

# **Economic Effects of Indirect Access Regime in the Mobile Telecommunication Market**

**Byung W. Kim**

*ETRI*, email: [bukim@etri.re.kr](mailto:bukim@etri.re.kr)

**Chang Y. Choo**

*San Jose State University*, email: [cychoo@email.sjsu.edu](mailto:cychoo@email.sjsu.edu)

**Seong H. Seol**

*ETRI*, email: [ssh1517@etri.re.kr](mailto:ssh1517@etri.re.kr)

## **Abstract**

This study investigates the economic effects that may be expected from the introduction of an indirect access scheme in Korea's mobile market, a potentially effective tool for stimulating competition. We estimate changes in consumer surplus and operator revenues attributable to the indirect access system, using actual market data (or projections) related to price elasticity of demand, call traffic, prices and interconnection fees, and future competition scenarios. Our results indicate that the introduction of an indirect access scheme in Korea's mobile market is likely to result in a substantial gain in consumer surplus. Our results also suggest that the social benefits of an indirect access scheme would be sizeable, regardless of its type, as long as its access pricing is based on a cost-plus or retail-minus model. Meanwhile, we found that, for an indirect access scheme to be able to effectively promote competition, access must be either priced on a cost-plus basis to guarantee viable revenue streams for newcomers in the mobile market, or according to a retail-minus model with appropriate discount rates. We also concluded that, to ensure the full effectiveness of indirect access as a competition tool, it may be necessary to make offering prepaid cards and unlocking the SIM card of the customers a mandatory requirement for all carriers.

**Keywords:** Carrier Pre-Selection (CPS), Indirect Access (IA), Network Neutrality, Retail-minus, Mobile Virtual Network Operators (MVNO)

## 1. Introduction

A significant improvement in competition in Korea's Mobile Communications was underway after 1997. However, SKT (SK Telecom)'s acquisition of Shinsegae in 2001 had a regressive effect on competition. SKT's market share has been expanding every year since then, contributing to an increase of market concentration around carriers with significant market power (SMP).

To help reduce this phenomenon of market concentration around a few large providers, MIC (Ministry of Information and Communications), the chief regulatory authority for the Korean telecom market, introduced a new competition policy in July 2003. Measures to promote competition introduced by MIC included mobile number portability, unification of operator prefixes, differentiated spectrum pricing, opening of wireless internet gateways and rules requiring operators to share wireless communications facilities with competitors. These various pro-competitive programs and mechanisms by MIC proved ultimately unsuccessful in tackling the problem of market concentration. The phenomenon is, in fact, expected to worsen in coming times, due to recent developments such as the partial authorization of bundling among significant market power operators (SMPOs), going into effect in July 2007.

The expansion of market power among incumbent operators has two main contributing factors: first, customers do not have control over how their calls are routed, and second, the control by mobile network operators (MNOs) of both routing paths and pricing has been restrictive on competition within the call origination market. Outside Korea, a growing number of developed countries have been adopting an indirect access scheme as a pro-competitive solution for the mobile communications market. Competition sparked by indirect access benefits consumers by bringing down the prices of both voice calls and other service packages. Furthermore, indirect access providers (IAPs), unlike service providers, have the ability to flexibly price their services and develop service packages of their own, which makes indirect access a much more powerful competition tool than a service resale scheme.

At a public policy hearing held in December 2006, MIC announced its decision to introduce an indirect access scheme sometime between 2008 and 2009, upon the completion of a study to assess pre-conditions for this transition, which will be conducted during 2007. The adoption of an indirect access scheme, MIC relates, will be part of an effort to promote service-based competition in the mobile communications market, in other words, competition based on call rates and not basic charges. Indirect access customers will be given the right to pre-select carriers and be allowed to choose any provider with a network identification number (Ministry of Information and Communication, 2006).

The vast majority of existing studies on the economic effects of service-based competition have focused on those economic effects that are attributable to the expansion of mobile communications networks by MNOs. Hausman (1997) estimated consumer surplus in the U.S. mobile communications market, using data from 1989-1993. Australia's ACA (2001) measured changes in consumer benefits in mobile communication over the period 1995-2000. In Korea, Lee, D. H. et al. (2002), Lee, H. J.

et al. (2002) and Kim, Y. K. et al. (2003) estimated the price elasticity of call demand within the Korean mobile communications market, using sales, survey and call traffic data, respectively. Finally, Alexander et al. (2000) calculated consumer surplus using their own estimation method.<sup>1</sup>

The results reported by these studies generally lack direct relevance to the current situation of the mobile communications market, as critical data such as the latest call traffic statistics and data of individual operators were left out from their analysis, due to the limited availability. Instances of estimation of price elasticity of mobile calls and consumer surplus, based on actual traffic volume data, are exceedingly rare;<sup>2</sup> and few, if any, economic analyses of indirect access have been comprehensive enough to consider technical interconnection systems and access charges.<sup>3</sup>

This study estimates consumer surplus using actual traffic volume data from individual operators. It further considers a variety of market scenarios that may result from the introduction of an indirect access scheme and how they affect consumer surplus and operator revenues, to determine the most effective strategy for implementing an indirect access scheme for Korea's mobile market. In our measurement of changes in operators' sales revenues, costs and income, we take into consideration both technical interconnection systems and wholesale pricing restrictions to increase the practical and policy relevance of our results.

## **2. Overview of Mobile Indirect Access and Examples of Indirect Access Scheme**

### **2.1 Overview of Indirect Access to Mobile Networks**

#### **2.1.1 Definition of Mobile Indirect Access**

The British telecom authority Ofcom (Ofcom) describes indirect access as a solution to provide a broader choice to mobile network customers concerning calls as well as value-added services.<sup>4</sup> Meanwhile, ODTR (ComReg), the Irish telecom regulator, defines it as a scheme allowing mobile customers to choose a carrier by dialing a short access code (SAC) or enabling the application of carrier pre-selection (CPS) to mobile networks.<sup>5</sup> According to Ovum (2003), the telecom market research organization, indirect access is a solution to provide

---

<sup>1</sup> Consumer surplus = Sales revenue/(2× price elasticity).

<sup>2</sup> Kim, Y. K. et al. (2003), in their study estimating consumer surplus following the method proposed by Alexander et al. (2000), used actual traffic volume data to calculate the price elasticity of mobile calls.

<sup>3</sup> One of the hottest issues in the Korean telecom market of late is wholesale pricing restrictions concerning interconnection for the provision of indirect access services, services by mobile virtual network operators (MVNO), VoIP (Voice over Internet Protocol) services; a topic with important implications for network neutrality.

<sup>4</sup> Indirect access gives customers of telecom networks the chance to select, on a call by call basis, which operators carry their calls for them. IA for mobile networks could give their customers the choice of suppliers of call services and possibly a wider choice of value-added services Indirect access for mobile networks could offer their customers a similar freedom of choosing their suppliers and possibly also a wider choice of value-added services (Ofcom, 1999a).

<sup>5</sup> Indirect access customers could dial a short access code (carrier selection) or a freefone number or carrier pre-selection (CPS) could be employed in the network. Indirect access only works for outgoing calls and customers still need to subscribe to (or have pre-pay credit with) a mobile network - i.e. rental of access to the network (ODTR, 2000).

subscribers of existing MNOs with access to services of other carriers and service providers.<sup>6</sup>

In the example of a routing path of a mobile-to-land (ML) and mobile-to-mobile (MM) calls shown in <Fig. 1>, a caller first dials the access code for an IAP (callers with a pre-selected carrier do not dial an access code), then dial the receiving party's number. This call so emitted is routed by the mobile switching center to the intended IAP's system. Upon receiving the call, the IAP's system transmits it to the destination land or mobile number through the most efficient path. IA customers pay the IAP for their calls (also basic charges, after the introduction of pre-paid cards and mandatory unlocking of SIM cards), and not the mobile network operator.<sup>7</sup> A portion of call charges collected by IAPs is used to pay access charges to network operators (Ofcom, 1999a). IAPs only provide call origination services and do not earn interconnection revenues from wholesale transactions as do MVNOs (Full MVNOs) (Kim & Seol, 2007). An IAP which is a fixed network operator (FNO) receives a fee on each call it routes toward a land number (Kim & Kweon, 2005).

[Fig. 1 about here]

#### 2.1.2 Types of Indirect Access

There are four main types of indirect access, whose precise definitions vary depending on the country: carrier selection (CS), carrier pre-selection (CPS), pre-paid card and SIM card. With CS (including pre-paid card-based access), mobile subscribers can route their calls via external networks operated by other carriers, by dialing a prefix code. The mode of access is essentially the same for pre-paid card-based indirect access. CPS (including SIM card-based access) dispenses with the prefix code, as calls are automatically routed via an external carrier that has been pre-selected.

[Table 1 about here]

Regardless of their individual modes of implementation, all indirect access schemes offer improvements over service resale, in terms of quality and breadth of service offerings and pricing, as well as brand requirements and facilities need, and they also add independent and enhanced functions not available through the latter. One of the chief advantages of indirect access is that mobile networks are used only for call origination. In other words, the level of reliance on mobile networks is significantly lower for IAPs than for tied service providers (TSP) or independent service providers (ISP), which gives them competitive advantages concerning costs, packaging, tariffing and value-added services (Ofcom, 1999a). Indirect access based on CPS (including SIM Card-based access)<sup>8</sup> can be especially beneficial for consumers, as it not only helps lower their phone bill, but also is easy to use and offers a great variety of new functions. Also, as CPS makes provider-switching easier for customers, it will increase competitive

---

<sup>6</sup> Indirect Access refers to the access that a subscriber whose service is directly connected to the network of one carrier may have to the services provided by another carrier or service provider (Ovum, 2003)

<sup>7</sup> In Korea, the pricing of mobile communications service comprises two components: basic charges and call charges. As pre-paid cards and SIM (Subscriber Identification Module) cards are currently not in use, IAPs can only claim the call charge portion of the service fee.

<sup>8</sup> IAPs can purchase MNO-issued SIM cards at a wholesale price and offer outgoing call services to their customers under their own brand.

pressure for the mobile market, bringing about positive changes for consumers (Productivity Commission, 2001).

## **2.2 Examples of Indirect Access Scheme**

In many countries, indirect access has been practiced since as early as the late 1990s. In the U.S., both CS and CPS are in use since the early years of its mobile market. Providers of CMRS (Commercial Mobile Radio Services) are allowed in the U.S. to serve only local areas, alongside incumbent local exchange carriers (ILECs). In other words, U.S. MNOs are not permitted to handle long distance calls. Hence, all long-distance calls made from a cell phone are routed in the same way as fixed-line calls, either through CS or CPS. If a mobile user chooses CS as the method to route his/her long-distance calls, the calls will be forwarded to an IXC (Inter-Exchange Carriers) nearest to the exchange point. The IXC, then, routes the call to the nearest exchange point in the called parties' location. In the U.S., both CPP (calling party pays) and RPP (receiving party pays) are used for billing outgoing calls transmitted via indirect access routes. The billing method in use in most other countries is CPP.

In Denmark, the introduction of CS in August 1996 was followed by CPS, which became mandatory in April 1998. Provision of indirect access interconnection is currently a mandatory requirement for Sonofon and TDC, Denmark's two largest MNOs. Interconnection charges, in the context of provision of CS services, are left to be decided through commercial negotiation between interested parties. As a result of this, the going prices of mobile network interconnection in the inter-operator market in Denmark are quite high, surpassing even retail prices charged by some mobile operators. Although Denmark is one of the first countries to adopt an indirect access scheme (shortly after Finland), the entry barrier is quite high for IAPs due to the elevated interconnection prices.

In the U.K., indirect access was given a serious consideration by its telecom regulator following a 1998 market evaluation which found its mobile segment not sufficiently open to competition. The idea that indirect access may be an effective solution to stimulate competition in the mobile market further gained support, when Oftel took part in the resolution process for a dispute between INMS (International Simple Voice Resale) and Vodafone and BT Cellnet (O2). The two MNOs refused the service provider's interconnection request for provision of indirect access call services. In an official statement issued in June 1999, Oftel announced the inclusion of CS-based indirect access services among interconnection services (Oftel, 1999b). Since January 1, 2000, CS has been mandatory in the U.K. for both ML and MM calls. In other words, British SMPOs are required to provide interconnection services to competitors. Also, in December 1999, Oftel singled out Vodafone and BTCellnet (O2) as operators with market influence and made it obligatory for them to negotiate CS arrangements with third-party operators on a non-discriminatory basis, using retail-minus pricing (Oftel, 1999b). The U.K. indirect access scheme stands out in two aspects: the use of retail-minus pricing, unlike for its fixed market where interconnection is priced on a cost-plus basis, and the very detailed retail-minus scheme, as shown in <Table 2> below.<sup>9</sup>

---

<sup>9</sup> 0.2 is retail costs related to customer service. Marketing and selling costs, cost of customer support (maintenance, service inquiries) and cost of billing (post-paid customers) and issuing pre-payment

[Table 2 about here]

In Ireland, CS was introduced in July 2000 for its ML call market, and in July 2005, CPS became mandatory both in the ML and MM markets. Currently, only SMPOs are mandated to provide CPS services, and no restrictions are imposed as to the types of operators eligible to use the services. The pricing of indirect access interconnection is on the cost-plus basis. Ireland is one of the very few countries where the type of indirect access scheme, pricing and carriers that are imposed the interconnection burden are identical between the mobile and fixed markets.

[Table 3 about here]

In most countries, the indirect access scheme does not impose any special restrictions concerning types of operators who may act as an IAP. In other words, both SPs (service providers) and FNOs (Fixed Network Operators) can be an IAP. The pricing of interconnection is decided through negotiations between operators, and only when interested parties fail to reach an agreement, the regulatory authority steps in. In this case, pricing may be either on a cost-plus basis or a retail-minus basis.

As has been mentioned above, in December 2006, the Korean regulator announced its decision to introduce an indirect access scheme in 2008-2009, after the completion of a study to assess related pre-requirements in 2007 (Ministry of Information and Communication, 2006). The most important details to be determined over the preparatory period leading up to 2008-2009 are which and how many carriers will be mandated to provide indirect access interconnection, what types of operators will be eligible to be IAPs and the wholesale pricing of interconnection. The wholesale price of indirect access interconnection is an especially important variable, as it has a direct impact on consumer surplus and operator revenues. The current Telecommunications Business Act of Korea provides for CPS only in the long-distance market. Therefore, for the introduction of an indirect access scheme in the mobile market, a series of legal and regulatory amendments is necessary. First, details related to CS should be added to Article 38-3 (Carrier Pre-selection), and the content of Article 25-2 (Services Requiring Carrier Pre-selection) of the Enforcement Decree to the same Act must be modified to include services provided through frequency assignment. Further, Article 65 (Implementation of Carrier Pre-selection Scheme) of the Rules on Interconnection to Telecommunications Facilities and Equipment must be revised to include a clause making it mandatory for MNOs to allow the customers to select an IAO of their choice and access the IAO without having to use a prefix code. Finally, in the Enforcement Regulations on Number Management, a new article should be added to specify details related to the assignment of prefix codes to CS access providers.

---

receipts (pre-paid customers) fall into this category of cost. The recommended retail price (RRP) is the retail-minus charge based on each type of call. The outpayment refers to all payments made by a host MNO to peer operators or terminating operators for their service of routing calls originating within its network to their destination parties (Ofitel, 2000).

### 3. Research Model and Results

#### 3.1 Research Model

To estimate the economic effects of the introduction of an indirect access scheme in Korea's mobile market, we developed three market scenarios, as shown in <Fig. 2> below, which follow each other chronologically. Stage I is the phase in which the regulator decides on the details of the indirect access scheme to be introduced. Whether the mandatory requirement to provide interconnection should be limited to SMPOs or to all MNOs, whether the pricing must be on a cost-plus basis, or a retail-minus basis similar to the model developed by Oftel (2000), are two key questions in this decision-making process (see <Table 4>). The government's decisions during Stage I, concerning these issues, will have a determining influence on the two ensuing stages, serving as exogenous variables.

[Fig. 2 about here]

[Table 4 about here]

During Stage II, potential IAPs enter the market, to offer indirect access call services according to the scheme (Type i) decided by the government in Stage I. Market entry by newcomers triggers a price competition, and the overall price of mobile calls drops. Prices will be brought down first by incumbent MNOs who will seek to so defend their market shares ( $P_0$ , the current price, slashed by  $r_i\%$ ). IAPs, the latecomers, will then follow suit and beat the MNOs' prices ( $g_i\%$  lower than the MNO prices), pushing prices even lower.

In Stage III, consumers respond to the price developments by either staying with the incumbent or switching to a new provider. Actions taken by consumers in this stage affect the market share distribution, giving a  $s_i$  share to MNOs and  $1 - s_i$  share to IAPs.

Meanwhile, the price fall caused by the competition between operators will drive up the overall mobile call demand ( $Q_{li} - Q_0$ ), increasing consumer surplus. To more accurately predict the effect of an indirect access scheme on consumer surplus and operator revenues, our estimation used the price elasticity of mobile calls and other demand data, forecasted market shares and rates of price drops in different competition stages, and interconnection and marketing costs incurred by operators. Further, for the sake of convenience of analysis, the demand function of the mobile communications market was assumed to be a first-order linear equation.<sup>10</sup>

[Fig. 3 about here]

The changes in consumer surplus ( $\Delta CS_i$ ), attributable to the indirect access scheme, are calculated through the following steps: First, the

---

<sup>10</sup> Willig (1976) pointed out that, given the secondary and rather negligible role of income effect, consumer surplus can be estimated with reasonable accuracy, using an ordinary demand curve. Willig's claim was verified by Hausman (1981).

overall call traffic volume ( $Q_{li}$ ), after the introduction of the indirect access scheme, can be expressed in relation to the price elasticity of demand as below:

$$Q_{li} = Q_0 - \frac{e(p_{li} - p_0)Q_0}{P_0}. \text{ Here } P_{li} \text{ is the average price of a mobile call}$$

after the introduction of a type-i indirect access scheme, which may be expressed as  $P_{li} = [s_i(1 - r_i) + (1 - s_i)(1 - r_i - g_i)]P_0$ . Substituting this equation into the above equation of the overall call traffic in the mobile market, we obtain equation (1) below:

$$Q_{li} = Q_0[1 + e(r_i + g_i(1 - s_i))] \quad (1)$$

$\Delta CS_i$  is the area of the shaded trapezoid in <Fig. 3>, which may be written as  $\frac{(P_0 - P_{li})(Q_0 + Q_{li})}{2}$ . Substituting this into equation (1) gives equation (2). These steps allow us to estimate changes in consumer surplus, using only the current prices and volume of calls, price elasticity of demand and the projected rate of price fall and market share distribution following the introduction of an indirect access scheme.

$$\Delta CS_i = \frac{T_i(2 + eT_i)}{2} P_0 Q_0 \quad (2)$$

where,  $T_i = (r_i + g_i(1 - s_i))$

Changes in the net income (net sales - net cost of selling) of existing MNOs and IAPs newly entering the market were estimated using equations (3) and (4), respectively. If  $\Delta PS_i > 0$  in equations (3) and (4), this means that MNOs' income will increase in spite of the introduction of a type-i scheme, and if  $\Delta PS_i < 0$ , their income decreases. If  $\Delta PS_{Iai} > 0$ , this indicates that IAPs will realize profit. Interconnection income and cost in equations (3) and (4) reflects the inter-operator settlement relationships shown in <Fig. 4>. They are the sums of the call traffic (changes in call traffic) multiplied by corresponding interconnection prices.

For example,  $\Delta C_{ai}$  in equation (3) is calculated by adding the result of multiplying the change in the call traffic handled by an existing MNO, from j to k, by the per-minute charge for interconnection ( $a_k$ ), to (j, k) (see equation (3-1)). Meanwhile,  $\Delta C'_{ai}$  in equation (4) is calculated by adding the result of multiplying the change in the call traffic handled by a type-i IAP, from n to j, by the per-minute interconnection charge paid by the latter for an MNO ( $a_{Iaij}$ ), to (n, j). A similar method can be used to estimate changes in interconnection income and cost (changes) concerning all other items. As for marketing costs, we assumed that existing MNOs will maintain the same level of spending, and set the spending of IAPs, in need of an aggressive marketing campaign, to the level of the top marketing spender among the three largest mobile operators.

[Fig. 4 about here]

$$\begin{aligned}\Delta PS_i &= \Delta TR - \Delta TC \\ &= [P_0(1-r_i)s_iQ_{li} - P_0Q_0 + \alpha_{IAi}] - [\Delta C_{ai} + \Delta C_{ali} + \Delta C_{li} + C_{zIAi}] \quad (3)\end{aligned}$$

Here,  $\Delta C_{ai}$  is the change in cost of connecting to MNO networks;  $\Delta C_{ali}$ , the change in connecting to FNO networks;  $\Delta C_{li}$ , the change in costs incurred by MNOs (takes into consideration incomes from interconnection services provided to other mobile networks); and  $\alpha_{IAi}$  and  $C_{zIAi}$ , the new interconnection income earned by MNOs from IAPs and the interconnection cost incurred by IAPs, respectively.

$$\begin{aligned}\Delta C_{ai} &= \sum_j \sum_k a_k s_i s_{jk} (Q_{li} - Q_0) \\ &= s_i (Q_{li} - Q_0) \sum_j \sum_k s_{jk} a_k \\ &= s_i (Q_{li} - Q_0) \bar{a}\end{aligned} \quad (3-1)$$

where,  $\bar{a}$  is the weighted per-minute charge paid by MNOs to connect to other MNOs' networks.

$$\begin{aligned}\Delta PS_{IAi} &= R - C \\ &= [P_0(1-r_i-g_i)(1-s_i)Q_{li} + \alpha_i] - [C'_{ai} + C'_{ali} + C'_{IIAi} + C'_{ma}] \quad (4)\end{aligned}$$

Here,  $a_i$  and  $C'_{ai}$  each correspond to the interconnection income earned from MNOs for receiving land calls, and the cost of connecting to MNO networks;  $C'_{ali}$ , the cost of connecting to FNO networks;  $C'_{IIAi}$ , the internal cost incurred by IAOs (connection cost); and  $C'_{ma}$ , the cost of marketing incurred by IAOs.

$$\begin{aligned}C'_{ai} &= \sum_n \sum_j a_{IAij} (1-s_i) s_{nj} (Q_{li} - Q_0) \\ &= (1-s_i) (Q_{li} - Q_0) \sum_n \sum_j s_{nj} a_{IAij} \\ &= (1-s_i) (Q_{li} - Q_0) \bar{a}_{IAi}\end{aligned} \quad (4-1)$$

Here,  $\bar{a}_{IAi}$  is the weighted per-minute charge of connecting to MNO networks paid by IAPs (type i). Finally, the overall economic effect of the introduction of an indirect access scheme is calculated by adding up the results of equations (2), (3) and (4).

## 3.2 Data

### 3.2.1 Volume of Call Traffic

The total airtime used by 38.342 million mobile subscribers in Korea amounted to 78.4 billion minutes in 2005. The airtime usage has been

growing at an average annual rate of 9.3% for the three preceding years. In 2005, the total airtime increased by 7.8% over the previous year.<sup>11</sup> If one assumes that there will be no additional demand replacement by new services (WiBro, DMB, VoIP, etc.),  $Q_0$ , the total airtime, is likely to rise to 899.9 billion minutes, 92.3 billion minutes and 94.2 billion minutes in 2008, 2009 and 2010, respectively (see <Fig. 5>).<sup>12</sup>

[Fig. 5 about here]

By operator, 57% of the overall mobile call traffic is handled by SKT, followed by KTF and LGT each accounting for a 30% and 13% share. Meanwhile, 74% of all MM traffic is serviced by SKT 74%, with leaving the shares of 22% and 4% to KTF and LGT. The distribution of ML traffic breaks down to 63% for SKT, 27% for KTF 27% and 10% for LGT (SK Telecom, 2004).

### 3.2.2 Pricing

Currently, in 2007, both SKT and KTF subscribers pay a basic charge of 13,000 won. The basic charge paid by LGT subscribers is 12,000 won, slightly lower (7.69%) than the amount charged by the two other operators. This gives a traffic-weighted basic charge of 12,868 won.

<Table 5> lists per-minute call rates charged by the three mobile operators, effective as of January 1, 2007. The rate disparity between operators is up to 11%. To calculate the average mobile call rate, we set the ratio of full tariff to discount tariff to late-night tariff to 6:3:1. The weights for the three operators were determined based on their respective shares of call traffic in 2005.<sup>13</sup> The average rate ( $P_0$ ) prior to the introduction of indirect access, obtained through this calculation, was 100.68. There has been no drop in call rates offered by the three MNOs over the past five-year period between June 2002 and June 2007.

[Table 5 about here]

Meanwhile, to minimize traffic churn that may be triggered by the introduction of the indirect access scheme, MNOs are likely to slash their call prices. In this study, we assumed that, in response to the introduction of a type-i scheme, MNOs will choose to lower their rates by  $10\%(r_i)$ .<sup>14</sup>

---

<sup>11</sup> As of May 2007, mobile subscribers in Korea totaled 41,783 (Ministry of Information and Communication, 2007).

<sup>12</sup> Mobile-to-land traffic, on a steady decline after the 2003 peak of 15.9 billion minutes, dropped to 15.1 billion minutes in 2005. The volume of mobile-to-mobile traffic, however, has been continuously increasing, reaching 63.3 billion minutes in 2005.

<sup>13</sup> Kim, Y. K et al. (2003) assigned the weights of 0.65, 0.3 and 0.05 to the three MNOs.

<sup>14</sup> The reason why telecom regulators adopt a service-based competition scheme is that it not only promotes fair competition, but also results in price drops, increasing consumer surplus. The Australian Productivity Commission (2001) said, in an official statement, that the primary purpose of its introduction of a service-based competition scheme was to induce decline in call prices. The prices of land-to-mobile calls in Australia indeed fell by 17-20% following the implementation of the service-based competition scheme (OECD, 2001). European countries adopting a service-based competition scheme also saw a 10-45% decline in land-to-mobile rates (Ovum, 2003). In Japan, NTT East and NTT West, its two SMPOs, responded to the service-based competition scheme by slashing their rates by 12% six months prior to the entry into effect of the scheme (Nikkei Communications, 2001). These examples from outside Korea provide ample evidence that mechanisms to promote service-based competition like indirect access are likely to be accompanied

As for the price gap ( $g_i$ ) to occur between MNOs and IAPs, we set it to 10%<sup>15</sup>( $i=1,3$ ) for the cost-plus-basis scenario of interconnection pricing, and 20%<sup>16</sup>( $i=2,4$ ) for the retail-minus pricing scenario.

### 3.2.3 Price Elasticity of Demand

The price elasticity of demand in Korea's mobile communications market has been estimated by Kim, Y. K. et al. (2003), using call traffic data. They obtained a price elasticity of -0.74, based on monthly airtime consumption calculated by dividing monthly volumes of call traffic handled by each of the operators over the period between January 2000 and May 2002, by the cumulative numbers of subscribers in the corresponding month.<sup>17</sup> For our estimation of the price elasticity, we divided our traffic data into two periods; before and after May 1, 2002, the time of the most recent price drop, when the per-minute regular-tariff rate fell 5%, from 126 won to 120 won. The calculation was done using equation (5). With all other conditions being constant, the price elasticity of call demand in the Korean mobile market was -1.02.

$$e = -\frac{\Delta Q/Q_0}{\Delta P/P_0} \quad (5)$$

### 3.2.4 Market Share Distribution

On November 1, 1997, in a bid to spark competition in Korea's long-distance call market, MIC adopted a CPS-type indirect access scheme using the balloting method. <Table 6> lists the numbers of subscribers and market shares of five long-distance carriers over the ten-year period since the introduction of the indirect access scheme. The combined market share between the four latecomers (Dacom, Onse Telecom, Hanaro Telecom and SK Telink) stood at 14.4% in 2006 and during the first half of 2007.<sup>18</sup> In this study, we assumed that a CPS-type indirect access scheme was adopted as a marketing method for ML and MM calls. We further assumed that newcomers (type-i IAPs) can capture a 14.4% share of the market, one year after their market entry.

[Table 6 about here]

### 3.2.5 Cost of Marketing and Interconnection Charges

---

by price cuts by MNOs, entailing a price decline of at least over 10%. In Korea, SKT lowered, in 1997, its call rates by 19% (from 192 won/minute to 156 won/minute) ahead of the market entry by PCS operators (KTF, LGT, HansolM.com), equivalent to a 7% price drop over the previous month (168 won/minute → 156 won/minute).

<sup>15</sup> We assumed that the price gap will be roughly the same as the price disparity currently existing between the incumbent MNO and latecomer MNOs.

<sup>16</sup> One.Tel and BT entered the U.K. mobile market by offering rates that are 20% cheaper than those offered by MNOs. We assumed that an IAP, making its market debut, will devote about 30% of total sales to marketing, which is the size of marketing spending among latecomer MNOs (The Electronic Times, 2007).

<sup>17</sup> Lee, D. H. et al. (2002) and Lee, H. J. et al. (2002) estimated the price elasticity of mobile calls in Korea, using sales data and survey response data. The price elasticities reported by the two studies are -1.185 and -0.89, respectively.

<sup>18</sup> Hanaro Telecom and SK Telink each made their debut in the long-distance market in July 2004 and January 2005.

Both MNOs and IAPs incur marketing costs. According to the estimation made by the Electronic Times (2007), based on the operators' annual reports, the marketing-to-sales ratios of SKT, KTF and LGT stood at 21.6%, 27.6% and 30%, respectively. The same figure for the overall market was about 24.9%, according to the same report. In this study, we measured the cost of marketing of the three operators (excluding basic charges) against their call revenues from the period after the opening of the market to competition. The marketing-to-sales ratio of IAPs is assumed to be equal to that of LGT.

[Fig. 6 about here]

The cost-plus-based, per-minute termination charges laid down by MIC, effective in 2007, are 32.8 won, 39.6 won and 45.1 won for SKT, KTF and LGT, respectively. For fixed-line networks, termination charges for KT's terminals and gateways are 17.3 won and 19 won.<sup>19</sup> Over the past three-year period, per-minute charges for connecting to SKT, KTF and LGT's mobile networks fell by 1.08%, 1.15% and 3.99%. Meanwhile, charges for terminating fixed-line calls in KT's gateways and terminals increased by 3.42% and 3.62%, respectively.<sup>20</sup> Estimated MIC-set mobile-network termination charges in 2008E, 2009E, 2010E, taking into consideration these past rates of changes, are provided in <Fig. 7> below.

Currently, all of the three MNOs are paying mobile call termination charges to other MNOs and are also incurring costs for network operation (cost of connection). The introduction of an indirect access scheme, although it will increase network operation costs for MNOs, will also bring them additional income in the form of interconnection charges (or network use charges) paid by IAPs.

Appropriate network use charges can be calculated using either a cost-plus method or a retail-minus method like the one developed by Oftel (2000) whereby the charge equals the retail tariff multiplied by an applicable discount rate, then subtracted by the termination charge. There are two main variants of retail-minus pricing: SRRC (Single Representative Retail -minus Charge) and ACR (Average Retail-minus Charge). Under the SRRC scheme, the regular tariff is multiplied by a retail cost-based discount rate, then subtracted by the termination charge. ACR, while similar to SRRC in most other aspects, distinguishes itself from the latter for its use of averaged tariff by call types.<sup>21</sup> The estimates of retail-minus-based charges on call origination services for 2008E, 2009E and 2010E are given in <Table 7>.<sup>22</sup> In this study, we used retail-

---

<sup>19</sup> The 2000-2003 interconnection charge data are cited from the Digital Times (2004), and the 2004-2007 data from Yonhap News Agency (2006).

<sup>20</sup> Starting from 2002, MIC has been re-calculating cost-plus-based charges every two years, to ensure that the prices provide an appropriate return on investment over and above the actual cost of networks.

<sup>21</sup> In the U.K., its telecom authority adopted a differentiated retail-minus approach (DRA) for pricing indirect access interconnection. The fairness of SRRC, although a simple and easy-to-use method for operators used to a single tariff, is somewhat undermined, the British regulator pointed out, by the fact that standard tariffs (also known as weekday tariffs or full tariffs) cannot be representative of overall retail tariffs.

<sup>22</sup> SRRC (Single Representative Retail -minus Charge) is calculated using one of the tariffs in <Table 5>, deemed the most representative, and excludes all avoidable costs. With the ARC (Average Retail-minus Charge) pricing, avoidable costs are subtracted from an average call rate, calculated based on all calls. Meanwhile, under a DRA (Differentiated Retail-minus Approach), avoidable costs are subtracted from each of the rates applying to different call types (Oftel, 2000). In Korea,

minus pricing for type-2 and type-4 SMPOs, and cost-plus pricing for type-2 latecomers, concerning termination services, as in this case, retail-minus-based charges frequently prove to be lower than the cost of connection.

[Fig. 7<sup>23</sup> about here]

[Table 7 about here]

### 3.3 Estimation Results<sup>24</sup>

Our estimates of consumer surplus, calculated under the assumption that, after the introduction of an indirect access scheme, new operators entering the Korean mobile communications market will capture a 14.4% share of the market, are as follows: 1,118.9 billion won and 1,254.3 billion won for type 1 and type 2, and 645.7 billion won and 723.9 billion won for type 3 and type 4. The results were essentially the same, when re-calculated using the price elasticity of -0.74 or -1.185 estimated by Lee, D. H. et al. (2002) and Kim, Y. K. et al. (2003), respectively (see <Table 8>).<sup>25</sup> Due to the special characteristics of the telecom market, a price cut by SMPOs naturally entails a similar price cut by latecomers. Given this price mechanism, indirect access schemes, no matter what their types, tend to yield a similar size of increase in consumer surplus. The gain in consumer surplus is rather sizeable, ranging from 1,004.4 billion to 1,082.5 billion won.

In the meantime, the analysis of the wholesale market indicates that the reduction in cost of interconnecting to MNO networks, caused by the substitution of call traffic between MNOs and IAPs, amounts to 182.5 billion won and 85.2 billion won, respectively for the type-1 and type-2 schemes and the type-3 and type-4 schemes. Revenues generated from interconnection services to IAPs are likely to amount to 432.8 billion won, 464.8 billion won, 248 billion won and 292.6 billion won for type 1, type 2, type 3 and type 4, respectively. As for IAPs, they are expected to realize a combined revenue of 20.4 billion won from land call termination services, if the indirect access scheme is type 1 or type 2, and 11.7 billion won, if the type is 3 or 4.

[Table 8 about here]

[Table 9 about here]

Our estimation of changes in sales and net income of MNOs and IAPs, after the introduction of an indirect access scheme, takes into account changes in the wholesale market. Changes in individual operator's income are listed in the 2<sup>nd</sup> and 3<sup>rd</sup> row of <Table 10>. The estimation of the overall income change, based on these individual data, resulted in -659.9 billion won and -627.9 billion won under a type-1 or type-2 scheme where

---

an ARC is identical to a DRA-based charge, as the rates are the same across all call types .

<sup>23</sup> Gateway charges are fees paid by long-distance, international and mobile carriers to fixed-line operators (KT, Hanaro Telecom) for use of their networks. Terminal charges are fees paid by Dacom and other long-distance network operators for connecting to KT's local switches.

<sup>24</sup> The estimation results are annual averages over the three-year period between 2008 and 2010.

<sup>25</sup> Although this estimation used arc elasticities, its results are very close to estimates obtained using point elasticities.

all MNOs are mandated to provide indirect access interconnection. Under a type-3 or type-4 scheme, where only SMPOs are imposed the obligation to provide indirect access interconnection, their call income is likely to decline by 397.5 billion won or 353 billion won. Our estimation further indicates that IAPs will incur net losses under all types of scheme, except a type-3 scheme, under which they will realize a net combined income of 111.6 billion won. The net gain in social welfare, including the gain in consumer surplus, was worth almost 367 billion won. Under the scenario that latecomers respond to SMPOs' price cut by a commensurate or larger price cut, this figure is likely to more than double.

[Table 10 about here]

The implications of these results are as follows: First, the drop in MNOs' net income, following the introduction of an indirect access scheme, will be mostly offset by an increase in their wholesale market revenue; in other words, the reduction in interconnection cost, combined with an increase in interconnection income thanks to the additional demand created from IAPs. Second, under a type-3 scheme where only SMPOs are required to provide indirect access interconnection, and the price of network use is decided on a cost-plus basis, IAPs will be able to realize a net income from call revenue alone, thereby also stimulating competition. Third, for a type-1, type-2 and type-3 scheme to be able to make a concrete difference for the status of competition in the Korean mobile market, operators should be required to unlock the SIM card of their customers to allow pre-paid calls. This way, IAPs can increase their income with the basic charge component of pre-paid calls.

#### **4. Recapitulation and Conclusion**

In the U.K., Denmark, Spain, Finland, Ireland, Austria, Belgium and Italy, only MNOs with significant market power are required to provide interconnection services for indirect access. In the U.S., Norway, Portugal, Sweden, Switzerland and Hungary, the requirement is imposed on all MNOs. Regarding interconnection pricing, a mandatory cost-plus scheme is in use in Ireland, Austria and Belgium. In the U.K., IAPs' access to MNO networks is priced according to a retail-minus method under which the charge equals (retail price x discount rate)-termination charge.

In Korea, mobile network interconnection fees are regulated on a cost-plus basis and remain comparatively low, and MNOs occupy a significant amount retention for mobile calling fee. The likelihood is therefore high that an indirect access scheme will produce rather substantial economic effects in Korea; indirect access services will prove in Korea an economically viable business model and benefit consumers by bringing down mobile call prices.

Based on these projections, this study performed a quantitative analysis of economic effects of an indirect access scheme for the Korean mobile market, scheduled for implementation sometime between 2008 and 2009, using actual market data (traffic volume projections based on the current traffic volume, rates offered by the three Korean MNOs and fixed-line and wireless inter-operator connection charges, etc.).

The principal contributions of this study are as follows: First, we estimated the price elasticity of mobile calls and changes in consumer surplus, attributable to indirect access, using actual call traffic data. Second, we estimated changes in interconnection cost and income for MNOs and IAPs, under a retail-minus-based wholesale pricing scheme. Third, we constructed a mathematical income and cost model, which takes into account technical interconnection systems used by MNOs, IAPs and FNOs, to estimate changes in related income and cost. Fourth, we suggested the best type of indirect access scheme, in terms both of consumer surplus and operator revenues, and the directions for future policies, pointing out also several policy issues that need to be researched before the introduction of indirect access.

Our results confirmed that the gain in consumer surplus expected from an indirect access scheme is significant, regardless of its type, providing empirical evidence of the effectiveness of indirect access in promoting competition in the mobile market. Under the scenario where the duty to provide interconnection services for indirect access is imposed only on SMPOs, newcomers will be able to successfully generate profit, contributing also to competition.

Meanwhile, in the case of the adoption of a retail-minus pricing model for network interconnection, the success of pro-competition policy is likely to depend largely on the treatment of marketing costs and other retail costs.

The key policy implications of this study are as follows: First, the market entry by IAPs paying for their use of MNO networks on a cost-plus or retail-minus basis is socially beneficial. In particular, under an indirect access scheme where the interconnection duty applies only to SMPOs, and interconnection is priced on a cost-plus basis, IAPs' call income, we found, will be positive. Second, for a scheme using a retail-minus model of interconnection pricing to produce the intended benefits of indirect access,

certain regulations or mechanisms may be needed to ensure that IAPs can generate an adequate level of income. This requires establishing a precise method for determining the prices for network use, either concurrently with the introduction of the indirect access scheme or in the course of a revision of the resale service regulations.

Lastly, many of the telecom regulators in countries where mobile indirect access are already being practiced did not use quantitative indicators of the economic effects of the scheme on consumers and operators, in their decisions on the type of scheme, categories of operators mandated to provide interconnection and the type of connection pricing. By basing their policy decisions on quantitative economic analysis of indirect access, Korean regulators can improve on the precedents set before them, to develop an optimally effective scheme. The findings of this study can also serve as useful references, we believe, for countries outside Korea, as they try to minimize uncertainties associated with introducing an indirect access scheme in their national telecom markets.

## References

- Alexander, D.L., Kern, D.W., Neil, J. (2000) Valuing the Consumption Benefits from Professional Sports Franchises, *Journal of Urban Economics*, **48**, 321-337.
- Analysys (2000) Study for EC DG Information Society.
- Australian Communications Authority (2001) Benefits to Consumers of Telecommunications Services in Australia 1995-96 to 1999-2000.
- European Telecommunications Office (2000) ETO progress report on carrier selection in public telephony networks in ECTRA countries.
- Hausman, J.A. (1981) Exact Consumer's Surplus and Deadweight Loss, *The American Economic Review*, **74**, 662-675.
- Hausman, J.A. (1997), Valuing the Effect of Regulation on New Services in Telecommunications, *Brookings Papers on Economics Activity, Microeconomics*, 1-38.
- Kim, Y.K. et al. (2003) The Estimation of Price Elasticity and Consumer Surplus for Mobile Communications Services, *Economics Association Joint Conference 2003, Korean Academic Society of Industrial Organization Program*.
- Kim, B.W., Kweon, S.C. (2005) Economic Benefits of Carrier Pre-selection in the LM Telecommunication market, *Communications & Strategies*, **57**, 119-140.
- Kim, B.W., Seol, S.H. (2007) Economic analysis of the Introduction of the MVNO System and Its Major Implications for Optimal Policy Decisions in Korea, *Telecommunications Policy*, **31(5)**, 290-304.
- Korea Information Society Development Institute (2003) Telecommunications Services: Common Carrier Services, *Telecommunications Industry Trend*, 9.
- Lee, D.H. et al. (2002) Estimation of the Demand for Mobile Communications Services and Consumer Surplus, *Korean Telecommunications Policy Review*, **9**, 169-195.
- Lee, H.J. et al. (2002) An Economic Analysis of the Telecommunications Industry, Korea Information Society Development Institute research report, 52-193.

Ministry of Information and Communication (2006) Proceedings of the Public Hearing for the Development of Medium to Long-term Directions for Telecommunications Policy.

Ministry of Information and Communication (2007) Long-distance Carrier Pre-selection Subscriber Statistics.

Ministry of Information and Communication (2007) Fixed-line and Wireless Telecommunications Service Subscriber Statistics.

Nikkei Communications (2001) Japan Telecom Seeks to Enter Local Call Service, But NTT's High Fee Is an Obstacle.

ODTR (2000) The Regulatory Framework for Access in the Mobile market, report on the consultation, 1-32.

OECD (2001) Development in Carrier Selection and Pre-selection.

Oftel (1999a) Customer choice: Oftel's Review of Indirect Access for Mobile Networks, 1-23.

Oftel (1999b) Oftel's Review of the Mobile Market, 1-32.

Oftel (2000), Determination under provisions of regulation 6(6) of the telecommunications (interconnection) regulations 1997 (the "Regulations") to set interim charges for the provision of indirect access ("IA") services by telecom securicor cellular radio limited ("BTCellnet") to intelligent network management services ("INMS"), 1-7.

Ovum (2003) Indirect Access and Carrier Pre-selection.

Ovum (2006) Request on CS and CPS.

Productivity Commission (2001) Telecommunications Competition Regulation, inquiry report, report no.16.

SK Telecom (2004) Monthly fact sheet.

The Digital Times (2004) Telecom Interconnection Rate Schedule Finalized, July 12.

The Electronic Times (2007) Keeping Marketing Costs Under Control: Selectivity and Concentration, May 7.

Willig, R.D. (1976) Consumer's surplus without Apology, *The American Economic Review*, 589-597.

Yonhap News Agency (2006) MIC Finalizes Interconnection Rate Schedule for 2006 and 2007, September 22.

## Figures

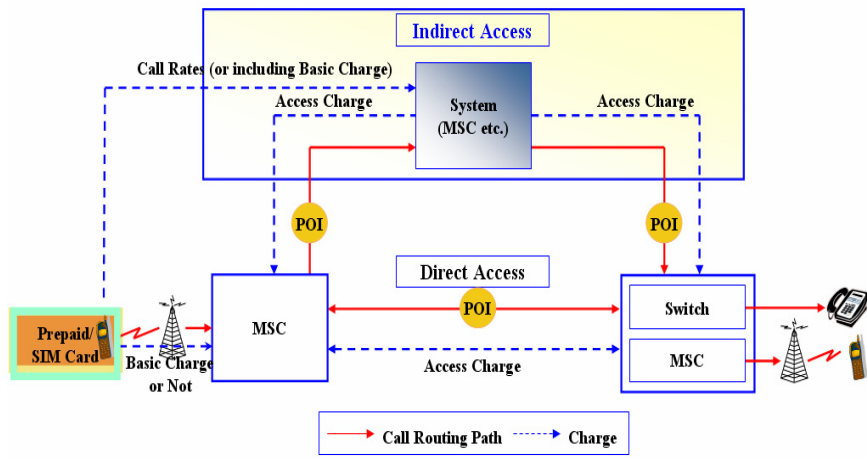


Fig. 1 Concept of Indirect Access

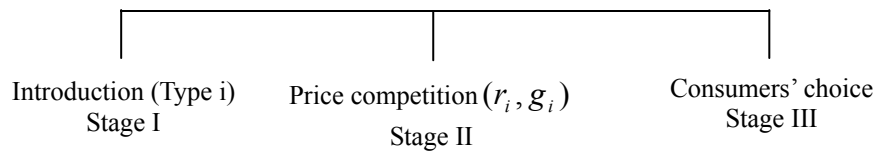


Fig. 2 Indirect Access Scheme and Market Stages

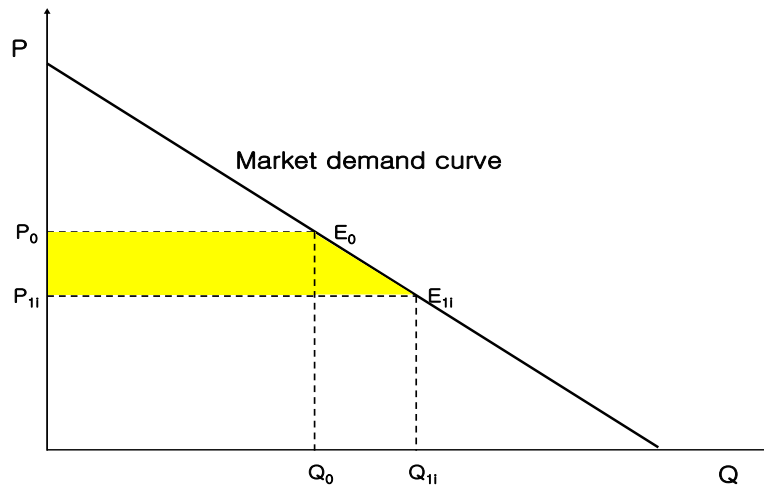


Fig. 3 Changes in Consumer Surplus Attributable to Competition

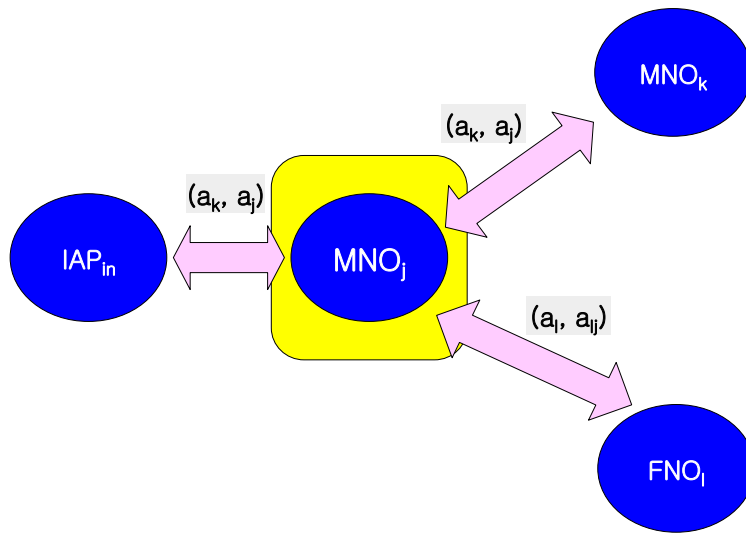


Fig. 4 Inter-operator Settlement Relationships

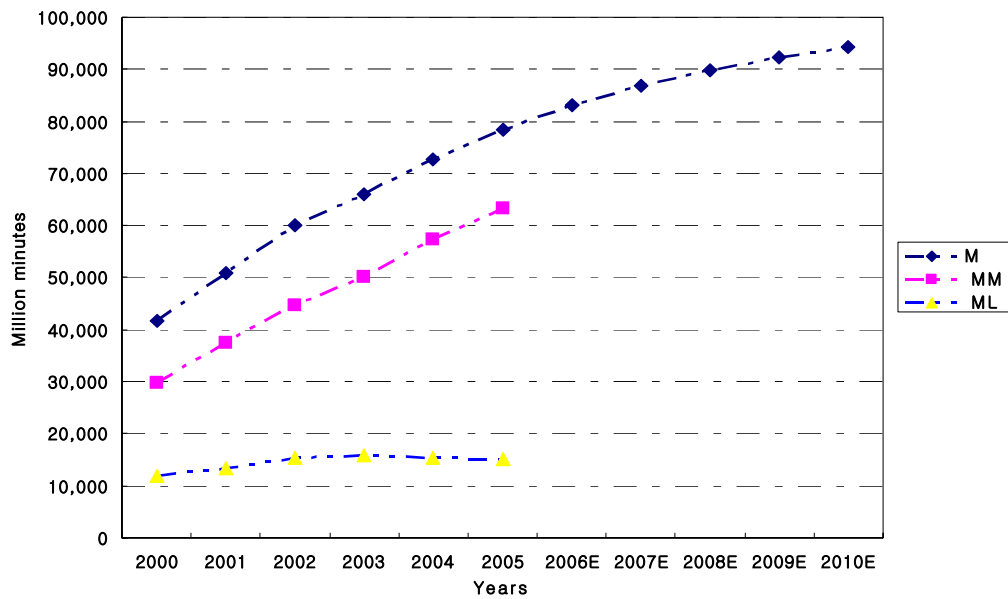


Fig. 5 Changes in Airtime Consumption

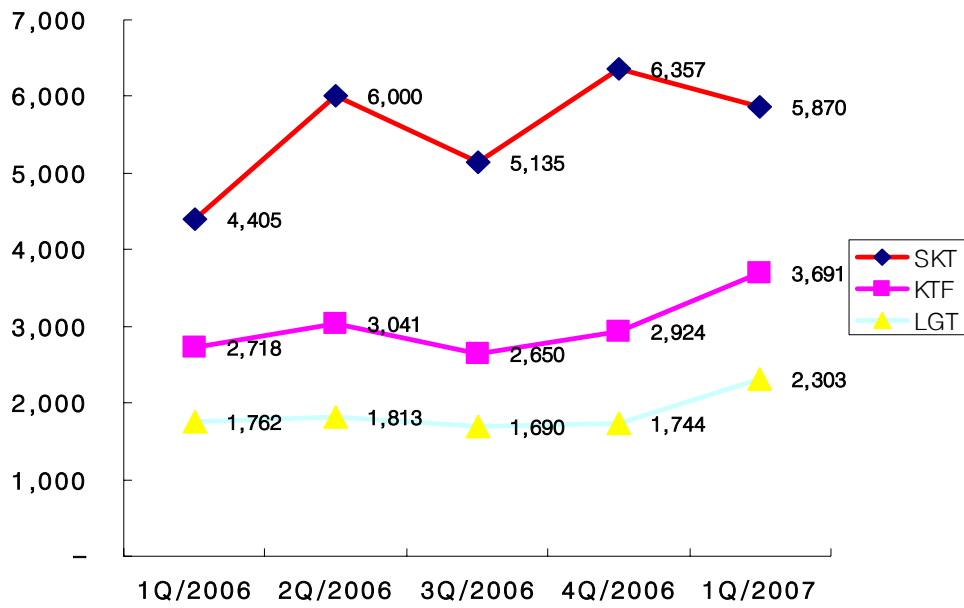


Fig. 6 Marketing Costs Incurred by Three Korean MNOs (as of the 1Q 2007)

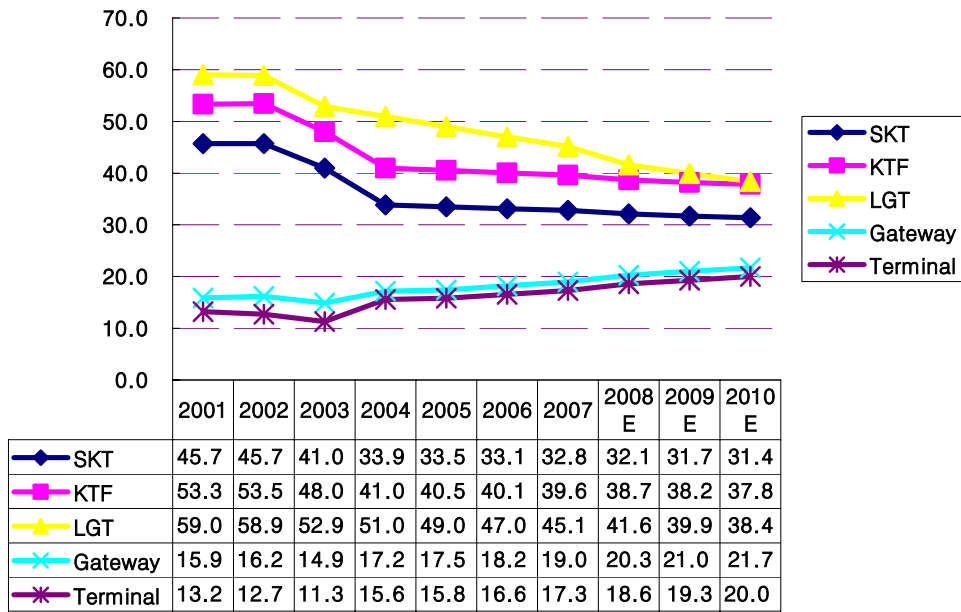


Fig. 7 Changes in Fixed and Wireless Network Interconnection Charges<sup>26</sup>

<sup>26</sup> Gateway charges are fees paid by long-distance, international and mobile carriers to fixed-line operators (KT, Hanaro Telecom) for use of their networks. Terminal charges are fees paid by Dacom and other long-distance network operators for connecting to KT's local switches.

## Tables

**Table 1**

Types of Indirect Access

Items	Types of Indirect Access			
	CS	CPS	Pre-paid card	SIM card
Services offered	Call origination services using third-party networks, to route calls to the operator designated by the access code dialed by a caller, and related value-added services	Call origination services using third-party networks, to route calls to the operator that has been pre-selected by a caller, and related value-added services	Call origination services using third-party networks, to route calls to the operator matching the access code contained in a pre-paid card, and related value-added services	Call origination services using third-party networks, to route calls to the operator matching the access code contained in a caller' SIM card, and related value-added services
Customer choice	No control over access providers		Can choose call and access service providers	Can choose call and access service providers
	Can choose call service providers			
Operator Prefix	Yes	No	Yes	No
Facilities required	MSC, HLR, transmission equipment	MSC, HLR, transmission equipment	Billing equipment	MSC, HLR, transmission equipment
Billing party	- Basic charges: MNOs - Call charges: IAPs	- Basic charges: MNOs - Call charges: IAPs	-Basic charges + call charges: IAPs	- Basic charges + call charges: IAPs

Note) SIM: Subscriber Identity Module, MSC: Mobile Switching Center, HLR: Home Location Register

**Table 2**

Retail-minus Pricing Scheme for Indirect Access Interconnection

$C = (0.8 * RRP) - OP$ <p>where:  C is the charge to be made to the IA operator,  RRP is the recommended retail price (exclusive of VAT),  OP is the outpayment made to the terminating operator (and any transit operator) for that call at that time of day.</p>
--

**Table 3**  
Indirect Access Schemes in Select Countries

Country	Type of Indirect Access Scheme				Pre-paid cards SIM cards	Carriers mandated to provide indirect access services	Operators eligible to use indirect access services	Associated conditions
	CS		CPS					
	ML	MM	ML	MM				
US	1984				Yes	All MNOs	N/A	N/A
Denmark	Aug. 1996		Apr. 1999		Yes	SMP	All MNOs	Commercial
UK	Jan. 2000		N/A		Yes	SMP	All operators with interconnection rights	Retail-minus
Spain	Dec. 2000				Yes	SMP	Common carriers	N/A
Finland	Jul. 1994		Jan. 1999		Yes	SMP	N/A	N/A
Ireland	Jul. 2000	Jan. 2005			Yes	SMP	All MNOs	Cost-plus
Austria	Aug. 1999		N/A		Yes	SMP	N/A	Cost-plus
Belgium	Oct. 2005		N/A		Yes	SMP	N/A	Cost-plus
Norway	Jan. 1998		Nov. 2000		Yes	All MNOs	All MNOs	N/A
Portugal	Apr. 2000	N/A			Yes	All MNOs	All MNOs	N/A
Sweden	Jul. 1999				Yes	All MNOs	N/A	N/A
Switzerland	Jan. 1998	N/A			Yes	All MNOs	All licensed and registered operators	N/A
Italy	Feb. 2005		N/A		Yes	SMP	N/A	Commercial
Hungary	Yes		N/A		Yes	All MNOs	N/A	N/A
Japan	N/A		N/A		Yes	N/A	N/A	N/A
Hong Kong	Jun. 1995		N/A		Yes	N/A	N/A	N/A

Source: Analysys (2000), European Telecommunications Office (2000), Ovum(2003), Ovum(2006)

**Table 4**  
Types of Indirect Access Scheme

Mandated Operators	All MNOs		SMPOs	
	cost-plus	retail-minus	cost-plus	retail-minus
Interconnection Pricing				
Scheme i	1	2	3	4

**Table 5**  
Call Rates (as of 2007)

(unit: won/ minute)

Item		SKT			KTF			LGT		
		Regular Tariff	Discount Tariff	Late- night Tariff	Regular Tariff	Discount Tariff	Late- night Tariff	Regular Tariff	Discount Tariff	Late- night Tariff
Won/minute		120.0	78.0	60.0	108.0	84.0	60.0	108.0		
Weight	Per Operator	101.4			96.0			108.0		
	Combined	100.68								

**Table 6**  
Long-distance CPS Subscriber Statistics

(unit: thousand subscribers, %)

Year	KT	Dacom	Onse Telecom	Hanaro Telecom	SK Telink
2000	18,661 (88.4)	2,040 (9.7)	407 (1.9)	-	-
2001	18,844 (86.2)	1,956 (9.0)	1,046 (4.8)	-	-
2002	19,346 (87.3)	1,869 (8.4)	965 (4.3)	-	-
2005	18,599 (85.4)	1,324 (6.1)	592 (2.7)	1,042 (4.8)	216 (1.0)
2006	18,688 (85.6)	1,057 (4.8)	457 (2.1)	1,324 (6.1)	305 (1.4)
3Q/2007	18,725 (85.6)	971 (4.4)	432 (2.0)	1,423 (6.5)	319 (1.5)

Source: The 2000-2002 data are cited from the Korea Information Society Development Institute (2003), and the 2005-2007 data from the Ministry of Information and Communication (2007).

**Table 7**  
Estimated Retail-minus Prices of Indirect Access Interconnection

(unit: won/minute)

Year\Price	SKT Retail Prices		KTF Retail Prices		LGT Retail Prices	
	Weighted: 101	Standard: 120	Weighted: 96	Standard: 108	Weighted: 108	Standard: 108
2008E	39.5	52.6	23.9	31.7	26.4	
2009E	39.8	53.0	24.3	32.1	28.1	
2010E	40.2	53.3	24.7	32.6	29.7	

**Table 8**

Changes in Consumer Surplus (unit: billions of won)

Category Type of scheme (i)	Lee, D. H. et al. (2002) e=-1.185	Kim, Y. K. et al. (2003) e=-0.74	This study e=-1.02
1	11,280	11,030	11,189
2	12,639	12,377	12,543
3	6,510 (10,131)	6,365 (9,891)	6,457 (10,044)
4	7,294 (10,915)	7,143 (10,668)	7,239 (10,825)

Note) The figures inside ( ) are estimates under the scenario that the latecomers slash call prices by an equal rate to SMPOs.

**Table 9**

Changes in Wholesale-market Interconnection Cost and Income

(unit: billions of won)

Category Type of scheme (i)	Cost	MNO	IAP
1	$\Delta C_{ai}$	1,825	-9,115
	$\alpha_{IAi}$	4,328	-
	$a_i$	-	204
	$C'_{ma}$	-	-3,591
2	$\Delta C_{ai}$	1,825	-10,164
	$\alpha_{IAi}$	4,648	-
	$a_i$	-	204
	$C'_{ma}$	-	-3,142
3	$\Delta C_{ai}$	852	-3,836
	$\alpha_{IAi}$	2,480	-
	$a_i$	-	117
	$C'_{ma}$	-	-2,072
4	$\Delta C_{ai}$	852	-4,668
	$\alpha_{IAi}$	2,926	-
	$a_i$	-	117
	$C'_{ma}$	-	-1,813

Note)  $\Delta C_{ai}$ : change in the cost of interconnecting to MNO networks (size of cost reduction),  $\alpha_{IAi}$ : new interconnection income earned from IAPs,  $a_i$ : land call termination income earned from MNOs,  $C'_{ma}$ : cost of marketing incurred by IAOS.

**Table 10**  
**Producer Surplus and Social Welfare**

(unit: billions of won)

Type of scheme ( i )	Category	Changes in Call Income		Producer Surplus	Social Welfare
		MNO	IAP		
1		-6,599	-532	-7,131	4,058
2		-6,279	-2,629	-8,908	3,635
3		-3,975	1,116	-2,859	3,598 (7,185)
4		-3,530	-320	-3,850	3,389 (6,975)

Note) The figures inside ( ) are estimates under the scenario that latecomers slash call prices by an equal rate to SMPOs.