Communication media diffusion and substitutions: longitudinal trends from 1980 to 2005 in Korea

Yoonjae Nam
The State University of New York at Buffalo, USA

George A. Barnett
University of California, Davis, USA

Abstract
This study analyzes longitudinal trends in Korean use of (1) domestic mail, (2) international mail, (3) domestic telephone calls, (4) international outgoing telephone calls, (5) telex, (6) mobile telephones, (7) televisions and (8) the internet to examine the media's displacement or supplementary effects. The results show that international mail, domestic telephone and telex can be best described by a quadratic indicating they are undergoing disadoption while the trends for domestic mail and international telephone calls show exponential growth. Correlations confirmed that new media have displaced international mail, domestic telephone and telex, yet they do not substitute for domestic letters and international telephone calls. Finally, television, mobile telephones and the internet are at the exponential or logistic growth stage and supplement each other.

Key words
diffusion of innovation, displacement effect, longitudinal media use trends, media substitutions, supplementary effect

Both domestically and internationally, Korea is generally acknowledged to be a leading internet nation (Kim, 2006). According to the Ministry of Information and Communication (MIC), the number of broadband internet subscribers has jumped from fewer than 4 million in 2000 to 10 million in 2002 and 12 million in 2004. In terms of subscribing households, the growth rate was 27 percent in 2000, 69 percent in 2002 and 77 percent in 2004
(MIC, 2004). In 2002, Korea ranked fourth, behind Iceland, Sweden and the USA, with an internet penetration of 55.2 per 100 inhabitants (ITU, 2003). Today, Korea leads the world in broadband internet usage. In 2003, Korea’s broadband penetration was approximately 21 percent, significantly higher than that of the next country in the ranking, Hong Kong (15 percent). Seventy percent of Korean internet users connect via broadband (Lee and Chan-Olmsted, 2004). These numbers clearly show that Korea is leading in the deployment of a high-capacity information infrastructure.

Similar to the evolution of broadband internet, mobile services in Korea have also achieved successful diffusion. At the beginning of the 1990s, Korea had only one mobile telephone operator with less than 5 percent penetration. Most people used mobile phones and network devices manufactured by foreign companies. A little over a decade later, more than 75 percent of Korea’s population were using mobile phone services (Yoo et al., 2005).

Although diffusion of new communication technology happened rapidly, it does not mean that the deployment of new technology led to an immediate replacement of the older technology. Traditional and new communication media still compete with each other. Both displacement and supplementary effects co-occur in the telecommunication market. Since Korea is a leading country in terms of new telecommunication technology, its IT environment is a barometer to forecast future global trends. This study analyzes longitudinal trends in Korean media, including (1) domestic mail, (2) international mail, (3) domestic telephone calls, (4) international outgoing telephone calls, (5) telex, (6) mobile telephones, (7) televisions and (8) the internet, to examine the displacement or supplementary effects in accordance with diffusion theory at the individual and social levels.

**Literature review and research hypotheses**

**Media substitution studies at social level**

New technologies do not replace old ones overnight; rather substitution often requires a long period of time (Wang and Lan, 2007). The substitution process is a gradual one. Fisher and Pry (1971) proposed the ‘technological substitution model’, based on the assumption that new technology will displace older established technology. Their model is based on natural competition, which means that regulation and market interventions are absent. Natural competition can serve as both an opportunity and threat to technological substitution (Johnson and Bhatia, 1997). In this model the introduction of a technological substitution is valid only after a modest initial gain. This will lead to full substitution with the newer technology, which has been assumed to have obtained market acceptance and thus reached its full potential.

Ford and Ryan (1981) proposed the ‘technology life cycle’. In developing the concept of the technology life cycle from the more familiar notion of the ‘product life cycle’, they examined technology development, application and degradation in such diverse industries as electronics components, consumer electronics, automobiles, shoe manufacturing, construction, mining equipment and air conditioning. The initial stage is technology development, which begins long before any production, when research indicates a potentially valuable technology. The second stage is technology application, a move to new product development that derives income from the sale or licensing of the technology.
The third stage is the application launch of the developed technology either through product modification or through application to different or perhaps wider product areas. The fourth stage, application growth, is equivalent to market growth within the product life cycle. The technology is at its highest value during this stage. The technology is further modified and improved and then starts the technology maturity stage. The final stage of the technology life cycle occurs when it has reached the point of virtually full exploitation, and the subsequent new market identification process begins.

The Bass (1969) model focuses on initial adoption. This model assumes that the probability of adoption of a new product or technology at time $t$ given that it has not yet been adopted would depend linearly on two forces, one of which is independent of the number of previous adopters and the other would be positively influenced by previous adopters (Bass et al., 1994). A bell-shaped curve is created since the new product expands in numbers during the first half of the diffusion process and thereafter declines in numbers per the ensuing time periods. The Bass model has been developed as the ‘generational diffusion model’, which develops an understanding of the demand dynamics and interrelationships between product generations (Norton and Bass, 1987). The S-shaped curve starting from the single generation has no substitution and is proportional to the distributed cumulative function of the adoption rate. As the second generation is introduced, there comes a point at which the first generation becomes negative. There are three phases of generational diffusion. The first phase is the introduction and development of uses for the first generation, leading to a rapid rise in use. The second is the introduction of the second generation, which causes the first to become negative. The third phase is when the second generation has saturated the substitution potential. At this point, the first generation becomes obsolete as use reaches zero (Johnson and Bhatia, 1997). Information technology products and services are typically released in successive generations that diffuse in wave-like patterns such as in Figure 1 (Bass and Bass, 2004).

Based on the aforementioned media substitution studies at the social level, this article examines the best-fit curve model for describing the adoption and disadoption patterns of use and longitudinal trends of communication media in Korea. Communication media growth can be measured by changes in the number of users or overall level of use (Barnett et al., 1993). Generally, the diffusion model suggests that the trends would be exponentially

![Figure 1. Generational diffusion model](image-url)
non-linear if the medium has an S-shaped logistic growth and does not reach a saturation limit. However, this study suggests that the introduction of new technologies in the 1990s will alter the growth pattern of traditional media. Ford and Ryan’s ‘technology life cycle’ and Norton and Bass’s ‘generational diffusion model’ are applied, since traditional media in Korea have already passed the point of full exploitation. In addition, the diffusion process for subsequent media such as the mobile telephone and internet has saturated the substitution potential. Therefore, this study assumes that the exponential or logistic curve is not the best description of traditional media growth trends (see Figure 2):

\[ H1: \] The growth trends of traditional media will differ from those of new media.

\[ H1a: \] The trends in use for traditional media such as mail, telephone, telex and television will best be described by a quadratic curve rather than an exponential or logistic curve.

\[ H1b: \] The trends in use for new media such as mobile phone and the internet will best be described by an exponential or logistic curve.

**Media substitution at individual level**

Rogers (2003) explained the adoption of innovation at the individual level in terms of the adopter’s characteristics, his/her social network and organization, the communication process, the change agent’s characteristics and the attributes of the innovation, including its relative advantage, compatibility, complexity, trialability and observability. Diffusion of new technology is a type of social change, defined as the process by which innovations...
are adopted by social systems (Rogers, 2003). An individual is exposed to new technology and gains an understanding of how it functions. Then, he/she forms a favorable or unfavorable attitude toward the technology, which leads to a choice to adopt or reject it. After deciding to adopt, the individual puts a new idea into use and confirms his/her decision.

The compatibility between innovations and existing social norms or patterns of behavior influences the adoption of new technology (Rhee and Kim, 2004). The media substitution hypothesis (Atkin et al., 1998; Lin, 2001) suggests that the introduction of a new medium encourages a restructuring of the way people perceive existing media.

There are conflicting views on media substitution: displacement and supplement. Basically, it is assumed that the introduction of new technology leads people to redistribute the time they allocate to other activities and establish new patterns of behavior (Vitalari et al., 1985). However, emerging new media, like the internet, could increase the absolute amount of time for communicative activities by expanding the communication infrastructure; thus, new communication technologies complement older ones.

**Media displacement** occurs due to superior content, technical benefit and cost efficiency (Lin, 2001). Lasswell (1948) suggested that television would displace radio in terms of entertainment because of television’s visual aspect. Lin (1994) argued that audiences abandon an old technology and replace it with a new one when the latter is considered more functionally desirable. New media such as the internet will displace functionally similar traditional media if people perceive that the new medium is superior in function or content, less costly or more convenient (Lin, 2001). The subsequent cross-national research suggested that new media may substitute time online for attention to functionally equivalent social and media activities (DiMaggio et al., 2001; Weiss, 1968). As a result of the impact of television, for example, audiences abandoned their radios, movie theater attendance declined and general-interest magazines ceased publication.

Lazarsfeld (1940) studied broadcasting’s impact on print media based on the assumption that new media would lead to reduced use of old media. Increased television viewing time had led to reductions in time spent going to the movies, listening to radio and reading fiction (Bogart, 1956; Coffin, 1955). Television use has had effects on not only use of other media but also daily life patterns such as out-of-home socializing, in-home conversation, housework, personal care activities and even sleep (Robinson and Godbey, 1999). For example, Robinson (1981) and Weiss (1968) reported that individuals’ use of television reduced the amount of time spent with other media and social activities. James et al. (1995) showed that use of electronic bulletin boards reduced the time spent with other media such as TV, telephone, books and letters. Kayany and Yelsma (2000) also found displacement effects of online media on the use of television, newspapers and family conversation.

Many studies, however, have provided scant support for time displacement due to the functional equivalence of other media. The functional-equivalence model that described the effects of television thus far appears not to fit the experience of internet users (DiMaggio et al., 2001). Those studies have shown that people will consume media based on the media supplement hypothesis, which is predicated on whether the information technology is ‘functionally similar’ to those already in use (Atkin et al., 1998; Kang and Atkin, 1999). Media technologies rarely become extinct; they typically endure by improving or updating their content offerings or delivery system (Lin, 2002). Many studies
support media supplementation. Dutton et al. (1987) found that computer use was not related to television viewing. Atkin et al. (1998) and Busselle et al. (1999) reported that traditional media use was not significantly related to internet use. The Pew Center for the People and the Press (1995, 1999) also indicated that internet use was unrelated or positively associated with social interaction. Further, Robinson and Kestnbaum (1999) found, based on 1997 data from the federal Survey of Public Participation in the Arts, that internet users more frequently use other media or engage in social activities than do comparable non-users. They read more literature, attended more arts events, went to more movies and watched and played more sports. However, the relationship between use of new media and old media differs by user characteristics. Robinson et al. (2002) reported that internet use was associated with greater use of print media among users who had been early adopters, while this relationship had disappeared among new internet users.

Matei and Ball-Rokeach (2003) and Wellman et al. (2001) argued that new media, especially the internet, are increasingly incorporated into everyday life and communication infrastructure. Thus, the internet acts as a part of the general media system, and supplements rather than replaces old communication channels. For example, Flanagan and Metzger (2001) found that the internet is a multidimensional technology used in a manner similar to other, more traditional technologies. In this media supplement argument, the internet, even though it is more convenient and affordable, provides an additional means of communication to telephone and face-to-face contact (Müller, 1999). Therefore it continues and intensifies the interpersonal transformation from door-to-door to individualized place-to-place and person-to-person networks (Wellman, 2001). Face-to-face and telephone contact continues, complemented by the internet’s ease in connecting geographically dispersed people and organizations bonded by shared interests (Wellman et al., 2001).

Based on the preceding arguments, this study examines media substitutions in Korea. Which media displace or supplement other media? To do so, the study examines the relationships between the residuals of the communication media’s trends over time to determine whether new technology has substituted or complemented the existing technologies. Positive relations will indicate that the media supplement each other. A negative correlation suggests replacement:

H2: New communication media will have displacement effects on old media.

Methods

This study examines the changing trends and media substitution patterns of Korean communications media through regression analysis. Data were collected from the Universal Postal Union Database (UPU, 2006), and the International Telecommunications Union World Telecommunication Indicators Database (ITU, 2005).

The International Bureau of the UPU has published postal statistics regularly since 1875. The UPU database provides a single source of information on data that have been gathered from all parts of the world, and serves as an analytical working tool at both the international and national level. The ITU has taken on the responsibility to collect the data regarding telecommunication and ICT infrastructure for all nations. The data are
collected from an annual questionnaire sent out by the Telecommunication Development Bureau (BDT) of the ITU. The database covers telephone network size, mobile and internet services, quality of service, traffic, staff, tariffs, revenue and investment.

To determine longitudinal trends, the annual values for eight communications media were examined, including (1) domestic mail (the number of postal letters within Korea from 1980 to 2005), (2) international mail (the number of outgoing international postal letters from 1981 to 2005), (3) domestic telephone (the number of domestic telephone calls from 1982 to 2001), (4) international telephone (the number of outgoing international telephone calls from Korea from 1981 to 2001), (5) telex (the number of subscribers from 1980 to 1999), (6) mobile telephone (the number of subscribers from 1986 to 2004), (7) television (the number of households equipped with a television from 1980 to 2004) and (8) the internet (number of hosts from 1991 to 2004, and the number of users from 1990 to 2004). In addition, both GDP and population were collected from the ITU database to identify their effects on each medium. Newspaper and radio were not included in this study for two reasons: (1) there were no credible national data for those media, such as number of newspaper subscribers and radio audience ratings, and (2) they were fully adopted for the time period examined.

Through regression, the best-fit curve model for describing the trends of each medium is determined. Then the trend is removed, and the residuals examined to determine when the departure from the trend occurred. To explore media substitution in Korea, correlations among the communication media and the residuals of the trends are examined.

Results

Hypothesis 1: trends in Korean communications

H1 predicted that trends in the use of traditional media would best be described by a quadratic curve rather than an exponential or logistic. The regression results confirmed that international letters, telex and domestic telephone calls were best described by a quadratic curve, but trends in domestic letters, international phone calls and television were depicted by exponential or logistic curves. On the other hand, trends for the new media, the mobile phone and internet, were best explained by exponential or logistic curves, which indicate that these media are still in the development stage (see Figures 3 and 4).

Table 1 summarizes the best-fit curves for the various media. It provides the information necessary to address hypothesis 1. H1a is partially supported. The patterns of use for international letters ($R^2 = .956$), domestic telephone calls ($R^2 = .956$) and telex ($R^2 = .956$), the traditional media, are best explained by a quadratic equation. Although domestic letters was best described by an exponential ($R^2 = .956, p = .00$), the residuals with the exponential trend removed show that the largest departures from the predicted curve occurred beginning in 2003, magnifying in 2004 and 2005, with a much lower number than expected. International telephone was best explained by an exponential ($R^2 = .942, p = .00$), but the quadratic was also significant ($R^2 = .913, p = .00$). Television use was best described by a logistic ($R^2 = .965, p = .00$), indicating a saturated level of adoption. It has not been replaced by an alternative medium such as the internet. The two
Hypothesis 2: media substitutions in Korea

Before testing H2, correlations were calculated to determine the relationships among GDP, population and the various media (Table 2). The results indicate that both GDP and population are significantly and positively correlated with domestic letters, international telephone, television, mobile phone and internet, while international letters and telex are negatively correlated.

To test H2, correlations among media trends were determined. Table 3 shows the correlations among the domestic communication media. There is a positive correlation between the amount of domestic mail and the number of telephone calls but it is not significant. However, the correlations between the amount of domestic mail and new media, the internet and mobile telephones, are best experienced by an exponential or logistic equation. These results support H1b.
media, including the number of mobile telephone subscribers, the number of internet hosts and the number of internet users, are positive and significant ($r = .874, p < .01$, $r = .602, p < .05$ and $r = .908, p < .01$). After removing the overall trend from the media, the correlations among the residuals of each medium were determined. Only the residuals of domestic mail are positively and significantly correlated with the residuals of domestic telephone calls ($r = .518, p < .05$). These results indicate that telephones, mobile telephones and the internet do not have a displacement effect on domestic mail. Domestic mail has not been affected by the new media. There is a supplementary effect between domestic mail and the other media.

The results also indicate a significantly negative relationship between the number of domestic phone calls and new media use, while the residuals of telephone calls are negatively and not significantly correlated with mobile telephones and internet hosts and users. These results indicate that mobile telephones and the internet have a displacement effect on domestic phone calls. However, the residuals of telephone calls are not statistically significant.

For media substitutions in international communications in Korea, the correlations among international outgoing letters, telephone calls and internet hosts and users were conducted. The number of outgoing letters is negatively and significantly correlated with

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**Figure 4.** The residuals from the best-fit curve for Korean communication media.
Table 1. Best-fit curve for the growth trend of communication media in Korea

<table>
<thead>
<tr>
<th>Medium</th>
<th>Equation</th>
<th>Model summary</th>
<th>Parameter estimates</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>$R^2$</td>
<td>$F$</td>
</tr>
<tr>
<td>Domestic letter</td>
<td>Exponential(^a)</td>
<td>.956</td>
<td>515.86</td>
</tr>
<tr>
<td>International letter</td>
<td>Quadratic(^a)</td>
<td>.922</td>
<td>129.83</td>
</tr>
<tr>
<td></td>
<td>Exponential</td>
<td>.529</td>
<td>25.87</td>
</tr>
<tr>
<td>Telex</td>
<td>Quadratic(^a)</td>
<td>.866</td>
<td>54.88</td>
</tr>
<tr>
<td></td>
<td>Exponential</td>
<td>.409</td>
<td>12.45</td>
</tr>
<tr>
<td>Domestic telephone call</td>
<td>Quadratic(^a)</td>
<td>.729</td>
<td>17.48</td>
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<tr>
<td></td>
<td>Exponential</td>
<td>.016</td>
<td>.23</td>
</tr>
<tr>
<td></td>
<td>Exponential (1980–2005)</td>
<td>.956</td>
<td>216.13</td>
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<tr>
<td></td>
<td>Exponential (1980–95)</td>
<td>.913</td>
<td>94.43</td>
</tr>
<tr>
<td>International telephone call</td>
<td>Quadratic</td>
<td>.942</td>
<td>307.40</td>
</tr>
<tr>
<td>Mobile telephone</td>
<td>Logistic(^a)</td>
<td>.988</td>
<td>1373.91</td>
</tr>
<tr>
<td></td>
<td>Exponential</td>
<td>.963</td>
<td>447.74</td>
</tr>
<tr>
<td>TV</td>
<td>Exponential(^a)</td>
<td>.965</td>
<td>633.71</td>
</tr>
<tr>
<td>Internet hosts</td>
<td>Logistic</td>
<td>.960</td>
<td>284.65</td>
</tr>
<tr>
<td></td>
<td>Exponential(^a)</td>
<td>.961</td>
<td>292.57</td>
</tr>
<tr>
<td>Internet users</td>
<td>Logistic(^a)</td>
<td>.982</td>
<td>711.00</td>
</tr>
<tr>
<td></td>
<td>Exponential</td>
<td>.964</td>
<td>352.22</td>
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</tbody>
</table>

\(^a\) Best-fit curve.
the number of outgoing telephone calls as well as internet hosts and users, and there is a significant correlation between international mail and telex (Table 4). These results show that international telephone calls and the internet have a displacement effect on international mail. The correlations between their residuals are not significant.

<table>
<thead>
<tr>
<th>Table 2. Correlations among GDP, population and media</th>
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<tr>
<td>Media</td>
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<tr>
<td>Domestic letter</td>
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<td>International letter</td>
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<tr>
<td>Telex</td>
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<tr>
<td>Domestic telephone</td>
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<td>International telephone</td>
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<tr>
<td>Television</td>
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<td>Mobile telephone</td>
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<tr>
<td>Internet host</td>
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<td>Internet user</td>
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Notes: ** .01 level (two-tailed). * .05 level (two-tailed). N = 25.

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<th>Table 3. Correlations among domestic communication media</th>
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<tr>
<td>Domestic telephone</td>
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<tr>
<td>Domestic letter</td>
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<td>(Residuals)</td>
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<tr>
<td>Domestic telephone</td>
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<tr>
<td>(Residuals)</td>
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</tbody>
</table>

Notes: ** .01 level (two-tailed). * .05 level (two-tailed). N = 26.

<table>
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<tr>
<th>Table 4. Correlations among international communication media</th>
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<tr>
<td>International letter</td>
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<tr>
<td>International letter</td>
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<tr>
<td>(Residuals)</td>
</tr>
<tr>
<td>Telex</td>
</tr>
<tr>
<td>(Residuals)</td>
</tr>
<tr>
<td>International telephone</td>
</tr>
</tbody>
</table>

Notes: ** .01 level (two-tailed). * .05 level (two-tailed). N = 25.
The new media have complementary effects on each other. Table 5 shows the correlations among mobile telephones, the internet and television. These media correlate with other media positively and significantly. The correlations of the residuals are negative but not significantly related.

In sum, H1 is generally supported by the results. The exponential or logistic curves do not describe the best-fit to account for traditional media growth trends, since these media in Korea have already reached the point of full exploitation. In addition, the diffusion process of the newer media has begun, and these media, mobile telephones and the internet, have saturated the substitution potential. The results show that traditional communication media including international letters, domestic telephones and telex can be best described by a quadratic, not an exponential curve, indicating that they are at the disadoption stage. Correlations confirmed that new media have displaced international letters, domestic telephones and telex. On the other hand, the trends for domestic letters and international telephone calls continue to show exponential growth, which means that both media are still in the adoption stage. The correlations also suggest that domestic letters and international telephone calls have not been replaced by new media. These traditional media supplement the new media.

H2 is partially supported by the results. For domestic communication, there is a positive correlation between mail and other media, and the correlations among the residuals of each medium show that domestic mail is positively and significantly correlated with only the residuals of domestic telephone calls. This indicates that domestic mail has not been affected by the new media. There is a supplementary effect between domestic mail and the other media. On the other hand, there is a negative relationship between the number of domestic telephone calls and the new media, which suggests mobile telephones and the internet have had displacement effects on domestic telephones.

For international communication, the results show that the telephone and internet have had a displacement effect on mail since outgoing letters are negatively and significantly correlated with outgoing telephone calls and the internet. On the other hand, the correlation between international telephone and the internet indicates that the internet has a supplementary effect on telephones. The internet may have begun to displace international telephone calls since the correlations between the residuals are negative and significant.
Discussion

The purpose of this study was to analyze the growth and decline of Korean media, including (1) domestic mail, (2) international mail, (3) domestic telephone calls, (4) international outgoing telephone calls, (5) telexes, (6) mobile telephones, (7) television and (8) the internet, to examine displacement or supplementary effects in accordance with diffusion theory at the individual and social levels. In addition, through the regression and residual analyses, not only media displacement/supplement phenomena, but also changes in the trend of each medium reflecting Korean social change and media circumstances in the specific points in time can be revealed.

For domestic letters, the result shows that in 1998 and 1999, when there was an economic crisis in Korea, the number of domestic letters was smaller than expected. Furthermore, the largest departures from the predictive trend began in 2003, magnified in 2004 and 2005, with fewer domestic letters than expected. It is hypothesized that the growth of the internet may have had an impact on the number of letters being sent within Korea. In other words, it is assumed that new media, such as email, text messaging using mobile telephones and VoIP (voice over internet protocol), could have replaced the traditional postal letter as a medium of communication.

For international postal letters, from the early 1980s to the early 1990s, the number of outgoing international letters increased gradually, and then decreased rapidly after the early 1990s. The results suggest that use of the international telephone and internet has had an impact on outgoing international letters from Korea. Although the residuals do not present a clear pattern in this case, they roughly indicate that, from 1993, the number of outgoing international letters diverged from the expected trend, even though between 2003 and 2005 the residuals were higher than expected.

The result indicates that the decline in the use of telex, a global network for international telegraphic message transfer, occurred earlier than for international mail. From the early 1980s to 1987, the number of telex subscribers in Korea increased gradually, and then it decreased rapidly. Similar to international letters, it is suggested that the growing use of the international telephone had an influence on the use of the telex, since the growth in the international telephone began at the end of the 1980s.

The number of domestic telephone calls in Korea increased gradually from the early 1980s to 1993, and then it decreased rapidly. While the quadratic residuals have cycles, it is not a matter of great import, because before the mid-1990s, there seems to have been the normal exponential growth stage of innovative diffusion. The trend in domestic calls in Korea from 1980 to 1995 can best be described by an exponential. The curve accounts for 95.6 percent of the variance in the trend. This suggests that the impact of new media on use of land-based telephones has occurred since the mid-1990s and changed domestic telephone patterns.

For international telephone calls, the residuals result shows that, from the end of the 1980s to the end of the 1990s, the number of outgoing telephone calls increased more than expected. This assumes that the deregulation of international travel in 1989 and the continuous drop in international telephone call prices had an influence on the number of telephone calls. The cost for an international telephone call in 2000 was 57 percent less than in 1990 (Korea Information Society Development Institute, 2001). This suggests
that the diffusion of international telephone use influenced the use of international letters from the early 1990s because of the drop in the cost of telephone calls. The largest departures from the predictive trend began in 2000, as the greatest residuals occurred between 2000 and 2001. It is suggested that use of the internet had an impact on Korean telecommunications, with fewer outgoing international telephone calls.

Results from television data also indicate how the Korean television industry has developed since 1980. The number of television-equipped households in Korea grew from 6.2 million in 1980 to 16.3 million in 2003. And the total number of television sets has exceeded the number of households since 1996 (ITU, 2005). When the data are shown with the exponential curve removed, the direction of residuals changed between 1988 and 1989. In September 1988, Korea held the Olympic Games. This event led to rapid growth in the number of television-equipped households. In 1995, cable television services began. The results show that residuals became relatively larger from 1996 to 1999. There were many fringe areas in Korea because it is mountainous. Cable services, which solved the problem of poor signals, increased the number of television households. The results show that, since 2000, the number of television-equipped households was smaller than expected because most households in Korea already had one or more television sets (ITU, 2005).

The number of mobile telephone subscribers, which is one of the most current new media, has been going up since the mid-1990s and now it has reached saturation. The results show that, since 1995, the number of subscribers began to increase. Negative departures from the predictive trend occurred beginning in 2002, stagnating from 2003 to 2004, with fewer mobile telephone subscribers than expected. This suggests that their diffusion has entered the later stage of the diffusion process. In 2003, more than 70 percent of the population used mobile telephones; 83.23 percent of the population used them in 2006.

To test trends in internet usage, both the number of internet hosts and the number of internet users in Korea were examined. The result indicates that the number of internet hosts decreased compared with the previous year in 2002. This is because of the server name changes from ‘.kr’ to ‘.com’ in this period for global use. The result from the analysis of residuals describes the trend in the number of internet hosts in detail. Although the greatest negative residuals occurred in 2001 and 2002, there were positive departures from the predicted values for 2003 and 2004.

The diffusion of the internet has reached the saturation stage, according to results from the number of internet users. The growth in the number of internet users in Korea began at the end of the 1990s. When the data are shown with the logistic trend removed, there is a change in direction in the departure from the trend that began in 1999. Since 2002, the number of internet users negatively diverged from the expected trend due to its saturation. In 2004, the number of internet users was 31.6 million (66.1 percent of the total population).

The correlations among television, mobile telephones and the internet were analyzed. All three are at the exponential or logistic growth stage and supplement each other. This suggests that the supplementary effect will increase since media convergence is accelerating. For instance, with DMB (digital multimedia broadcasting), the users of mobile telephones can enjoy video, audio and data services. IPTV (internet protocol television), another example of media convergence, allows users to watch television via a broadband connection, but they can still use a traditional television rather than a computer for this
service. This example implies that increasing broadband service promotes television use rather than replacing it. Also, this result is consistent with recent research. For example, Nielsen (2008) confirmed that people are watching more video than ever on the so-called ‘three screens’ of television, internet and mobile telephones. Its survey revealed that the average American television viewer watches more than 151 hours of TV per month. Meanwhile, those who watch video over the internet consume an additional three hours of monthly online video and those who use mobile video watch nearly four hours per month on mobile telephones and other devices.

This study has several implications for the new media and society. First, previous media diffusion studies have focused on either the individual or the market. The former has emphasized individual-level adoption by focusing on individual media use patterns, adopter characteristics, the individual’s social network and organization and the attributes of the innovation. The latter has mainly focused on the growth of emerging media, their competition with others in national or global market and related policies. Although this study mainly attempted to offer a broad picture of the recent diffusion of communication innovations in Korea by focusing on longitudinal trends at the macro level, the results enable us to deem how individual media use patterns, especially adoption and disadoption, have varied over time as social changes.

Second, this study confirms that both displacement and supplementary effects are valid for explaining media substitution phenomena. This study did not limit the subject of the research to new media effects on some specific media, such as email over postal letters, mobile phone over land-line, or the internet over television service. Through investigating the relationships among eight media at both domestic and international communication levels, this study demonstrates their complex relations in the media market.

Unexpectedly, the results showed that domestic mail, international telephone and television have not been affected by the new media. There have still been supplementary effects of the new media against a commonsense view that the new would displace these older media due to their technical superiority. It is suggested that these supplementary effects are due to the following. First, Korean economic growth and technological progress would extend the communication infrastructure, as Matei and Ball-Rokeach (2003) and Wellman et al. (2001) have previously argued. In addition, Rice (1993) maintained that new media would transition toward the roles of traditional media due to their capacity to improve the capabilities of existing technologies. The fast-growing economy and the extended communication infrastructure would provide impetus to more active uses of not only new ICTs but also traditional communication technologies. Although email and mobile technologies should have displaced domestic mail for person-to-person communication, the growth in the population and economy has boosted domestic mail use for business-to-business and business-to-consumer communication. Also, globally extended communicative actions by ICTs may slow the decline of international telephone use. Rapid growth in foreign trade, overseas expansion of business, the increase of Korean foreign travel, studying abroad and emigration have encouraged both international telephone calls and new media uses complementarily. For television, the interactive features of broadband may induce people to produce a variety of video content for all sectors of users. As a result, people will enjoy this new content with converged television service such as IDTV (integrated digital television) and IPTV.
Third, the findings suggest that the diffusion of new communication technologies does impact the use of a nation’s traditional communication media. The analysis of the diffusion of new media in Korea provides a test case of new media diffusion at the national and global level. Korea has a remarkable infrastructure for broadband and mobile communication services. Rapid diffusion of new technologies and the tendency of their early adoption in Korea caused keen competition among the media in the national market while Korea was still neither a technological leader nor a wealthy and developed nation. On this account, so many current ICT diffusion studies (Choudrie et al., 2003; Kim, 2006; BG Lee et al., 2009; H Lee et al., 2003; Oh et al., 2003; Song, 2007) have focused on Korean communication trends because it is an innovative country. Therefore, the analysis of Korean new media diffusion will help not only to forecast new media diffusions in other countries, especially developing countries, but also to build a global diffusion model of new media.

Nevertheless, this study has some limitations. First, the levels of analysis of each telecommunication medium are different. The growth of postal letters and telephone calls was measured by changes in the amount of use. The growth of telex and cellular phones was measured by the number of users and the growth of the internet by both the number of hosts and users. Second, yearly data from the ITU (2005) World Telecommunication Indicators Database and the UPU (2006) database may be too crude for precisely describing growth trends and examining the media substitution phenomena. One reason for the equivocal findings is that the sample contained only between 14 and 26 points in time depending on the medium. This is probably too few to precisely fit non-linear curves and to correlate the residuals. A third potential hazard is the differential starting points of the diffusion process for the various media. It is uncertain what impact these differences will have on the magnitude of the correlation among the residuals. However, the analyses used databases that represent the most credible indicators to determine global and national trends in telecommunications and postal services. Also, Korean data were well reported with few missing values. Therefore, we assume that the non-linear curves determined through regression analysis and their residuals are valid for the traditional and emerging new media. They represent their life cycles and how they affect each other.

Finally, the role of governmental intervention should be considered in predicting the media substitution phenomena in global or national markets, since the role of intervention in Korea is essential to developing its national innovative capacity (Kim and Johnson, 2006; Kwon et al., 2003). The Korean government has played a leading role in setting a national vision and agenda for broadband and mobile networks. It encouraged the adoption of new information technologies and has consistently pursued new media related policies for competition based on deregulation and market principles since the 1980s. As a result, a large number of network providers and ICT companies have been allowed to enter the highly concentrated market that arises from Korea’s high population density and the configuration of local apartment housing (Choudrie et al., 2003; Oh et al., 2003). Since the economic crisis in 1997, Korea has faced challenges in how to create, utilize and manage an advanced infrastructure for the new media (internet and mobile technology) effectively amid the belief that they bring visible economic, social and cultural benefits to the nation. Highly competitive and advanced, the Korean ICT industries have cultivated the public by providing new technologies and services with enhanced capabilities.
However, it is too early to conclude that governmental intervention in Korea’s media environment has always yielded positive results since market-oriented paradigms are required to achieve international competitiveness and adapt to external circumstances such as the IMF’s rescue conditions and OECD membership requirements. Governmental intervention can affect communication policy-making in ways that make the adoption of new technology more or less likely. Therefore, future research should be conducted to obtain broader and more precise data to determine the changing patterns of global communication. The role of government intervention should be stressed to explain how it initiates and promotes the new organizational and institutional arrangements needed for development and diffusion of new technology.

References


Yoonjae Nam is a PhD candidate at The State University of New York, Buffalo. His research interests lie in the fields of corporate communication, social network analysis diffusion study and computer-mediated communication.

George A. Barnett is Professor and Chair of the Department of Communication at the University of California at Davis. His research focuses on the international flow of information, in general, and international telecommunications, in particular.