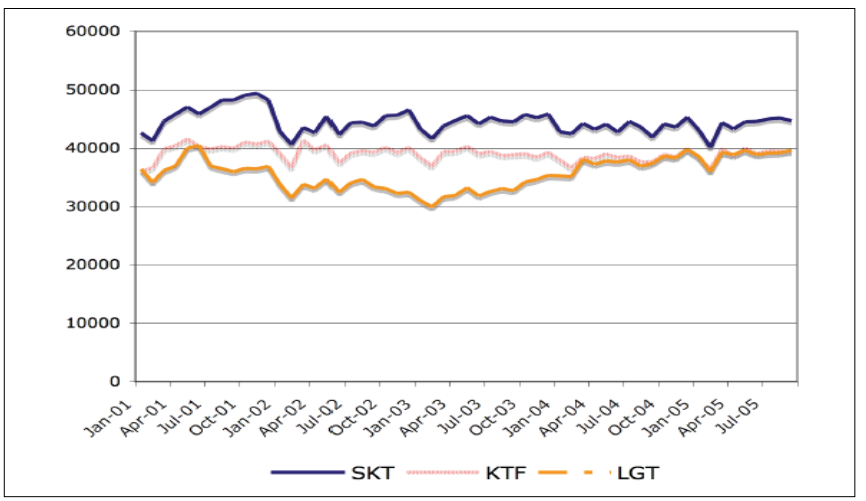
To examine the effect of MNP, first we need to calculate the

14) Average Revenue Per User

switching costs by applying the data to the model. The reason I used ARPU as the price proxy is due to the complicated pricing combinations in service plans, and ARPU can represent actual subscribers' price for the services without bias. There hasn't been any upset in the market share of Korean mobile market for the past 5 years.

The following chart can be interpreted as follow. It is clear that the larger subscriber-based network operators tend to have subscribers with higher switching costs, whereas the smallest firm, LGT has subscribers with low switching costs. This result coincides with the fact that LGT's subscribers have higher demand sensitivity to price. It also proves that it is not easy for SKT and KTF subscribers to switch from their network to LGT. LGT's relatively cheaper price is not low enough to cover the switching cost of SKT and KTF subscribers have to bear.

【Figure 1】Switching cost trend for the past 5 years



The largest part of the switching cost is likely to be the handset price. MIC regulation on handset subsidy since June 2000 increased subscribers' switching cost. As a result, it is no longer

possible for subscribers to get free handsets as do US subscribers with a long-term contract. The nuisance of changing one's phone number as switching carriers is another part of the switching cost. This type of cost is expected to be high for heavy mobile users.

On average, subscribers of SKT have higher ARPU than those of other carriers', and as we expected. The result shows that switching costs of SKT subscribers are higher than those of other carriers.

Other product-differentiating services such as discounts for long-term subscribers and membership benefits from each network operators also have an impact on switching cost also. Should anyone switch carriers, long-term loyal subscribers can lose her membership and discount benefit. Since SKT has been operating the longest, its subscribers would have higher switching costs than other carriers' subscribers.

It is noticeable that right after MNP was introduced, the switching cost of LGT started to climb while the switching cost of SKT is consistently falling. Being able to keep the same number when switching carriers seems to lower the switching costs. This is partly due to the subscribers with high switching cost churned into LGT from SKT and KTF. Heterogeneity of subscribers and the composition of a network's subscribers can be a significant attribute that makes switching costs of each firm differ.

Ⅴ. Lock-in vs. Switching

The above section showed us how MNP impacts each firm's switching costs in relative terms. In this section, I identify what would stop consumers from switching the carriers, and what would make them choose one carrier over the other.

It is safe to say that recent mobile telecommunication service market is in transition. Boosted by the rapid development of information and communication technologies and more sophisticated demand from the consumers, the reasons for switching carriers is quite different from what they used to be. Voice-oriented communication service is now shifting to high speed data-oriented services.

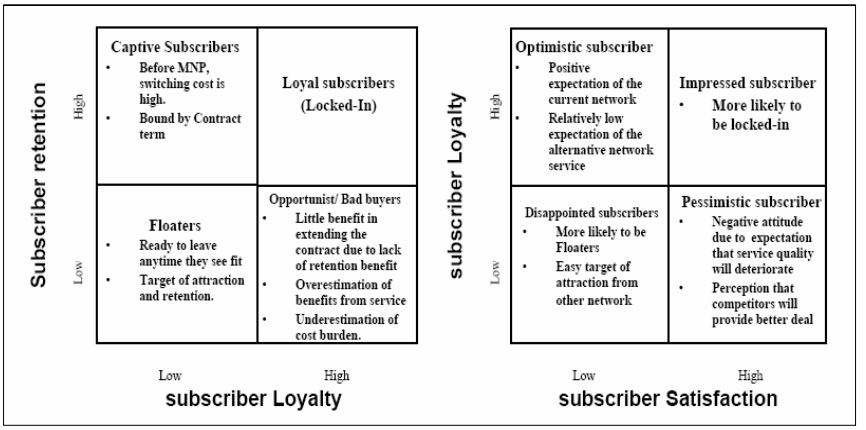
Some studies suggest that customer loyalty provides the foundation of a company's sustained competitive edge, and that developing and increasing customer loyalty is a crucial factor in companies' growth and performance. However, not enough studies have been conducted on this subject in mobile telecommunications services. This is partly due to the relatively short history of the industry. Only in the late 1990s did research on factors affecting customer loyalty and carrier switching began. It is important to verify the relationship between subscriber loyalty, satisfaction and switching costs.

Proposition 1: *subscribers' loyalty levels depend upon satisfaction level and switching barriers, and they change the firms' market strategy. High loyalty level can be translated into a high probability of staying within the network.*

Fig 2 shows the relationship between the subscribers' loyalty, satisfaction level and level of retention. I define customers with low loyalty level and low retention as "Floaters". If one network operator has this group of subscribers within its own network, a high effort towards retention strategy is needed. The subscriber retention can be accomplished by maximizing customer satisfaction and the switching costs in order to enhance customer loyalty level. Raising switching costs of consumers may not sound good, but it

can very well be beneficial effort for consumers.

【Figure 2】Customer loyalty, Satisfaction and Retention of the subscribers



If the same network spotted this type of subscriber in competing networks, they have a clear chance to attract them to its own network. The more floaters are in a network, the more vulnerable is its market share. The introduction of MNP actually shifts a large percentage of "Captive subscribers" to "Floaters" by removing the switching cost caused by the change of phone number. Therefore, introducing MNP to the market is expected to encourage effective competition. Marketing strategy has two types: retention and attraction. Network operators usually mix their marketing strategies either to increase customer loyalty level or to gain new subscribers.

Subscribers experiencing a high level of satisfaction are likely to remain with their existing providers and maintain their subscription. However, according to some research, customer satisfaction, while positively influencing subscriber loyalty, is not always a sufficient condition, and, in some cases, fails to produce the expected effect. Therefore, it is necessary to analyze other

potentially influential factors. Jones, Mothersbaugh and Betty (2002) proposed the concept of the switching barrier for this reason. The switching barrier plays the role of an adjustment variable in the interrelationship between customer satisfaction and customer loyalty. In other words, with identical levels of customer satisfaction, the level of customer loyalty can differ depending on the size of the switching barrier.

Customer satisfaction leads to loyalty and prevents switching of customers in general. Satisfaction level can be measured by voice communication quality, data communication quality, pricing structure, handset, value added applications such as mobile banking and VOD services, and customer support.

These attributes change what used to be homogeneous mobile service into today's differentiated service product. These attributes raise or lower the switching barrier of each subscriber. The switching barrier includes switching costs, attractiveness of alternate choice, and herding behavior of subscribers.[15] Attractiveness of alternatives indicates the brand image, reputation, killer applications, and service quality of the alternative carrier that are expected to be better than those of the existing carrier. If current network is providing more attractive service than other alternative network, subscribers would be locked-in and stay with the current service.

Proposition 2: *Heterogeneity of subscriber can be a key factor of each firm's customer loyalty and switching costs. In general, the firm's future profits depend on its customers' types.*

Assuming there are three types of consumers: High, medium,

15) Family, couples, business subscribers and close circle of friends would more likely use same network especially when there is rate discount within the network.

and low. We can express these types of consumers by τ_j, where $j = \{h, m, l\}$. Then we can write a simple form of firm's value $\tilde{\pi}_i$, as the sum of profit from each types of consumers as follow:

$$\tilde{\pi}_i = \tau_{i,h}\pi + \tau_{i,m}\pi + (1 - \tau_{i,h} - \tau_{i,m})\pi, \quad (1)$$

Where $\tau_{i,h} = f$(price, benefits, costs, usage),

Customer segmentation of each network is a very important factor that decides the size of switching costs. It is one of the most important factors that comprises switching cost. We observed that SKT has the highest relative switching costs among three network providers in Korea. One must ask why? One of the easiest answers to the question is that the heterogeneity of the subscribers and that SKT has the largest segment of heavy users.

We can classify the subscribers into nine different segments: Work-driven weekday users, work and family users, housewife and family users, college students, new generation, event-only users, happy hour users, pleasure users, and old generation users.

【Table 2】 Market segmentation of the Korean mobile network operators

Segment	SKT	KTF	LGT	Voice Usage	Data Usage	Duration of a call	Price Sensitivity	Overall Loyalty
Work driven	12.9	10.1	8.5	Heavy	Medium	Long	Low	High
Work & Family	14	12	10	Heavy	Medium	Long	Low	High
College student	8.3	9.5	11	Medium	High	Long	High	Medium
Housewife	9.7	11.1	13.2	Medium	Low	Medium	Medium	Medium
New generation	8.8	8.9	12.3	Low	High	Medium	High	Low
Pleasure	14.1	16	14.6	Low	Medium	Short	Medium	Medium
Happy hour	6.5	10.4	11.2	High	Medium	Long	High	Low
Event-only	7	9.9	9.8	Low	Low	Short	High	Low
Old generation	18.7	12.1	9.4	Low	Low	Short	Medium	Medium

Source: SKT Customer segment and CRM strategy, 2007. (% of total subscribers).

Each segment has its own characteristics of mobile usage. If a network has large segment of heavy users, its ARPU will be higher than other networks. On the other hand, large happy hour and event only segments will not be beneficial for a network's revenue.

The above table shows that SKT has 26.9% of its subscribers with high loyalty level whereas KTF and LGT only have 22.1% and 18.5% respectively. Subscribers with low levels of loyalty are the biggest segment in LGT's consumer composition with 33.3% when SKT only has 22.3% of its total subscribers. One promising factor of LGT's subscriber segmentation is a high percentage of new generation users. These users are the most data-oriented segment. If LGT can successfully lock-in this segment, it will turn out to be a 'work driven' segment with high levels of data usage in the long run.

Proposition 3: *Brand image, handset incompatibility, and loyalty program raise the switching barrier.*

Brand image is one of the major factors that bring consumer inertia into the purchasing decision. When a new mobile subscriber is about to activate a new mobile service, she is more likely to go with the mobile service that she heard of the most providing that she doesn't have clear information on all the available network carriers. This brand image can come from many different sources such as advertising, quality of service, better handset features, killer applications, and others.

Ⅵ. Conclusion and policy implication

The fundamental objective of introducing MNP was to reduce switching costs and engender effective competition in the mobile market. The result in the paper shows that the objective of MNP was achieved. It is estimated that the switching cost of SKT subscribers dropped by 4.5% in the first quarter of 2005 compared to the same quarter of 2004, and dropped by 6.7% in the first quarter of 2004 compared to the same quarter of 2003. The model introduced in this paper showed the changes in switching costs of three networks before and after MNP was introduced.

Lowering the switching costs of the market leader is certainly a positive sign for effective competition of the market in the future. But sequential introduction of the MNP was not necessary. It may have seemed to be a sensible measure in a myopic vision, but delaying full implementation for a year only deprived KTF and LGT subscribers of freedom of choice during that period when the subscribers of SKT enjoyed the benefit of MNP. When we admit that the full effect of MNP will take some time to be absorbed in the market, sequential introduction of MNP was a byproduct of simple-minded regulation measure which only benefited LGT for a year.

Identifying the factors that make each firm's switching cost differ is more important than simply knowing that differences exist.

The most successful application of MNP is the Hong Kong (HK) market. HK introduced number portability in 1999, and 20% of total subscribers switched their network carriers within the first 12 months of implementation. As of January 2005, about 7 million accumulated cases of MNP switching were recorded. But HK's high volume of MNP service usage is mostly because of the

compatibility of handsets among switching carriers. But Shi, Chiang and Rhee (2006) warned about MNP's backfiring effect in the long run. They argued that under price discrimination between on-net and off-net calls, the larger firm prevails while the smaller firm may have to exit the market in the long run. And consumers may have to pay for the higher prices as a consequence of the more concentrated market structure. But one should keep in mind that market characteristics vary significantly from one country to another.

When MNP can reduce only a small part of switching cost, lowering the handset price for the subscribers would be necessary to really reduce the overall switching cost. Regulatory authorities may have to devise such measures if they truly want to induce effective competition and increase consumer benefits. By allowing some handset subsidy, introducing dual-band handset with 'symbiotic firmware'[16] can be very effective in reducing the switching costs. These measures could have many difficulties and unforeseen negative effects for the market. Thus they have to be devised and introduced after careful assessment of the costs and benefits. Lee *et al*. (2006) also suggested dual-band handsets along with other possible measures to lower the switching cost even further, but most of their suggestions are too idealistic such as integrating billing systems among the network carriers.

This paper leaves room for further research. The model assumes active price competition when tariffs are pretty much controlled by asymmetric regulation. But by the nature of two-tier tariffs of telecom pricing, price competition in initial subscription fee is

16) I meant 'Symbiotic Firmware' that can carry all three network operators' mobile operating interfaces to browse internet, SMS, MMS, and other 3G services. Without this type of firmware, dual band handset can only function as if it is 1st generation handset that only has voice communication.

considered price competition here. This paper serves its purpose in identifying the effect of a new regulation in the mobile market rather than being a theoretical discussion of switching cost. Further studies on the long term effect of the policy or welfare analysis would be desirable when more data accumulates. And a dynamic model considering handset prices together needs to be established to better understand switching behavior. Developing a general dynamic model from this static model, or adopting more holistic methodology by systemic approach modeling[17] would further contribute to the topic of study.

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17) Via "System Dynamics" tools, we can have more heuristic variables into considerations.

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번호이동성도입에 따른 한국 이동통신사업자들의 전환비용추정

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논문초록

무선번호이동성 도입 이후 많은 이동통신서비스 소비자들이 가입서비스를 변경한 경험을 가지고 있다. 2004년 한국에 무선번호이동성이 도입된 것이 소비자들의 서비스 전환비용을 낮추는 역할을 한 것이 사실이다. 그러나 본 연구에서는 번호이동성의 도입 이후에도 소비자들이 여전히 높은 전환비용을 인지하고 있으며 통신사업자들은 번호 이외의 고객 lock-in전략을 다양하게 사용하고 있어서 번호이동성뿐만 아니라 다양한 요소들이 여전히 고객들에게 전환비용으로 존재함을 보이고 있다.

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