Evaluating the Effects of Horizontal Mergers in the Korean Mobile Telecommunications Market

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ABSTRACT

This paper attempts to analyze the competitive implications of horizontal mergers that happened in the Korean mobile telecommunications market. A big increase in the concentration index after the mergers and acquisitions is often interpreted as evidence that competition in the Korean mobile telecommunications market has decreased. This paper, first, points out that such an interpretation is not necessarily correct and more competition may lead to higher HHI, so caution should be taken before one concludes that the Korean mobile market has become less competitive simply because the HHI index has increased. This paper also shows that the increase in the concentration can be associated with increases in welfare, so that one should not presume that concentration and market performance moved in opposite directions in the Korean mobile market. Since traditional merger analysis of using the Hirfindahl Index is misleading, we need to measure consumer surplus to correctly assess the effects of the mergers and acquisitions. We find that although the market concentration, as measured by the Hirfindahl index increased 59.6 percent after the mergers and acquisitions, the change in the consumer surplus was rather small. Estimates show that it is during the introduction of competition which shows significant changes in the consumer surplus rather than during the mergers and acquisitions. The adverse effects of mergers and acquisitions on consumer surplus, if any, were not as strong as the HHI index may imply.

Key words: Horizontal mergers, HHI, Concentration, Consumer surplus

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I. INTRODUCTION

While the Korean mobile market is extremely dynamic and is one of the leading networks in the world, contentions regarding a reasonable price for mobile telecommunications services remain intense. Korea leads in terms of the percentage of 3G in total subscription, with nearly 100 percent of mobile subscribers with 3G mobile handsets. Notwithstanding this performance, some believe that the Korean mobile market would have performed better in the absence of the horizontal mergers and acquisitions that took place in 2002. They assert that the SKT-STI merger unambiguously led to increased market power of SKT, the dominant carrier in the Korean mobile market, while the merger-specific efficiency was ambiguous. This paper tries to evaluate the effects of the horizontal mergers and acquisitions in the Korean mobile telecommunications service (MTS) market.

To make a fair evaluation of the Korean MTS market after the mergers, we have to compare the competitive situation with and without the mergers and acquisitions (M&A). This is a difficult task and therefore most of works use some indexes of market performances, like HHI, service prices, etc. to analyze the competitiveness of the mobile market. The HHI increased by 59.6 percent right after the M&A, so it is tempting to conclude that the competitive situation in the Korean mobile market has worsened and that the consumer welfare also decreased thereafter. This paper scrutinizes this assertion and tries to evaluate the competitive effects of the horizontal mergers in the Korean mobile telecommunications market.

Our paper is organized as follows: In section II, we review some critical issues on economic tradeoffs of horizontal mergers and provide simple examples, in which competition levels and HHI move in the same direction and therefore, a higher HHI does not necessarily imply that competitiveness has decreased. We also show that high HHI, taking granted that it can be interpreted as the market becoming less competitive, should not be interpreted to imply that social welfare has decreased. In section III, we provide a brief history of the Korean mobile market and explain the internal and exogenous motives for the mergers and acquisitions. In section IV, we apply four different measures of consumer surplus to analyze the competitive effects in response to mergers, and then we draw our conclusions.
II. ECONOMIC TRADEOFFS OF HORIZONTAL MERGERS

Traditional merger analysis has long been concerned with estimating the effects of a merger on market concentration, which is measured using the Herfindahl–Hirschman Index (HHI), \( HHI \) defined as the sum of the squares of each firm’s market shares. The presumption is that for a given merger an increase in the concentration index brings about a decrease in competition and welfare. This paper notes that such an interpretation is not necessarily correct, so caution should be taken to conclude that Korean MTS market has become less competitive and to presume that concentration and market performance has moved in the opposite direction.\(^1\) Figure 1 shows how the \( HHI \) changed after the horizontal mergers. \( HHI \) increased from 2577 to 3070 after Korea Telecom Freetel (Now KTF) was merged with Hansol (later M.com) and it also increased as a result of SKT’s acquisition of STI (Shinsegii Telecom) to 4113. In total, the \( HHI \) increased 59.6 percent compared with the pre-merger situation.

\[\text{<Figure 1> Changes in the HHI index}\]

\(^1\) We do not deny that other measures such as entry barriers, potential degree of competition, consumer responsibility have been used to fully analyze the M&A consequences.
1. Linear City Model: Competition and Concentration

Consider a Hotelling linear city model of length one. Firm A is located on the left end and firm B on the right end of this city. Consumers are uniformly distributed over the city with a density of 1. Each buys one and only one product from the firm with the lowest effective price that is the sum of the prices charged by the firm and the travel cost, $t$, to reach this firm. Assume that the consumer’s valuation is high enough that the consumer buys one product.

Let $c_i$ denote the constant marginal production costs of firm $i \ (A, B)$. As travel costs fall, each firm’s price difference becomes more important for consumers and more of them switch their purchases from the closest firm to the cheapest firm. Therefore, we can interpret a decrease in the travel cost $t$ as an increase in product market competition. This example shows that more competition in the sense of lower travel costs may lead to a higher concentration index.\(^2\)

Consumers at position $x \in [0,1]$ are indifferent between buying from firm A or B so that $x$ satisfies $tx + P_A = (1-x)t + P_B$, where prices $P_A$, $P_B$ are given. That is $x = \frac{1}{2} \frac{(P_B - P_A)}{2t}$. Because firm A is on the left of this city at position 0, we find $q_a = \frac{1}{2} + \frac{(P_B - P_A)}{2t}$ and $q_b = \frac{1}{2} + \frac{(P_A - P_B)}{2t}$. Solving simultaneously for the first order conditions of firms A and B the Bertrand-Nash equilibrium yields $P_i = \frac{(3t + 2c_i - c_j)}{3}$.

Substituting this into the firms’ output equations yields $q_i = \frac{1}{2} + \frac{(c_j - c_i)}{6t}$, $i, j = A, B$ and $i \neq j$, and the $HHI = \sum \frac{q_i}{Q}$, then can be expressed as $\frac{1}{2} + \frac{(c_i - c_j)^2}{18t^2}$.

If $c_A = c_B$, then $q_A = q_B = \frac{1}{2}$ and $HHI$ is unaffected by the travel cost $t$. However, if $c_A \neq c_B$, then any firm with lower cost can exploit its cost advantage better if $t$ is

\(^2\) The market situation in the Korean MTS market after the M&A does not necessarily confirm the model’s predictions.
lower. Consequently, more competition can lead to higher $HHI$. This example suggests that we cannot presume that competition in the Korean MTS market has decreased after the merger and acquisition simply because $HHI$ increased.

2. Cournot Equilibrium Example: Concentration and Welfare

Farrell and Shapiro (1990) showed that the traditional merger analysis can be misleading in its use of the Herfindahl Index. In the Cournot equilibrium, if larger firms are efficient, then economic welfare may be enhanced if output is shifted toward them and away from small, less efficient firms.

In this example, we show that in the Cournot oligopoly model with homogenous goods, concentration can be associated with a welfare increase. Demand is given by $p(X)$, where $p$ is the price, $X$ is industry output, and where $p'(X)<0$. The number of firms, $n$ is exogenous and we denote firm $i$’s cost function by $c'(x_i)$ where $x_i$ is the firm $i$’s output. We permit the firms to differ in efficiency. Then, firm $i$’s first-order condition is

$$p(X) + x_ip'(X) - c'_i(x_i) = 0 \quad i = 1, \ldots, n$$

For simplicity, if we use the demand function of the form $p(X) = 1 - X$, one can check the first order condition for each firm $i$ is satisfied if $x_i = \frac{(1 - n c_i + \sum_{j \neq i} c_j)}{(n+1)}$ and $
_i = \left[ \frac{1 - n c_i + \sum_{j \neq i} c_j}{(n+1)} \right]^2$ for constant marginal costs. We first consider the Cournot equilibrium with three firms whose marginal costs are $c^1=0.10$, $c^2=0.35$ and $c^3=0.40$ respectively. The first column of <Table 1> shows the each firm’s output, market

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3) They show that increases in the concentration can be associated with increases in welfare if $dX/X + dH/2H > 0$, where $X$ is aggregate output and $H$ is the Herfindahl Index.

4) Some critics have long argued that large firms may be large because they are efficient; see for instance Demsetz (1973).

5) If $n$ equally efficient firms with constant unit cost compete as Cournot oligopolists, then there is a rigid inverse relationship between concentration and welfare.
price, \( HHI \) and welfare measures, social welfare(\( SW \)), consumer surplus(\( CS \)), and producer surplus(\( PS \)). The next column then calculates the new market equilibrium consequences, where firm 3 is horizontally merged with firm 2.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Cournot Equilibrium with a Horizontal Merger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>( c_1 = 0.10 )</td>
<td>( c_1 = 0.10 )</td>
</tr>
<tr>
<td>( c_2 = 0.35 )</td>
<td>( c_2 = 0.35 )</td>
</tr>
<tr>
<td>( c_3 = 0.40 )</td>
<td>*<em>( c_3 = 0.40 )*</em></td>
</tr>
<tr>
<td><strong>( HHI = 4982 )</strong></td>
<td><strong>( HHI = 5965 )</strong></td>
</tr>
</tbody>
</table>

The output of firm 1, the larger firm, increased (5.55% increase from 0.36 to 0.38). The sum of outputs of firm 2, and 3 decreased (23.53% decrease from 0.17 to 0.13). Obviously the market price increased since industry output decreased in response to the merger. The social welfare level went up notwithstanding the increase in the \( HHI \). This example is not simply our curiosity. Given this example with the results for concentration, output, and welfare, the traditional merger analysis of Hirfindahl index is misleading and a more careful analysis of the welfare trade-offs of mergers is needed.\(^6\)

The anticompetitive harm of a merger is not an increasing function of concentration. The countervailing efficiencies should be weighed against the adverse effects. If total output is shifted toward more efficient larger firms and away from less efficient smaller firms in response to a merger, such shifts will increase the concentration, nevertheless create welfare gains. We will attempt to determine the quantitative welfare implications of horizontal mergers that took place in the Korean mobile market.

\(^6\) The merger case in this example does not exactly match with the circumstances in the Korean MTS market, where the merger has been accomplished with the largest firm.
3. How much economies of scale?

An oligopolistic merger could lessen competition without creating some degree of synergies or scale economies. Although the possibilities that some form of capital may be best recombined after a merger or that the merging parties may benefit from its partner’s management expertises are widely acceptable, many still believe that concuring cost reductions should be relatively high for the net allocative effects to be positive. But Williamson (1968) made it clear that a relatively modest cost reduction is usually sufficient to offset relatively large price increases even if the elasticity of demand is high. According to his calculation, if a reduction in average costs on the order of 5 to 10 percent is available through a merger, it must give rise to price increases in excess of 20 percent if price elasticity is 2, and in excess of 40 percent if it is 1/2, for the net allocative effects to be negative.7)

<Table 2> Percentage Cost Reductions to Offset Percentage Price Increases

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>2</th>
<th>1</th>
<th>1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.25</td>
<td>0.12</td>
<td>0.06</td>
</tr>
<tr>
<td>10</td>
<td>1.00</td>
<td>0.50</td>
<td>0.25</td>
</tr>
<tr>
<td>20</td>
<td>4.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>30</td>
<td>9.00</td>
<td>4.50</td>
<td>2.25</td>
</tr>
</tbody>
</table>

Williamson (1968), p 23.

<Table 2> shows the cost reductions percentages sufficient to offset percentage price increases for selected values of different price elasticities ($\alpha$). This result implies that economic benefits from mergers are not merely an illusion.8)

8) The common usage of several mobile telecommunications facilities might be one of the actual evidence of merger effect in Korean MTS market.
III. BACKGROUND AND DRIVING FORCES OF HORIZONTAL MERGERS IN THE KOREAN MOBILE MARKET

Korea Mobile Telecommunications Service (KMTS) started providing analogue services in 1984 and remained as a monopoly service provider for almost 12 years until a second provider, STI, entered the market in 1996. Not surprisingly, the Korean mobile telecommunications market was relatively stagnant during these periods. The number of subscribers at that time was around two million with a penetration rate of 4.49% as compared with around 42 million subscribers with a penetration rate of 16.44% in the U.S. at the end of 1996.\textsuperscript{9)}

As additional Personal Communications Service (PCS) providers- KTF, LGT, KMT- entered the market in late 1997, the total number of subscribers increased dramatically, reaching 24.5 million with a penetration rate of about 50% at the end of 1999, mainly because of the reduction in service prices, improvements in quality due to the active competition, and partly because of the supplies of handset subsidies. The supplies of handset subsidies were prohibited by a regulation after July 2000. At this time, mobile telecommunications service revenue of about 11.5 U.S. billion dollars surpassed that of fixed line service, which amounted only to 7.7 U.S. billion dollars.

However, fierce competition between new entrants and incumbent carriers, especially with the supplies of handset subsidies to attract new customers put some carriers in financial trouble and the worldwide financial crisis made the situation even worse. At the same time, digital convergence and liberalization in telecommunications fields led to various forms of mergers and acquisitions across Europe and the U.S. involving international firms with different platforms.

\textsuperscript{9)} Cellular service began in 1983 at Chicago in America.
With these internal and exogenous trends, SKT completed the takeover of Shinsegi Telecom (STI), its leading competitor in the CDMA 800 MHz field, in January 2002. In order to satisfy MIC, the Korean regulator, one of the requirements for allowing the acquisition obligated SKT to reduce its combined market share to below 50%. SKT was able to accomplish this by demarketing—getting rid of their least profitable subscribers and not advertising for new customers. The acquisition resulted in a sharp increase of the HHI from 2,577 in 2000 to 4,113 in 2002, a 59.6 percent change.

In 2004, the MIC began to promote new policies for mobile telecommunications service competition. The MIC converted the facility-based competition into a service-based competition to reduce the lock-in effect and promote competition. The MIC introduced the mobile number portability with a time difference between SKT, KTF and LGT, and with discrimination in frequency usage fees in consideration of the technical differences in frequency between cellular (800 MHz) and PCS (1.8 GHz).

<Figure 2> Mobile Subscribers in Korea

IV. COMPETITIVE IMPLICATIONS OF HORIZONTAL MERGERS AND ACQUISITIONS

In this section, we try to measure the consumer surplus in the Korean mobile telecommunications market. We compare the consumer surplus measures by applying the Hicks’ exact method, the Marshallian method and the often used, Australian method.

1. Marshallian Consumer Surplus

The most commonly used method for measuring consumer surplus is based on the ordinary demand curve. Given the specifications for the demand curve, one can integrate it between any two prices to calculate the Marshallian consumer surplus. In this paper, we use the log-linear functional form, one of the most widely used specifications, shown in equation (2).

\[ q = e^{\beta y} \]  
(2)

Where \( q \) denotes the quantity demanded, \( p \) price, \( y \) income, and \( z \) is a vector of variables that affect the demand. The parameters \( \alpha, \delta \) and measure the elasticities of demand with respect to the price and income respectively.

Integrating the demand curve from \( p_0 \) to \( p_1 \) yields:

\[ \frac{e^{\beta y} \left( p_1^{1+\alpha} - p_0^{1+\alpha} \right)}{1+\alpha} \]  
(3)

2. Exact Consumer Surplus

As pointed out by Hicks (1956), the Marshallian consumer surplus is not an exact welfare measure because as price changes the income effect is inappropriately included in the consumer surplus. Hausman (1981) derived the exact consumer surplus directly from an estimated ordinary demand curve. The appropriate exact
consumer surplus formula for the demand curve specified in equation (2) is given by equation (4).

\[ \left\{ \frac{1-\delta}{1+\alpha} y^{-\delta} (p_x x_i - p_0 x_0) + y^{1-\delta} \right\}^{\frac{1}{1-\delta}} - y \]  

(4)

The additional terms, as compared with equation (3) above, capture the implicit change in real income due to price changes by incorporating the income elasticity of demand. As Willig (1976) pointed out, it is interesting to see if these terms will only be of second-order in magnitude for the Korean mobile service market.

3. ACM Consumer Surplus

Whereas both Marshallian consumer surplus and the exact consumer surplus attributed the increase in quantities purchased over time entirely to lower prices, the ACM (Australian Communications Authority) method included a parameter to account for the diffusion of the technology. The ACM accounted for a demand shift by either assuming a parallel shift (PAR) of the demand curve or a pivotal shift (PIV) in the slope of the demand curve. If we use first-order Taylor approximation of equation (2), the linear form of the demand curve can be written as 

\[ q_t = m_t + \beta_t p_t \]

and the appropriate formula for the consumer surplus is given by equation (5)

\[ \frac{-\beta_t}{2} \left( \frac{m_t}{\beta_t} + p_t \right)^2 \]  

(5)

And the \( \beta_t \) can be calculated as \( \alpha (q_t / p_t) \) from the estimation of equation (2). As for the parallel shift of the demand curve, the slope \( \beta_t \) is assumed to be constant and \( m_t \) is calculated as \( q_t - \beta_t p_t \). As for the pivotal shift in the demand curve the price intercept \( r \) is first calculated as \( -m / \beta \) for the base year and then the shifting slopes are calculated as \( \beta_t = q_t / (r - p_t) \).
4. Evaluating the Horizontal Merger in Korea Mobile Market

In order to calculate the consumer surplus, we need to estimate the demand equation given by equation (2), especially to get the price and income elasticities. We do not go through the estimation of the demand equations, instead we use the estimates -0.75 and 1.04 given in Kim et al. (2008) for the price and the income elasticities respectively. In this paper, we are concerned with the changes in consumer surplus for the various methods.

<Table 3> and <Figure 3> present the changes of consumer surplus for the Hicks’ exact, Marshallian, ACM parallel, and ACM pivotal methods. Two measures of the consumer surplus, the Hicks’ exact and the Marshallian, were significant in the late 1990s and then remained somewhat stable in the early 2000s, though the ACM measures failed to catch these changes.

<Table 3> Changes in Consumer Surpluses in Korea’s Mobile Market

<table>
<thead>
<tr>
<th></th>
<th>Exact Method</th>
<th>Marshallian</th>
<th>ACM Methods</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Parallel Shift (PAR)</td>
<td>Pivotal Shift (PIV)</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>14.0151</td>
<td>13.3337</td>
<td>1.2904</td>
<td>1.5596</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>12.3730</td>
<td>11.6354</td>
<td>2.1196</td>
<td>2.0789</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>2.6236</td>
<td>2.5033</td>
<td>0.8730</td>
<td>0.6353</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>0.6048</td>
<td>0.7108</td>
<td>0.8388</td>
<td>0.7703</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>1.0761</td>
<td>1.0568</td>
<td>1.1595</td>
<td>0.9276</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>4.3421</td>
<td>4.1182</td>
<td>1.6487</td>
<td>0.8803</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>1.0004</td>
<td>0.9691</td>
<td>0.9807</td>
<td>0.5537</td>
<td></td>
</tr>
<tr>
<td>SUM</td>
<td>31.2952</td>
<td>30.0578</td>
<td>8.4445</td>
<td>6.7243</td>
<td></td>
</tr>
</tbody>
</table>

$\alpha = -0.754, \delta = 1.04$
As this figure shows, the change in consumer surplus was most significant in 1998 and 1999 due to fierce competition following the entry of new PCS operators in October 1997. This result also demonstrates that the negative effects on the changes in consumer surplus of the mergers and acquisitions that took place in 2002 have been relatively small, if any. Therefore, it would not be unreasonable to conclude that the introduction of competition in the mobile service market resulted in remarkable changes in the consumer surplus and the adverse effects of mergers and acquisitions were not as strong as the HHI implied.

11) This result may not come from the potential competition but from the price regulation, which this paper has not accounted for.
Ⅴ. CONCLUSION

Evaluating the competitiveness of the Korean MTS market after a merger needs a careful consideration of the various market factors. This paper reviewed some critical issues on economic tradeoffs of horizontal mergers and provided simple examples in which competition and the HHI move in the same direction, showing that a high HHI does not necessarily imply deteriorating competitiveness. We also showed that a high HHI should not be interpreted to imply that social welfare levels have decreased. The HHI increased 59.6 percent after the M&A and therefore it has been considered that the competitive situation in Korea’s mobile market has worsened and the consumer welfare decreased thereafter.

This paper assessed this assertion and showed that the negative effects of the mergers and acquisitions that took place in 2002 on the changes in the consumer surplus were relatively small, if any. Therefore, the adverse effect of the mergers and acquisitions was not as strong as the HHI index implied at least in terms of the changes in the consumer surplus. Of course, to have a complete evaluation of the M&A effects, we have to take a close look at some other indices of market performance rather than just the changes in the consumer surplus, but this paper has shed some lights on this issue. This paper provided four different measures of consumer surplus to analyze the competitive effects in response to the mergers. Two measures of the consumer surplus, the Hicks’ exact and the Marshallian, were most significant in late 1990s and then were somewhat stable in the early 2000s, though the ACM measures failed to catch these changes, and the adverse effects of mergers and acquisitions that took place year 2002 were not as strong as the HHI index implied.

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