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M.S. Dissertation in Economics

**A Socio-technical Analysis on Factors
Affecting the Adoption of Smart TV in
Korea**

스마트 TV의 수용에 영향을 주는 요인들의 사회기술적 분석
: 한국의 사례

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A Socio-technical Analysis on Factors Affecting the Adoption of Smart TV in Korea

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Abstract

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Smart TV has been highlighted as a new platform of broadcasting, powered for the last five years by its own application store as well as by internet-based contents. However, recently, smart TV's performance in the pay TV market has been below expectations. In the socio-technical view, this paper investigates three aspects surrounding smart TV: bundling as a market competition strategy; services using technological features represented by N-screen; and consumer attributes, including personal innovativeness and demographics. The results show that the bundles with IPTV have a lock-in effect, while other pay TV services do not, indicating that bundling by communications service providers is a more effective strategy to keep market share away from new entrants. Policy makers only consider competition among incumbents, neglecting the entrance of new service providers, like over-the-top

service providers. Therefore, bundling should be evaluated in terms of an entry barrier. Smart TV doesn't work as a platform because the adoption of smart TV has no influence on the watching of N-screen broadcasting services on TV. The positive effects of personal innovativeness and of household demographics are confirmed. There are implications that the new technology alone cannot encourage lean forward activity on TV. Managers should focus on what consumers expect from 'smartness', and develop contents for the smart TV as a home appliance.

Keywords: Smart TV, socio-technical, bundling, N-screen, adoption, Korean media panel

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1. Introduction

1.1 Changes in the Pay TV Market with Smart TV

The pay TV market is defined as the contract between a platform of broadcasters and a subscriber. The first cable TV service was launched in 1995 by regional-based system operators (SOs). Satellite TV followed in 2002 to support people in rural areas. Communications service providers (CSPs) entered the pay TV market in 2008 with IPTV. The regulation of the discount rate of bundles had been eased step by step since the launch of IPTV. Since then, offering services in a bundle has become a main competition strategy. Both SOs and CSPs have infrastructure for fixed-line phone or internet and offering mixed bundles for a discounted price has been welcomed by customers. Korea Information Society Development Institute (KISDI) (2014) reported that 85.3% of households use bundled services. Since the beginning of the 2010s, the rise of digital broadcast service and the spread of smartphones has changed the pay TV market. Players focus on a variety of digital-based contents, such as video-on-demand (VOD). But, they confront online video content providers, called over-the-top (OTT) service providers as new competitors. OTT contents are accessible on TVs with a set-top box, supporting streaming online contents directly to the TV, or mirroring the display of other devices. Initially, third-party contents providers were the majority, but now CSPs and program providers have expanded their field through their network and contents. Figure 1 provides an overview of the Korean pay TV market (KCTA, 2014).

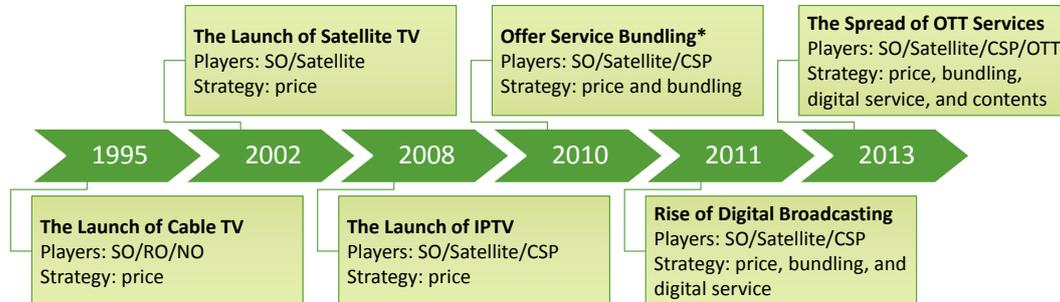


Figure 1. An Overview of the Korean Pay TV Market

Google suggested the initial concept of the smart TV. Smart TV is a kind of internet TV, defined as an internet-like interface for accessing and watching TV and delivering internet-based contents. The definition of internet TV includes the information channel synchronized with real-time broadcasting on one side, and a fully asynchronous, individualized TV on the other side. Internet TV encourages audiences to participate in the interactive features in a so called ‘lean forward’ viewing behavior, different from the traditional ‘lean back’ behavior (Gerbarg & Noam, 2003; Slot, 2007). Many efforts have been made to become successful in this digital convergence medium, including video dial tone or interactive TV, but most of them have failed. (Noll, 2003). The distinctive feature of Google TV, compared to its predecessors, is that it offers a TV set with a built-in android operating system and an application market, similar to the business model of the smartphone. Google TV enables real-time broadcasting, OTT contents, and other web-based contents (Google, 2010). The announcement of Google TV provoked TV

manufacturing incumbents, such as Samsung and LG, who had fallen behind Google in the smartphone market. As leading manufacturers in the TV market, these companies tried to occupy the market by launching their own internet connected TV products from 2010 to 2011 (Kwon, 2011). Similar to the smartphone, the new type of TV is called a 'smart TV'. A few other terms are used to indicate a similar type of TV, such as 'connected TV' or 'hybrid TV' but 'smart TV' is the only term that shows increasing search patterns according to Google trends.

The definition of smart TV is still ambiguous. Hwang (2010) defines smart TV as a multimedia device that provides features of both TV and internet, based on operating system. Song (2010) describes smart TV as a device that delivers videos and applications through the web or an application store. According to NPD DisplaySearch (2012), consumers can access branded portal and web-based service on a smart TV. Moon & Choi (2010) give a comprehensive definition of the smart TV as a system providing both a user interface/user experience and a contents format. Smart TV aims to establish a personalized environment with a variety of contents like video, using an internet-connected TV-shaped display. KISDI (2011a) also proposes that smart TV should be understood as a 'smart TV service', not only as a device, but also as a platform.

As seen in the above descriptions, there are various types of smart TV. In addition to the built-in TV set type, a set-top box type and a dongle type are also available in the market. But the Korean media panel questionnaire only describes the internet-connected feature and has not updated its definition of smart TV since 2011. According to the Korean media

panel data in 2014, 99% of the smart TV devices are produced by Korean domestic manufacturers. Therefore, it can be assumed that the interviewees have understood the term ‘smart TV’ in the most familiar way, as the new type of TV that Korean TV manufacturers have launched and promoted. In this paper, smart TV is defined as a TV set with built-in internet access, based on an operating system, providing both conventional TV-based contents and online-based contents through the web or the TV’s own application store.

For the first few years, smart TV was expected to integrate traditional broadcasting media and new internet media, and to promote related industry areas like peripherals, interactive advertisements, and software (Ko, 2011). From there, it was one step forward to smart home and smart work service (Kim, 2011). With cloud computing and N-screen service, customers looked forward to enjoying more diverse and personalized contents (Kwon, 2011; Briel, 2012). Manufacturers fostered their own application stores supporting developers and holding competitions, before launching an actual product (Joo, 2010). As a platform, smart TV could be a new distribution channel for independent content providers and could compete with cable TV and IPTV services (Hwang, 2010). Because audiences can select only the channels that they want to watch in an applications store, a la carte pricing can be applied in the smart TV platform, in contrast to the channel bundling by pay TV providers (Lim et al., 2009; Cho, 2012). IPTV and digital cable TV offer similar services to smart TV, like VOD, so smart TV is a rising competitor. In addition to video contents like VOD, a smart TV application store also provides gaming and educational contents. Feeling threatened, one IPTV provider blocked the internet connection to the

smart TV contents (Korea Communications Commission, 2012). The differences between smart TV and other TV service platforms are summarized in Table 1 (Lee, 2008; Shin et al., 2013).

Table 1. Differences between Smart TV and Pay TV Services

	Smart TV	IPTV	Digital Cable TV
OS	Yes	No	No
Set-top box	Built-in	Necessity	Necessity for VOD
Internet	Built-in	No	No
Web-browsing	Yes	No	No
App market	Yes	VOD only	VOD only
Provider	TV manufacturer	CSP	Local SO
Network	IP based	Own IP-based	RF & IP based

While issues of net neutrality and the categorization of the business remain, consulting firms have an optimistic outlook. Research and Markets (2012) forecasts that global unit shipments of smart TVs will grow at a compound annual growth rate of more than 20.8% until 2017. Strategy Analytics (2012) predicts that smart TV global sales will reach nearly 180 million units by 2017, and Frost & Sullivan (2013) suggests an even higher estimate, with a CAGR of 23.2% and 200 million units shipped. In the Korean domestic market, Kim (2011) estimates that smart TVs will make up more than half of TV sales.

Table 2. The Domestic Market Share of Pay TV Services and Smart TV

	2011	2014
Pay TV	85.9%	91.7%
-IPTV	11.1%	22.0%
-Cable TV	72.1%	67.2%
-Satellite TV	5.1%	4.1%
Smart TV	2.6%	9.6%

Despite smart TV's prospects, its performance is below expectations in Korea. According to Table 2 from Shin & Ha (2014), just 9.6% of the households surveyed watched smart TV in 2014, showing only a 7% increase since 2011. Pay TV's market share has even increased; there is no evidence of cord-cutting. According to Kim, M. (2012), 99.6% of watching time on smart TV is spent broadcasting contents, the same as on a conventional TV. Only 6.8% of Korean media panel respondents have used N-screen broadcasting services, and in 2014, the most used device for watching N-screen broadcasting contents was a smartphone (21.8%), not a TV (12.6%). (Ha, 2015). Park & Lee (2014) gave a low grade to the smart TV as a platform, because there is no killer application in smart TV services. The number of available smart TV applications is much smaller than that of smartphones', and almost half of smart TV consumers have never used the applications on their smart TV. Thus, the profit from smart TV applications sales was just a few thousand dollars in 2011 (Lee, 2012; Park, 2012). Moreover, internet availability isn't a more attractive feature when purchasing a TV than quality, price, brand, and design (Displaysearch, 2014).

1.2 Problem Statement

Rogers (1995) defines innovators as the first 2.5% of individuals who adopt a new technology, and early adopters as the next 13.5% of individuals. Although the average cycle of new TV purchases is around 4 to 5 years (Displaysearch, 2014), smart TV is suffering in the market penetration stage in Korea and it cannot shift to the growth stage (Lehman-Wilzig & Cohen-Avigdor, 2004). Why can't smart TV perform as expected? Based on the above overview of the smart TV, two research questions are drawn: market competition and services usage.

***RQ1.** Does the Korean pay TV market competition affect the adoption of smart TV?*

***RQ2.** Does smart TV succeed in encouraging the use of its services through its own technological features?*

Along with these questions, do consumers require the same attributes that were examined in previous studies of the smart TV? Which attribute is more important, person or household? Korean TV manufacturers held a 40% share of the global smart TV market share in the last quarter of 2013 (Strategic Analytics, 2014). The Korean market is used as a rehearsal stage for these manufacturers, making Korea an apt example to study when answering these questions.

***RQ3.** Which consumer attributes lead to the adoption of smart TV?*

Beyond consumer studies, this paper suggests a socio-technical analysis that focuses on the links between actors, not only on the supply side, but also on the demand side of innovation. Different actors, such as institutions, firms, and users are interdependent.

Outcomes of a technological progress are understood through the dynamics of actions (Geels, 2004). In the IT sector, a socio-technical approach has supported the interpretation of the relationships among infrastructure, competition, and user applications (Sawyer et al., 2003; Shin & Jung, 2012). As described in Figure 2, there are three categories to investigate from the existing market to the emerging market. TV has been a representative household-level appliance running broadcasting contents that are usually offered in bundle. Because the channels are bundled, people subscribe to channels that they never watch. These days, people can also select and pay for a channel or a program that they want via OTT service providers on more customized devices, such as smart TVs and mobile devices. More time, device, and contents options encourage consumers to exercise more ‘lean forward’ behaviors. Services become a major factor in using the device as a platform, so they should be considered. Marketing implications can be seen in the consumer characteristics and demographics. Among the factors described in Figure 2, this paper concentrates on the orange shaded region: service bundling strategy; N-screen service; and consumer characteristics, including demographics. The Korean media panel data was used to estimate the effect of each factor.

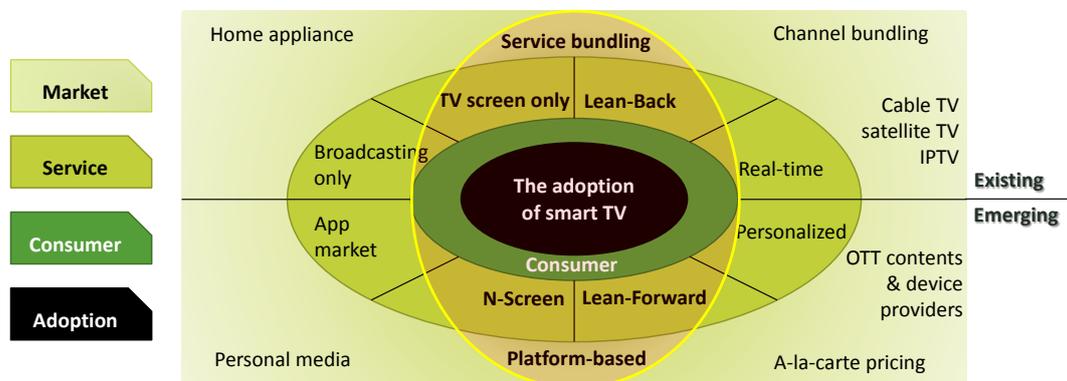


Figure 2. The Socio-technical View of Smart TV

This paper provides empirical evidence of the lock-in effect of bundling through a socio-technical analysis of the choices of consumers who have already adopted smart TV. Section 2 is a literature review of previous media and smart TV studies. Section 3 draws hypotheses with a detailed review of background research. The research model and the description of the data analysis are shown in Section 4. Section 5 shows the results of the analysis, and a discussion follows in Section 6. Finally, Section 7 gives a summary and implications about the pay TV market and smart TV.

2. Literature Review

2.1 Previous Media Studies

As telecommunication technologies have progressed, new media has threatened older media. Radio threatened newspaper, TV was predicted to replace radio, and recently, the internet has threatened to substitute most non-internet based media. (Schramm et al., 1961; Ries & Ries, 2000; Dimmick & McDonald, 2000). Lehman-Wilzig & Cohen-Avigdor (2004) suggest a media evolution model that focuses on how older media survives in the competition with new media. In the defensive resistance stage, the older medium may pose problems to the immature attributes of the new medium. The older medium also blocks the new medium's access to its contents. For example, the movie industry didn't allow licensing to the TV industry in the early stage (Napoli, 1998). Sometimes, new medium faces political and legal pressure from older medium. In addition to resistance, the older medium tries to diversify its field in defense. An example of this is the 'TV everywhere' model, in which cable TV operators and multichannel video programming distributors offer their online contents for free to their offline subscribers (Waterman et al., 2013). Whinston (1999) argues that the resistance and diversification strategy relieves the destabilizing effect of new medium on both older media and consumers.

The innovation diffusion theory has been applied to numerous consumer adoption studies. Rogers (1995) postulates that the relative advantage, compatibility, complexity, trialability, and observability of innovation affects new media's diffusion. Rogers divides

adopters into five categories according to their speed. The first 2.5% of adopters are categorized as innovators, and the next 13.5% are early adopters. The early majority is the following 34%, and at this stage, more than half of the population has adopted an innovation. The late 34% of adopters are called the late majority, and the remaining 16% is referred to as the laggards. An adopter's category is expected to vary with demographics, perception of innovation, and the consumer's behavioral attributes (Rogers, 1995; Chan-Olmsted & Chang, 2006; Park & Gang, 2007). The innovation diffusion theory gives a theoretical framework to discuss technology acceptance in a wider sense including media studies (Dillion & Morris, 1996).

Many empirical studies have investigated the factors that affect the adoption of new TV technologies and services. In the last decades of the 20th century, the adoption of high-definition TV was studied, exploring the demographics and early adopters' satisfaction with the technological features such as picture sharpness, color quality and screen size. (Bush, 1987; Lupker et al., 1988; Dupagne & Agostino, 1991; Dupagne, 1999). Consumers who adopted cable TV were compared to those who did not. But the effect of their TV use was unclear (Metzger, 1983; Krugman, 1985; Heeter & Baldwin, 1988). In studies of mobile TV service and digital multimedia broadcasting service, the use of TV and the use of portable devices was hypothesized (Shim et al., 2006; Yoon & Kim, 2007; Cui & Jung, 2007). Leung & Wei (1998) investigated the determinants of interactive TV adoption in Hong Kong. They collected interviews by telephone survey, and categorized the information into seven blocks: personal and household demographics, attitude towards

interactive TV, expected value, perceived practical value, innovativeness, media use, and ownership of new technology products. According to the results, personal demographics such as age and level of education did have a significant effect. Household income has a positive and significant effect on the adoption of interactive TV. In contrast, the household size and number of children gave no significant effect on the adoption of interactive TV. The number of TV watching minutes per day was insignificant. When compared to other factors, the individual's attitude on interactive TV made the biggest contribution. Tuunainen et al. (2009) suggested a new model for information and communications technology-intensive service in a two-sided market. Service innovation, organization, technology, and market environment are each investigated in three dimensions: service concept, client interface, and delivery system. In the case study of IPTV in New Zealand, interactive features of IPTV, like tagging contents to a social network service, received favorable comments.

2.2 Previous Smart TV Studies

The concept of 'personalized, interactive TV' has been proposed since the 1990s as one of the technology imaginaries that would lead to the creation of new media, like future TV. It was expected to end the centralized broadcasting system and to emphasize the importance of user choice (Lister et al., 2008). Rawolle & Hess (2000) categorized and evaluated new media devices including online digital TV, defined as 'TV-based online media integrating feedback capabilities'. The traditional role of TV has been only to receive broadcasting

contents, so users have been familiar with passive consumption and lean back behavior. Therefore, the paper assesses that it would be difficult to build interactive services with online digital TV users. Noll (2003) showed doubt that consumers would want to interact with their TV sets. Nevertheless, new TV concepts have continued to be suggested. Soursos & Doulamis (2012) offered both the concept of an 'enhanced connected TV,' supported by internet-based contents, and the framework of the TV, including the business model. The study anticipated that connected TV would be a complement of traditional broadcasting service, and that it would have its own personalization competencies. Vinayagamoorthy et al. (2012) introduced BBC's recent research into the user experience of internet-connected TV.

Previous smart TV studies have focused mainly on the marketing strategies in the early stage. Most of these studies have been done by Korean researchers. This is not surprising because Korean manufacturers are major players in the TV market. Kim & Park (2011) proposed strategies for smart TV promotion based on an expert survey and a SWOT analysis. The analysis reported a strength in the user's needs for customized broadcasting, but a threat to smart TV was seen in the growth of IPTV and low-priced internet TV

Several studies have investigated the factors that influence user acceptance. User acceptance is crucial in estimating the success or failure of any information technology product. Therefore, there are various theoretical approaches to understanding the psychology of user acceptance, such as the technology acceptance model and the theory of reasoned action. (Fishbein & Ajzen, 1975; Davis, 1989; Davis, 1993). The technology

acceptance model predicts a user's attitude and intention to use a new technology by its perceived usefulness and perceived ease of use (Dillon & Morris, 1996). Lee et al. (2012) uses the unified theory of acceptance and the technology model to show the importance of the user interface and the service interface. Lee (2012) analyzes both acceptance and resistance factors. The perceived risk has a significant positive effect on the innovation resistance, and a significant negative effect on the intention to use. In the study, the expected network quality was used to measure the perceived risk. Im et al. (2014) shows that the perceived ease of use reduced resistance, but it did not have a significant effect on the intention to use. Kim et al. (2013) compared the factors affecting the behavioral intentions of a much-experienced group to those of a less-experienced group. The former is relatively affected by perceived usefulness, and the latter is more affected by the perceived ease of use and the expected enjoyment of smart TV. Shin et al. (2013) focused on smart TV's interactivity. Based on the theory of reasoned action, perceived interactivity is measured by perceived personalization, perceived responsiveness, and perceived control. Perceived interactivity has the most significant effect on intention, which means smart TV's interactive feature is important to buying decisions. Bae & Chang (2012) applied a Bayesian network approach. The results showed that the most influential variable is relative advantage, followed by compatibility, entertainment, web-browsing, and N-screen.

Few studies have analyzed consumers' preference for smart TV. Park & Yoo (2012) selected five factors (VOD, video quality, real-time information, t-commerce, and monthly subscription fee) and calculated the marginal willingness to pay of consumers for each

factor. According to their results, t-commerce was a relatively less important factor. Kim (2015) evaluated smart TV's operating system, display size, web-searching, diversity of available applications, and price using the Bayesian mixed logit model. The result showed that the price is the most significant for consumers, and the diversity of available applications is the least significant. After analyzing the relationships between other smart devices, a smart TV is not a substitute or a complement to a smartphone and a tablet because of the TV's low portability.

In short, previous smart TV studies have paid attention to an individual's intention to adopt according to the social and technological features of a smart TV. However, the studies neglected to investigate who actually adopts smart TV, and how those adopters watch smart TV or use smart TV-providers' services. The competitive environment of the Korean pay TV market has also been ignored. The Korean pay TV market is oligopolized by CSPs and SOs, and their market strategies and reactions to entrants in the market should be considered. With this socio-technical point of view, three hypotheses are proposed in the next section.

3. Hypothesis

3.1 Market Competition

Bundling offers multiple products as one packaged product. When consumers must purchase a bundle and cannot purchase parts of the product separately, it is pure bundling. When consumers can purchase a product in a bundle or as a separate part, it is mixed bundling (Tirole, 1988). As a price discrimination strategy, bundling may increase total consumer surplus, and it draws social equilibrium when a bundle is purchased at a discounted price (Liao & Tauman, 2002). But the effect of bundling is still ambiguous in terms of welfare, especially when it is combined with monopoly issues. Leveraging monopoly power through bundling is one of the traditional issues of industrial organizations. Bundling can deter new entrants and the resulting new technological innovations (Whinston, 1990; Choi & Stefanadis, 2001). By the analysis of Carlton & Waldman (2002), bundling reduces the expected profit of entrants in a newly-emerged complementary market. So the monopolistic power of a primary market can be transferred to the complementary market by bundling a monopolist's primary good. For consumers, bundling gives more choices via price discrimination. Nalebuff (2004) compares the entry-deterrent effect of bundling to the price discrimination effect of bundling, and the result showed that the former is larger than the latter. A monopolist always earns more profit with bundled pricing than with independent pricing. In addition, the monopolistic market power increases when a bundle contains complementary goods or positively related goods.

In the information technology field, the convergence of products or services makes switching costs much larger; therefore, bundling becomes a major strategy for an incumbent. As the number of products in a bundle increase, switching costs also increases (Hurkens et al., 2011; Bakos & Brynjolfsson, 2000). Prince & Greenstein (2011) investigated the effect of bundling on churn in the telecommunication industry. They looked at bundling status, previous period purchase of bundling service, price of bundles, and consumers' demographics. The result showed that bundling reduced churn and created a kind of entry barrier. Service bundling appears to increase switching costs and locked-in customers, and sustains market size. Latin American telecommunications operators offered bundled services with pay TV service as one of the first strategies to compete with OTT service providers and to keep their market share (Ganuza, 2013). Hong et al. (2014) demonstrated that when incumbent broadcasting providers bundled products, it deterred new entrants and locked in customers. Furthermore, smart TV is a substitute for existing pay TV services.

Bundling is an important issue in the Korean telecommunications market. The bundling strategy became popular in 2008, when regulations on bundles were eased, allowing them to be discounted up to 30%. Most of the pay TV providers' services are available in mixed bundling, including internet, fixed-line phone, or mobile. KISDI (2014) reported bundling by CSPs can help them to leverage their monopolistic power through mobile services, even if that power is not yet considerable, although the report does not include a discussion of smart TV. This report gave a hypothesis to demonstrate the entry-deterrent effect of

bundling by incumbent pay TV service providers in the competitive market environment. Because the launch of smart TV follows the launch of bundled services, the cutting of bundled service should be preceded by the purchase of a smart TV. So rather than the current subscription of bundled service, it is the subscription in the previous period that is meaningful.

H1. The bundling strategy of incumbents in the previous period influences the adoption of smart TV.

3.2 Services using Technological Features

User-centered innovation becomes important to study how communications media are developed. It explains the innovation of both software and hardware information products (von Hippel, 1998; von Hippel, 2005). Hwang & Kim (2011) described an early adopter who tested a premature product and gave feedback to the producers. They empirically demonstrated that user-level participation has a significant effect on successful innovation by content-layer firms in Korea. As a part of innovation after adoption, looking into user participation is meaningful. Compared to other TV devices and pay TV services, the distinguishing feature of smart TV is its internet-based contents and applications which enlarge the range of consumer choice. Increasing the interactivity of TV allows consumers to give more feedback and to personalize their services (Katz, 2003), so consumers' participation can be explored through the services they use what they choose to watch and

for how long. When Dijk Van et al. (2003) conducted a survey of interactive TV owners about their reasons for the change in TV viewing behavior, selectivity was the second most common reason given, after movies. In the case of smart TV, VOD service and online video streaming service are suggested to show selectivity, but VOD is also available on cable TV or IPTV. Therefore, this paper focuses on online video streaming services, expanding its field from just the PC to include online-connected portable devices. This service concept is called N-screen in Korea, or multiscreen service in the United States (Hawley, 2012).

In a broad sense, N-screen service means sharing the same contents with multiple devices (Kim, 2012; Lee, 2014). The Korean media panel questionnaire data also follows the context of this definition; N-screen service supports experiencing the same multimedia contents on multiple devices seamlessly. AT&T launched this service concept in 2007. Named the ‘three-screen strategy’, it offered synchronization among TV, PC, and wireless phone (AT&T, 2008; Kim, 2009). Including real-time broadcasting contents and VOD a variety of streaming contents were available via the internet. As network quality has improved, cloud services and the following N-screen services became more popular (Nielsen, 2012). In the global market, various new and traditional industrial players, such as platform providers, device manufacturers, network providers, and OTT contents providers, have tried to enter or expand their field to include N-screen service. For instance, AirPlay by Apple allows consumers to stream contents wirelessly and to mirror their iTunes contents display on other iOS devices. Major program providers established Hulu, and Comcast offers its cable TV subscribers online access to content. The Korean domestic pay

TV market also has several new entrants and an expansion of incumbents. Olleh TV now by KT and U+HDTV by LG Uplus are serviced by CSPs. Pooq is operated by terrestrial broadcasters. Tving has provided VOD as well as real-time broadcasting of partnered program providers online, and it introduced its own stick-shaped OTT device called 'Tving stick', enabling all contents on TV in the middle of 2014.

The launch of smart TV meant the launch of traditional and powerful screens of internet-based contents (Kim, 2010). From discussions by academic and industrial experts, consumers' satisfaction of smart TV and their use of N-screen are the key issues. Recently, because consumers can control the place and time of watching, the power of broadcasters and TV has decreased. N-screen service on portable devices may accelerate cord-cutting in Korea (Chun, 2013). But manufacturers claim that N-screen gives the experiences of smart TV to consumers, so N-screen expands the ecosystem of smart TV. (Jung, 2014). Han & Lee (2012) used a two-stage least square analysis to show that N-screen service, represented by Tving, is a complement of home TV. In particular, the time spent watching comedy via Tving has the highest, most positive effect on the increase of watching comedy and movies on the home TV. But Lee (2014) claimed that the probability of N-screen broadcasting service usage decreases as the hours of home TV-viewing increases. Ha (2015) reported that the rate of watching N-screen broadcasting contents on TV has increased from 16.3% in 2013 to 27.8% in 2014 among N-screen users, according to the Korean media panel data. The most commonly used N-screen service on TV is Btv (30.6%). As a parameter of consumers' participation in smart TV, the N-screen usage is hypothesized.

H2. The adoption of smart TV impacts members of the household's usage of N-screen broadcasting services on home TV.

3.3 Consumer Attributes

Consumer studies are essential to estimating the adoption of new products and media. Several studies have shown that a preference for new products and a willingness to try new services results in a raised personal intention to adopt new innovative technology (Davis, 1986; Agarwal & Prasad, 1998; Park & Chen, 2007; Hooi Ting et al., 2011). Lin (1998) showed that consumer innovativeness affects the adoption of cable TV service. Park & Kang (2007) also found the same result, consumers who preferred new products tended to adopt digital cable TV service, consumers who did not prefer new products tended to keep analogue cable TV service.

Several smart TV studies have also examined consumers' innovativeness based on the technology acceptance model. Lee et al. (2012), Lee (2012), and Kim et al. (2013) measured innovativeness with the following questions: I am willing to take new things/services; I am an early-adopter; I enjoy trying on new things/services; and I think it is very interesting to try new things or services. Questionnaires asked how willing an interviewee is to try new products. In this paper, the earlier described consumer innovativeness is analyzed with the survey about product purchase behavior.

The amount of TV viewing has been studied to explain consumers' adoption of new media. While some studies argue that the total number of hours of TV watching is related

to the adoption of the personal computer (Lin, 1998) and internet access (Atkin et al., 1998), other studies have shown that it is not related to the adoption of HDTV (Dupagne, 1999) or e-books (Jung et al., 2012). In studies of the adoption of cable TV, the effect of TV viewing is inconsistent (Metzger, 1983; Wirth & Bloch, 1989; Li, 2004; Chan-Olmsted et al., 2005; Park & Kang, 2007). Dijk Van et al. (2003) found that interactive television subscribers in the Netherlands watched more extra channels and selected more movies than non-subscribers did. By Kim et al., (2010), the most frequent answer to questions on the motivation of the adoption of smart TV is the ability to watch broadcasting contents anytime. To validate it empirically, this paper categorizes TV viewing into the hours spent watching real-time broadcasting, the hours spent watching VOD of real-time broadcasting contents, and the hours of other activities using the TV to compare the effect of each activities.

Demographics have been a main issue, as shown by the history of rating firms such as Nielson, founded in 1923 (Nielson, 2013). In 1955, the American Research Bureau provided demographics, such as age and gender, which allowed advertisers to pick their audience. The measurement unit used was a household (Buzzard, 2003). Wirth & Bloch (1989) conducted a survey to identify the demand for cable TV at a household level. The questions included each respondent's demographics, household income, number of household members, and the number of TV sets in the household. As communications technologies have progressed, the role of the individual has been emphasized. Portable radios and multiple TVs in a household gave each audience his or her own time to enjoy

(Balnaves & O'Regan, 2008; Napoli, 2011). In cable TV audience research, Atkin (1993) says better-educated people tend to be early adopters, although demographics vary across studies. Yoon et al. (2007) concluded that because digital TV is shared in a household, household attributes, such as household income and location, are more influential than personal attributes. Kim et al. (2011) profiled potential smart TV users by demographics and personal characteristics. According to the results, the demographics of potential smart TV users are white-collar individuals in their twenties and thirties, living in the capital area with a household income that is higher than the median. From these results, consumers' product purchase behavior and hours of TV use are hypothesized. Likewise, personal and household demographics are suggested as hypotheses in this paper.

***H3.** Consumer attributes affect the adoption of smart TV.*

***H3A.** A person who prefers new products tends to adopt smart TV.*

***H3B.** A person who is young and highly-educated tends to adopt smart TV.*

***H3C.** A person who uses TV not for real-time broadcasting but for VOD and other activities tends to adopt smart TV.*

***H3D.** A person who lives in a higher income household and with a larger family tends to adopt smart TV.*

Figure 3 summarizes the three hypotheses.

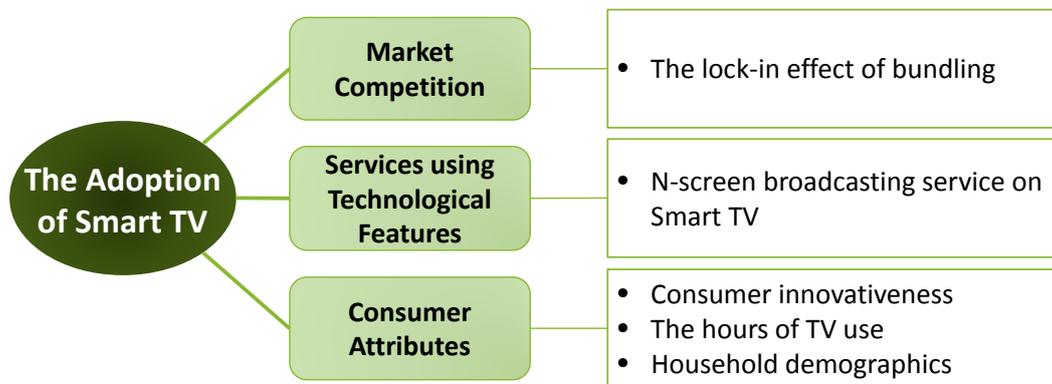


Figure 3. The Research Model

4. Research Methodology

4.1 Data Description

The Korean media panel survey was conducted from 2010 to 2014 by KISDI, a governmental institute of policy research for information, broadcasting, and telecommunications. The panel data set includes household, personal, and media diary data from each person for three days. After passing through the pilot survey in 2010, the Korean media panel data consists of 12,000 people from 5,109 households in 2011, 10,319 people from 4,432 households in 2012, 10,464 people from 4,381 household in 2013, and 10,172 people from 4,313 household in 2014. For the survey, interviewers visited each household to fill out the household questionnaire, and each interviewee filled out the personal questionnaire and media diary. The household questionnaire consisted of household demographics, device ownership, subscriptions to broadcasting and communications services, and children's media guidelines. The personal questionnaire contained personal demographics, mobile phone usage, broadcasting and communications services subscriptions, device ownership, and questions that were specific to the year, such as connections among devices from 2010 to 2011, personal value and lifestyle in 2012, life satisfaction in 2013, and physical and mental health in 2014. The media diary questionnaire required respondents to write down location, device, behavior, and connection of media use every 15 minutes for three days (Shin et al., 2014).

4.2 Research Design

4.2.1 Data Set

Pay TV service subscriptions and smart TV purchases are household level decisions, different from smart TV usage, which is an individual decision. So in this paper, household data was applied to estimate H1 and personal and media diary data were applied to estimate H2 and H3. Although the question about smart TV has been included since 2011, the questions on internet-connected TV experience and detailed N-screen usage have been conducted since 2012. Three-year balanced data sets from 2012 to 2014 were built.

There were 3,954 households who remained for the three-year balanced panel. Of these households, 74% consisted of two, three, or four members. Most of the households were located in urban areas (84.7%). The Korean million won was converted to about one thousand US dollars in Table 3.

Table 3. Household demographics in 2014

Variable	Description	Frequency	Percent
Household	Total	3,954	100.00%
Size	1	622	15.7%
	2	1,029	26.0%
	3	751	19.0%
	4	1,146	29.0%
	5	338	8.5%
	6	53	1.3%
	7	11	0.3%
	8	2	0.1%

Variable	Description	Frequency	Percent
	9	2	0.1%
Area	Urban	3,348	84.7%
	Rural	606	15.3%
Average monthly income	\$1000 and below	838	21.2%
	\$1000-\$2000	587	14.8%
	\$2000-\$3000	710	18.0%
	\$3000-\$4000	812	20.5%
	\$4000-\$5000	482	12.2%
	\$5000 and above	525	13.3%

In the personal data and the media diary data, only the household head and the household head's spouse were included in the sample, because they are adults who usually have no restrictions on their media use, and are regarded as home appliance decision makers in a household. In previous literature, Newman & Werbel (1978) considered age and marital status of the household head as a part of the life cycle to evaluate brand loyalty for major household appliances, such as televisions or refrigerators. Park & Yoo (2012) also conducted a survey covering the household head or homemaker to measure the marginal willingness to pay for a smart TV. Shin (2014) and KCC (2014a) reported that the subscription to cable TV and the adoption of smart TV was based on the household head's age. Table 4 shows the personal demographics of the data set. Female respondents made up more than half of the respondents (57.1%). Heads of household was 56%. The 40-49 age group was the largest (27.7%), followed by the 50-59 age group (21.7%). The mean age was 53.68. Of the respondents, 84.5% were married, and 65.9% had a level of education

higher than high school.

Table 4. Personal Demographics in 2014

Variable	Description	Frequency	Percent
Total		6,087	100.00%
Gender	Male	2,611	42.9%
	Female	3,476	57.1%
Relationship	Head	3,407	56.0%
	Spouse	2,680	44.0%
Age	20-29	62	1.0%
	30-39	857	14.1%
	40-49	1,689	27.7%
	50-59	1,320	21.7%
	60-69	939	15.4%
	70 and above	1,220	20.0%
Marital Status	Single	154	2.5%
	Married	5,141	84.5%
	Others	792	13.0%
Education Level	Primary	1,381	22.7%
	Secondary	693	11.4%
	High	2,301	37.8%
	Undergraduate	1,620	26.6%
	Graduate	92	1.5%

4.2.2 Variables

As Prince & Greenstein (2011) analyzed, bundled subscriptions to cable TV, satellite TV, and IPTV in a previous period were independent variables of H1 to estimate the effect of bundled pay TV services on the adoption of smart TV. In the Korea media panel

questionnaire, N-screen services are categorized into broadcasting, video, music, book/newspaper/magazine, photo, and documents. Among these services, N-screen broadcasting service usage was the focus in H2. The dependent variable of H2 was N-screen watching on TV. The adoption of smart TV was the main independent variable, and the number of N-screen broadcasting services in use and the amount of the payment for the broadcasting contents supported the equation. The payment for N-screen broadcasting contents could not be analyzed due to its lack of observations. The purchase behavior of a new product is a time-invariant variable, from the survey conducted in 2012. Age and level of education were included as personal demographics indicating consumer innovativeness. To estimate the effect of the number of household members and the household income, it is necessary to assume that both variables have the same influence on the decisions of the household head and spouse. The hours of watching a real-time broadcast or VOD on TV, and the hours of other activities on the TV showed consumer preferences of contents and time. Real-time broadcasting and VOD consisted of the same contents, but the VOD service enabled consumer to choose the time to watch them. Table 5 shows the description and symbol of each variable. Descriptive statistics of the variables and correlations between the variables are available in Appendix 1.

Table 5. Variable Descriptions

Variable	Description	Symbol
smtv	Households with smart TV	$Y_1, Y_2 X_{21},$
smtv_on	Households with internet-connected smart TV	X'_{21}

Variable	Description	Symbol
cable	Pay TV: Cable subscription	X'_{11}
satTV	Pay TV: Satellite TV subscription	X'_{12}
IPTV	Pay TV: IPTV subscription	X'_{13}
cable_b	Pay TV: Cable TV subscription in a bundle	X_{11}
satTV_b	Pay TV: Satellite TV subscription in a bundle	X_{12}
IPTV_b	Pay TV: IPTV subscription in a bundle	X_{13}
Nsc_bd_num	N-screen: The number of broadcasting services	X_{22}
Nsc_bd_dev	N-screen: Watch broadcasting contents on TV	Y_2
bd_paid	The payment for broadcasting contents	X_{23}
B_new	I prefer brand-new products; Never:1 ~ Always:5	B
TVbd_hr	Home TV viewing hours: real-time* broadcasting for 3days	T_1
TVvod_hr	Home TV viewing hours: VOD** for 3days	T_2
TVoth_hr	Home TV viewing hours: other activities*** for 3days	T_3
P_age	Age	P_1
P_school	Educational level; 1: no education, 2:primary, 3:secondary, 4:high, 5:undergraduate, 6:graduate	P_2
H_num	The number of household members	H_1
H_income	Household income (about \$500 USD record)	H_2

* Real-time broadcast of terrestrial, cable, and general broadcasting channels

** Video-on-demand of terrestrial, cable, and general broadcasting channels

*** Movie, video, user created contents(real-time and VOD), music, picture, newspaper, book, magazine, call, text message, e-mail, chat, web surfing, social network service, game, online shopping, word processor, drawing, writing a letter, checking home surveillance camera or camera in a car, and remote control.

4.3 Analysis

Among various models for panel data, the fixed effects and the random effects model are the two most frequently mentioned models. The key difference between the two models is how they deal with the unobserved individual heterogeneity among panels, such as family-specific characteristics. The Hausman test is applied to specify correlations with included variables and omitted heterogeneity (Hausman, 1978; Greene, 2012). The null hypothesis of the Hausman test is the explanatory variables that have no correlation with individual heterogeneity. If the p-value of the result is lower than 0.05, the fixed effects model is consistent. The statistics are shown in Equation 1.

$$H = (b_{FE} - \hat{\beta}_{RE})' [V_{FE} - V_{RE}]^{-1} (b_{FE} - \hat{\beta}_{RE}) \dots\dots\dots \text{Eq. (1)}$$

The fixed effects model assumes that the omitted effects are group-specific constant terms correlated with variables. So the model estimates them in the equation. To test H1 and H2, pay TV service variables and N-screen variables were correlated with heterogeneity, s the fixed effect model was applied. However, the fixed effects model ignored the time-invariant variables because they are considered estimated constants. Time-invariant individual characteristics like gender or race cannot be independent variables in the fixed effects model (Kohler & Kreuter, 2005). Therefore, H3 explaining personal attributes was estimated by the random effects model. In the random effects model, the individual effect was estimated as a randomly distributed term across cross-sectional units, because it was assumed that there is no correlation between the included variables.

The relationship of the dependent variables and the independent variables was assumed to be linear, so the linear regression is applied. Equations 2, 3, and 4 describe the dependent and independent variables of the hypotheses.

$$Y_{1it} = \beta_{10} + \beta_{11}X_{11it-1} + \beta_{12}X_{12it-1} + \beta_{13}X_{13it-1} + e_{it} \dots\dots\dots \text{Eq. (2-1)}$$

$$Y_{1it} = \beta_{10} + \beta_{11}X'_{11it-1} + \beta_{12}X'_{12it-1} + \beta_{13}X'_{13it-1} + e_{it} \dots\dots\dots \text{Eq. (2-2)}$$

Y_{1it} and Y_{3it} are households with smart TV, and Y_{2it} is whether a person watched N-screen broadcasting contents on TV. In Equation 2-1, the independent variables are subscriptions to cable_b, satTV_b, and IPTV_b in the previous period. The coefficient of these variables is compared to cable, satTV, and IPTV in Equation 2-2.

$$Y_{2it} = \beta_{20} + \beta_{21}X_{21it} + \beta_{22}X_{22it} + \beta_{23}X_{23it} + e_{it} \dots\dots\dots \text{Eq. (3-1)}$$

$$Y_{2it} = \beta_{20} + \beta_{21}X'_{21it} + \beta_{22}X_{22it} + \beta_{23}X_{23it} + e_{it} \dots\dots\dots \text{Eq. (3-2)}$$

In Equation 3-1, bd_paid, Nsc_bd_num, and smtv are independent variables. The coefficient of smtv is compared to smtv_on to explore the effect of user participation in Equation 3-2.

$$Y_{3it} = \beta_{30} + \beta_{31}B_{it} + \beta_{321}P_{1it} + \beta_{322}P_{2it} + \beta_{331}H_{1it} + \beta_{332}H_{2it} + \beta_{341}T_{1it} + \beta_{342}T_{2it} + \beta_{343}T_{3it} + u_i + e_{it} \dots\dots\dots \text{Eq. (4)}$$

In Equation 4, B_{it} is B_new, P_{1it} and P_{2it} are personal demographic variables P_age and P_school, and H_{1it} and H_{2it} are household demographic variables H_num and H_income. T_{1it} , T_{2it} , and T_{3it} are TVbd_hr, TVvod_hr, and TVoth_hr. e_{it} are error

terms according to each panel, and u_i is time-invariant individual heterogeneity. In the fixed effect model, u_i is estimated as a constant term, while it is assumed to be a normally distributed error term in the random effect model.

5. Result

Table 6 shows the result of the three estimations. By the first estimation, H1 is partly supported. The subscription to IPTV in a bundle in the previous period gives a negative significant effect (-0.0431153), but the subscription to cable TV and satellite TV in a bundle in the previous period is insignificant. The lock-in effect is only observed in IPTV service.

Table 6. The Results

Hyp.	Dependent	Coefficient			
H1	smtv	L.cable_b	L.satTV_b	L.IPTV_b*	Cons.***
		0.004211	-0.00348	-0.0431153	0.0847367
	RMSE		0.223	R-square	0.0016
H1	smtv	L.cable	L.satTV	L.IPTV	Cons.***
		0.0121208	-0.0094073	-0.0224637	0.078116
	RMSE		0.223	R-square	0.0049
H2	Nsc_bd_dev	smtv	bd_paid***	Nsc_bd_num***	Cons.***
		0.00306	0.0387143	0.2238067	-0.037521
	RMSE		0.091	R-square	0.2497
H2	Nsc_bd_dev	smtv_on*	bd_paid***	Nsc_bd_num***	Cons.***
		0.0107481	0.0388065	0.2234187	-0.0379205
		RMSE		0.091	R-square

Hyp.	Dependent	Coefficient				
H3	smtv	B_new**	P_age	P_school***	H_num**	Cons.
		0.0072481	-0.00047	0.0191574	0.0070978	-0.0487721
		TVbd_hr	TVvod_hr	TVoth_hr*	H_income***	
		0.000497	-0.00227	0.0154818	0.0057202	
		RMSE		0.235	R-square	0.0354

* p<0.05, ** p<0.01, *** p<0.001

The result of additional analysis is described in Table 7. Smart TV ownership is a complement of pay TV services. When the cable subscription is a dependent variable, smart TV ownership gives a positive significant effect (0.0269768) while the satellite TV subscription (-0.7624799) and IPTV subscription (-0.7876495) give a negative and significant effect at the same period. The following two estimations that the dependent variable is the subscription to IPTV and satellite TV, ownership of smart TV also gives a positive and significant effect.

Table 7. The Result of Additional Analysis of H1

Dependent	Coefficient			
cable	smtv*	IPTV***	satTV***	Cons.***
	0.0269768	-0.7876495	-0.7624799	0.8891083
	RMSE		0.220	R-square
				0.5761

IPTV	smtv***	cable***	satTV***	Cons.***
	0.07851	-0.5122693	-0.5164622	0.5548185
	RMSE	0.177	R-square	0.5241
satTV	smtv*	cable***	IPTV***	Cons.***
	0.0136618	-0.2488097	-0.2389035	0.2639974
	RMSE	0.123	R-square	0.2845

* p<0.05, ** p<0.01, *** p<0.001

H2 is not supported. The adoption of smart TV has no significant effect (0.00306) on watching N-screen broadcasting contents on TV, while internet-connected smart TV gives a positive and significant effect (0.0107481). The payment for broadcasting contents (0.039) and the number of N-screen broadcasting services in use (0.022) give a positive and significant effect on using their TV as a device to watch N-screen broadcasting contents in both equations.

The last regression examines H3. The behavior of preferring brand new products gives a positive and significant effect on the adoption of smart TV (0.0072481). Age gives a negative effect, but insignificant (-0.00047), and educational level is positive and significant (0.0191574). The hours of watching real-time broadcasting contents has a positive effect (0.000497) and the hours of watching VOD broadcasting contents has a negative effect (-0.00227), but both are insignificant. Among the variables about TV viewing, only the hours of other activities except watching broadcasting contents gives a

significant effect (0.0154818). The number of household members (0.0070978) and household income (0.0057202) gives a positive and significant effect on the adoption of smart TV.

6. Discussion

SOs and CSPs offer double-, triple-, and quadruple-play services with cheaper prices than subscribing to each of the services separately. Under the rationality assumption, consumers who can't get more utility from smart TV-providing contents than from pay TV services choose to be tied in with the cheaper bundled services rather than purchasing a smart TV because they don't need to pay double to watch broadcasting. Termination costs imposed by SOs and CSPs for breaking contracts could be a reason. The searching costs and the adoption costs of smart TV also play a role as the switching costs that prevent cord-cutting (Klemperer, 1995; Villanueva et al., 2007; Hong et al., 2014). By the results, the consumer lock-in effect of bundling by incumbents is partly confirmed in IPTV, offered by CSPs. One possible explanation is cable TV and satellite TV services' decreasing market share over the last four years, as seen in Table 2. IPTV is the latest entrant among them, and offers countrywide service unlike local service by cable TV and satellite TV. Therefore IPTV took market share away from its competitors. The other explanation is the importance of mobile service in a bundle. According to KCC (2014b), 85.3% of total households subscribed to bundled services. In the bundled service market, 82.1% of households subscribed to bundled services of CSPs, and 17.9% of households subscribed to those of SOs in 2013. The quadruple play service including internet, voice over internet protocol, IPTV, and mobile shows the highest growth rate over the last three years (KISDI, 2014; Kim, 2015) SOs claim that profit from pay TV service decreased because CSPs offered

IPTV service almost for free in bundles to promote their mobile service (Keum, 2015). Thus, consumers treat pay TV services as a gift, so they don't want to pay a lot for it. Because of low profits from subscription fees, pay TV providers tried to profit from VOD contents that were already popular. (Seo, 2015). The additional analysis showed that the broadcasting feature of smart TV is not a substitute of pay TV services. It shows that cord-cutting by smart TV owners hasn't yet occurred in Korea and that smart TV cannot work as a platform as had been expected. The main criticism of smart TV is that it is a scarce ecosystem without a killer application and that it has slower diffusion than that of smartphone, caused by longer replacement cycle of TV (Park & Lee, 2014). But the growth of N-screen services could change the situation.

The adoption of smart TV has limitations in motivating lean forward behaviors of consumers. In spite of these results, it is hopeful to N-screen service providers. In 2012 and in 2013, only about half of smart TV adopting households connected their smart TV online, but in 2014, all 302 households had internet-connected smart TV. People who adopted smart TV participated more. On the other hand, smart TV's profitability is questionable, even though the payment for broadcasting contents and the number of N-screen broadcasting services give a positive effect on watching N-screen broadcasting contents on TV. This paper aimed to analyze the payment for N-screen service at first, but there were only a few observations to which one could apply the regression analysis. It shows that the experience on N-screen services is not in proportion to the payment for N-screen services. Therefore, the variable was substituted by 'the payment for broadcasting contents' in the

analysis. The variable doesn't show whether the broadcasting contents is from VOD or N-screen. By Park (2015), the Korean N-screen service provider, Tving, has seven million subscribers, but it is still running a deficit after five years of service. . The rate of paid subscribers to Korean N-screen providers is less than the half of the total subscribers, in some cases it is less than 10% (IMinvestor, 2014; as cited in Song, 2014).

The positive effect of personal innovativeness on the adoption of smart TV that was described in previous studies when applying the technology acceptance model has been demonstrated again. The age of the decision maker was insignificant, but the level of education was significant. But if personal innovativeness is continuously demanded for the adoption of smart TV in the future, it will be hard to expect for smart TV to be fully adopted into consumers' daily life; rather, it would remain as a niche product. As the number of household members and the household income increases, people tend to adopt smart TV. The price of smart TV fluctuates depending on promotions or product segmentation, but it seems to be more expensive than conventional TV. This could be one reason that households earning higher incomes tend to adopt smart TV. The hours of viewing broadcasting contents, both real-time and VOD on TV, is not significant, and using TV for things other than watching broadcasting contents tends to increase the rate of smart TV adoption. The causality and frequently-used function cannot be discussed from the results; nonetheless the results show that smart TV use is not limited to broadcasting in daily life, considering that the media diary is only collected for three days.

7. Conclusion

Smart TV has been highlighted as a new platform of broadcasting based on its application store and the availability of internet contents. Even with optimistic prospects, smart TV's performance is below expectations. Previous smart TV studies have mainly focused on the consumer side, based on the innovation diffusion theory. To add to that, this study aimed to find factors affecting the adoption of smart TV with a socio-technical view, in the context of the pay TV market and the use of the smart TV's technological features. Service bundling was emphasized with the price discrimination and leveraging of the telecommunications market, but bundling's lock-in effect against new platforms in the pay TV market has recently become an issue. New services is necessary to promote a platform, so the use of distinguished technological features of smart TV was explored through N-screen service on TV. N-screen service encourages consumers to lean forward to search for and play the contents that they want; in contrast to conventional TV that only streams broadcasting contents. Consumer innovativeness dealt with in other studies was confirmed by panels who have already adopted smart TV. The Korean media panel data gave rich survey results to analyze for this research.

The results have policy and managerial implications. The bundling of IPTV service has a consumer lock-in effect on smart TV, while just the subscription to IPTV has no effect on smart TV. The evaluation of the competition in the broadcasting industry focused on the market share of each of the service providers in the pay TV market. The evaluation aimed

to foster a competitive environment that offered the best service with the cheapest price to consumers. Therefore it assumes perfect competition is ideal in terms of profitability and user satisfaction, and measures how the current competition is different from it (KISDI, 2011b). The report observed that CSPs' bundling with mobile may cause unfair competition between SOs, but it doesn't consider that it may deter entry of new media platforms (KCC, 2014b). In the analysis of the OTT market, the report also neglects the CSPs' bundling of IPTV and N-screen services that is in debate in the United States (Waterman et al., 2013). In the long term, the entry-deterrent effect of bundling against new media may hinder innovation in the pay TV market and lessen the incentive of entrants to innovate due to a low potential for profit. Instead, bundlers who keep their market share have incentives to innovate and can enlarge their market size overseas (Bakos & Brynjolfsson, 2000). With many considerations, the effect of bundling should be discussed and watched by policy makers for promotional and regulatory policy.

As confirmed through the second hypothesis, the adoption of smart TV has no effect on lean forward activities. A platform is developed by user participation; therefore smart TV manufacturers should introduce not only N-screen, but also other kinds of contents to sustain the current market penetration and to encourage smart TV purchases. Recently, the concept of the internet of things has risen and smart home appliances have been introduced. However, like in the smart TV case, how many consumers are willing to adopt new technologies and have a need for their 'smart' features? What features will consumers really want to use? Listing new technologies is not a solution. These questions should be

answered instead of just replacing an old product with a state-of-the-art new product. In addition, with TV as a traditional home appliance, the decision to buy a TV is still affected by the household demographics. This gives an orientation for contents developers and marketing directors in the industry.

One of the limitations of this study was that the reason for the lock-in effect was not clarified. It could be switching costs, the functional completion of the smart TV product, or non-friendly consumers of smart TV screened by the subscription to IPTV in bundle. It leaves questions for further research. After building a three-year data panel, the loss of the panel decreases the representativeness of the sample. The lack of N-screen related observations in the personal and media diary data creates boundaries in examining the usage of N-screen services in this study, but conducting new surveys may help to overcome this problem in future research. Investigating who uses the most and which activities are used the most on smart TVs, outside of watching broadcasting contents is also meaningful for the active user research.

In summary, this study emphasized a socio-technical view of smart TV adoption. Market competition, new services, and consumer attributes were analyzed based on data of smart TV adopters. Implications were given on both the policy makers and industrial players in the Korean pay TV market. For the fast-moving, converging environment of broadcasting and telecommunications, this research shed light on a part of future media studies.

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Appendix 1

Table 1. The Descriptive Statistics of Variables in the Household Data Set (3,945 households)

Variable	Obs	Mean	Std. Dev.	Min	Max
smtv	11,862	0.076	0.265	0	1
smtv_on	11,862	0.050	0.218	0	1
bundle	11,862	0.552	0.497	0	1
cable	11,862	0.723	0.448	0	1
satTV	11,862	0.052	0.221	0	1
IPTV	11,862	0.164	0.370	0	1
cable_b	11,862	0.412	0.492	0	1
satTV_b	11,862	0.028	0.165	0	1
IPTV_b	11,862	0.086	0.281	0	1

Table 2. The Descriptive Statistics of Variables in the Personal Data Set (6,087 people)

Variable	Obs	Mean	Std. Dev.	Min	Max
smtv	18,261	0.080	0.272	0	1
smtv_on	18,261	0.053	0.224	0	1
Nsc_bd_dev	18,261	0.012	0.110	0	1
Nsc_bd_num	18,261	0.045	0.250	0	5
bd_paid	18,261	1.019	0.249	1	8
Nsc	18,261	0.003	0.059	0	1
Nsc_num	18,261	0.005	0.097	0	3
Nsc_paid	36	1.389	0.599	1	3
B_new	18,261	2.698	1.012	1	5
TVbd_hr	18,261	11.246	6.885	0	55
TVvod_hr	18,261	0.173	1.116	0	30
TVoth_hr	18,261	0.012	0.245	0	13.5
P_age	18,261	53.677	14.515	18	95
P_school	18,261	3.727	1.127	2	6
H_num	18,261	3.070	1.239	1	9

Variable	Obs	Mean	Std. Dev.	Min	Max
H_income	18,259	6.305	3.668	1	22

Table 3. The Correlations of Household Variables

	smtv	smtv_on	bundle	cable	satTV	IPTV	cable_b	satTV_b	IPTV_b
smtv	1								
smtv_on	0.803	1							
bundle	0.0175	0.0005	1						
cable	-0.0769	-0.0941	0.0599	1					
satTV	-0.0134	-0.0204	-0.0037	-0.3502	1				
IPTV	0.123	0.1487	-0.022	-0.64	-0.0888	1			
cable_b	-0.0254	-0.0473	0.7546	0.5187	-0.1791	-0.3421	1		
satTV_b	-0.0216	-0.0227	0.1531	-0.2504	0.7287	-0.0656	-0.1206	1	
IPTV_b	0.0935	0.1053	0.2771	-0.455	-0.0622	0.6947	-0.2198	-0.0396	1

Table 4. The Correlations of Personal Variables

	smtv	Nsc_bd	Nsc_bd_num	Nsc_bd_dev	bd_paid	Nsc_num	TVbd_hr	TVvod_hr	TVoth_hr	H_num	H_income	B_new
smtv	1											
Nsc_bd	0.086	1										
Nsc_bd_num	0.079	0.912	1									
Nsc_bd_dev	0.054	0.565	0.492	1								
bd_paid	0.015	0.147	0.114	0.140	1							
Nsc_num	0.053	0.192	0.270	0.010	0.021	1						
TVbd_hr	-0.048	-0.070	-0.058	-0.021	-0.018	-0.010	1					
TVvod_hr	0.001	0.030	0.026	0.024	0.043	0.005	-0.093	1				
TVoth_hr	0.027	0.026	0.025	0.001	0.009	0.001	-0.008	0.013	1			
H_num	0.131	0.088	0.073	0.070	0.035	0.016	-0.195	0.013	0.028	1		
H_income	0.161	0.107	0.095	0.055	0.048	0.035	-0.261	0.021	0.020	0.584	1	
B_new	0.081	0.073	0.066	0.026	0.021	0.019	-0.079	0.000	0.012	0.191	0.229	1

초 록

스마트 TV는 지난 5년간 인터넷 멀티미디어 콘텐츠와 어플리케이션 마켓에 기반하여 새로운 방송 플랫폼으로 주목을 모았다. 하지만 최근 유료 방송 시장에서 스마트 TV는 기대 이하의 성적을 거두고 있다. 기존 연구에서는 설문조사를 통해 스마트 TV의 속성에 대한 개인의 선호와 수용 의도에 초점을 맞추었다면, 본 연구는 사회기술학적 관점에서 스마트 TV의 수용에 영향을 미치는 요소를 시장에서의 경쟁, 신기술 기반 서비스, 그리고 사용자 특성까지 세 가지 측면에서 살펴보았다는 점에 의의가 있다. 분석은 한국미디어패널 데이터를 이용하여 유료방송시장에서의 결합상품 전략, N스크린으로 대표하는 스마트 TV의 신기능을 활용한 서비스, 그리고 개인의 혁신성과 인구통계학적 특성으로 나누어 선형회귀모형을 적용하였다. 분석 결과 다른 유료방송 서비스와는 다르게 IPTV 서비스를 포함한 결합상품을 이용하는 소비자들이 스마트 TV를 도입하지 않은 경향이 있었으며, 스마트 TV의 수용은 N스크린 방송 서비스를 TV로 시청하는 데에 아무런 영향을 주지 못했다. 그리고 개인의 혁신성과 가구의 인구통계학적 특성이 스마트 TV의 수용에 미치는 긍정적인 영향을 확인하였다. 본 연구는 통신사업자들의 결합상품 전략이 소비자들의 이동을 막고 스마트 TV와 같은 신규 진입자로부터 시장 점유율을 지키는 데 효과적임을 보여준다. 현재 방송통신산업정책의 결정 과정에서는 기존 사업자

들간의 경쟁에 주로 초점을 맞추고 있다. 따라서 결합상품 중심의 경쟁 전략이 진입 장벽의 관점에서 온라인 동영상 서비스 사업자와 같은 신규 진입자에 미치는 영향을 평가해야 할 필요성을 시사하였다. 실무적인 관점에서는, 스마트 TV가 플랫폼으로 기능하지 못한다는 점과 가족이 공유하는 가구로서의 TV의 특성이 중요하다는 점을 바탕으로, 소비자들이 단지 새로운 기술을 넘어선 ‘스마트함’에 요구하는 바를 탐구하여야 할 것을 시사하였다.

주요어: 스마트 TV, 사회기술적 분석, 결합상품, N스크린, 사용자 수용, 한국미디어패널
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