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Digital television adoption: Comparing the adoption of digital terrestrial television with the adoption of digital cable in Taiwan

Shu-Chu Sarrina Li *

Institute of Communication Studies, National Chiao Tung University, 1001 University Road, Hsinchu City, Taiwan, ROC

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ABSTRACT

This study employed Rogers' model to compare the diffusion of digital terrestrial television with the diffusion of digital cable in Taiwan. A telephone survey, which yielded 753 valid questionnaires, was conducted to collect data. The results of this study show that the factors affecting the intention to adopt digital terrestrial television differed widely from those affecting the intention to adopt digital cable. The diffusion of digital cable was discovered to be generally congruent with the prediction of Rogers' model, while the diffusion of digital terrestrial television was not. This second finding reveals a limitation in Rogers' model, namely, its alleged pro-innovation bias. It may be that the respondents in this study looked favorably on digital cable because they considered it, and not digital terrestrial television, to be an inevitable technology. Furthermore, this study found that awareness played an important role in respondents' adoption of digital television. This study therefore suggests that, to accelerate digital conversion, Taiwan's government should establish policies to educate people about digital television.

1. Introduction

Television digitization is considered by Taiwan's government to be a key part of the national information infrastructure. As a result, following the American digital television conversion in 2009, the governing organization, Taiwan's National Communications Commission (NCC), also mandated that Taiwan's five terrestrial television stations complete their digital conversion by 2012. That is, after 2012, Taiwan's five terrestrial television stations have to broadcast only digital signals instead of broadcasting both digital and analog signals as the five stations are currently practicing. However, more than 75% of Taiwan's television households subscribe to cable television, and the government has realized that both terrestrial and cable television must be digitalized before Taiwan can complete the digital television conversion. Therefore, the government has also instituted several policies that give cable operators an incentive to accelerate cable digitization (Li, Liu and Chen, 2007; NCC, 2010).

Taiwan's five terrestrial television stations, including one public broadcasting station, began the process of digital conversion in 1998. By 2004, all of the terrestrial television stations had completed their digitization, and 15 digital TV channels were available for the public in Taiwan. However, the 15 digital TV channels are not incorporated in the current cable channels, and consumers have to purchase set-top-boxes in order to receive the 15 digital channels. Furthermore, the NCC plans to issue five more licenses for digital terrestrial television, which will make the platform of digital terrestrial television more competitive because the total number of channels for digital terrestrial television will reach 30. In addition to television

* Tel.: +886 3 5712121x58211; fax: +886 3 5727143.
E-mail addresses: shuchu@mail.nctu.edu.tw, shuchuli@gmail.com

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programs, digital terrestrial television stations will offer many interactive services including the Internet to consumers. The NCC attempts to enhance the competitiveness of Taiwan's terrestrial television in order to give consumers more options for television viewing. After digitization, cable system operators do not have to carry all terrestrial television channels. According to the revised Taiwan's cable law, cable system operators must carry at least 1/3 of the terrestrial television channels and must negotiate with terrestrial television stations regarding the fees they will pay for carrying these channels (NCC, 2011; Tsai, 2010). In contrast, digital cable is on a much slower path than digital terrestrial television, and a recent survey has shown that only approximately 6% of Taiwan's population has adopted digital cable. Furthermore, a report by the NCC (2008) has indicated that most people were satisfied with the number of cable channels available in Taiwan and did not feel a need to have digital cable, which has greatly slowed the diffusion process of digital television in Taiwan.

Taiwan's cable TV was legalized in 1993, which brought strong competition to the then terrestrial TV stations. Since then, terrestrial television has been competing fiercely with cable television for advertising income, which was evidenced by the decreasing advertising shares of the terrestrial TV stations after 1993 (Li and Lee, 2010). Specifically, for Taiwan's television advertising income, the shares of the terrestrial television declined drastically from almost 100% in 1993 to only 12.6% in 2011 comparing with cable television's share of 87.4% in the same year (Brain, 2011). Similar to the US, Taiwan's cable television industry is heavily integrated both horizontally and vertically with four multiple system operators dominating the market. To preserve free television in the market, Taiwan's cable law requires that cable system operators must carry the five terrestrial television channels in their cable systems. Because of this must-carry rule, the terrestrial television channels are able to keep a small share of advertising income when encountering the competition from cable television. Scholars predict that after digitalization, terrestrial television and cable television will be in more direct competition for consumers because (1) the number of terrestrial television channels will reach 20–30, which allows the terrestrial television to form its own platform rather than to incorporate its channels into cable television; (2) though cable television has more channels, terrestrial television is available free of charge. Therefore, scholars consider digitalization as an advantage that gives terrestrial television more competitiveness in the market (Tsai, 2010). This study, by adopting Rogers' diffusion of innovation model, attempts to compare the diffusion process of digital terrestrial television with that of digital cable to understand the factors that influence consumers' choice between the two competing media.

The two theoretical models often used to predict technology adoption are Rogers' diffusion of innovation model and Davis' technology acceptance model (TAM). TAM is a concise and powerful model for technology adoption, but it is only useful for technologies that are adopted in work environments. In particular, studies show that TAM is more useful to examine technology adoption under the circumstances that adopters are not voluntary. The focus of this study is the adoption of digital television that is more entertainment-oriented and that adopters are voluntary, and thus Rogers' model is more suitable for this study (Davis, 1989; Rogers, 1995, 2003; Schepers and Wetzels, 2007; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008; Zhou, 2008). Although Rogers' diffusion of innovation model has been widely recognized as a powerful model for predicting technology adoption, it has been found to have limitations, one of which is the exclusion of awareness from the model (Atkin et al., 2003; Chan-Olmsted and Chang, 2006; Rogers, 1995, 2003). Taiwan's digital television is still in its early stages of diffusion, and most people are unaware of the technology. Therefore, this study takes the concept of awareness into consideration to investigate its predictive power for the adoption of digital television. Because digital television conversion in some countries has not yet been completed; the findings of this study will allow policy-makers to better understand how to accelerate their country's adoption of digital television.

2. Literature review

Rogers (1995) defined the diffusion of innovations as "the process by which an innovation is communicated through certain channels over time among the members of a social system." (p. 10). Three elements in this model have been identified as critical for technology adoption: innovation attributes, communication channels, and adopters' characteristics.

2.1. Innovation attributes

According to Rogers (1995, 2003), an innovation's perceived attributes, namely, its relative advantage, complexity, compatibility, observability, and trialability, explain 49–87% of the variance in technology adoption, and most empirical studies have confirmed that this variable is critical for predicting adoption behavior. For example, Chan-Olmsted and Chang (2006) found that the intention to adopt digital television was positively related to consumers' perceptions of the relative advantages, compatibility and observability of digital television. Chang et al. (2006) examined the adoption of online games in South Korea and discovered that perceived relative advantage, complexity, observability, risk-time, and risk-money were factors that could differentiate adopters from non-adopters. Lin (2004) found that technology fluidity was positively correlated with interest in adopting webcasting in the United States. Dupagne and Driscoll (2010) compared the owners with non-owners of high-definition television in the US and found that perceived relative advantage, compatibility, trialability, and observability were able to differentiate owners from non-owners.

Recently, scholars have stressed the necessity of revising the conceptualization of Rogers' five attributes. For example, Zhu and He (2002) proposed the addition of one attribute—perceived image of a technology. Zhou (2008) suggested that Rogers' complexity attribute be replaced by the concept of "ease of use". In addition, several empirical studies found that relative advantage was not distinguishable from compatibility (Moore and Benbasat, 1991; Wei, 2006).

According to a report released by Taiwan Digital Television Committee (2011), there are 16 digital terrestrial television channels available in Taiwan including one HDTV channel that is available after 2008. In addition to the five channels that offer general interest services, the remaining channels provide special interest services including four news channels (two general news channels, one financial news channel, and one traffic news channel), one variety shows channel, one cultural and educational channel, one health channel, one leisure channel, one Hakka channel and one mobile channel. Moreover, terrestrial television stations plan to collaborate with telecommunication companies to offer data broadcasting services including the Internet service to consumers. Scholars predict that the Internet service offered by terrestrial television will be competitive to digital cable because the Internet service offered by terrestrial television will be wireless that is more flexible as compared to the fixed service provided by digital cable (Taiwan Digital Television Committee, 2004, 2011; Lai, 2006; Tsai, 2010; Huang, 2010).

Because digital terrestrial television and digital cable are competing media in Taiwan, this study assumed that the positive attributes of digital terrestrial television would positively predict the adoption of digital terrestrial television but, negatively predict the adoption of digital cable. Based on this reasoning, this study's first hypothesis is developed as follows:

H1. The perceived positive attributes of digital terrestrial television will be positively related to the intention to adopt digital terrestrial television, but negatively related to the intention to adopt digital cable.

2.2. Communication channels and awareness

Rogers' model defines the diffusion process as a communication process in which mass media play the role of informing and interpersonal communication plays the role of persuading. Empirical findings show that exposure to mass media is important because it is through this means that the public is made aware of an innovation. In particular, mass media play an important role in the early stages of the adoption process (Chan-Olmsted and Chang, 2006; Leung and Wei, 1998, 1999; Lin, 2004; Rogers, 1995).

Atkin et al. (2003) found that interest in adopting digital television in the US was positively related to magazine reading, but negatively related to newspaper reading. Leung and Wei (1998) discovered that most mass media use was positively correlated with the intention to adopt interactive television. Dupagne (1999) found that newspapers, movie going, and sports viewing were positively related to HDTV awareness, HDTV interest, or HDTV purchase intention. However, Chan-Olmsted and Chang (2006) examined Americans' intentions to adopt digital television and found that the intentions were positively related only to Internet tenure. Garitaonandia and Garmendia (2009) investigated e-commerce use among digital television subscribers in Spain and discovered that e-commerce use was not significantly related to any mass media use other than the Internet. According to Rogers' model, when a technology is in its initial stages, adopters tend to be heavier users of mass media than non-adopters. Digital terrestrial television and digital cable have only just started to diffuse in Taiwan's society, and recent data show that their penetration rates are 19% and 6%, respectively (Huang, 2010). Therefore, mass media use should be an important predictor of the intention to adopt digital terrestrial television and digital cable. Based on the literature review, this study proposes the following hypothesis:

H2. Mass media use is positively related to the intention to adopt digital terrestrial television and digital cable.

Several studies discovered that people's awareness of a given technology is a key antecedent within Rogers' model that predicted the adoption of that technology. In particular, when a technology is in its early stages of diffusion, awareness of this technology plays an important role in differentiating adopters from non-adopters. For example, Atkin et al. (2003) discovered that when respondents were not aware of digital television, they did not know how to relate it to functionally similar technologies. Functional similarity, therefore, did not have a significant effect on the adoption of digital television. Conversely, Chan-Olmsted and Chang (2006) found that consumers' awareness levels were positively related to their intention to adopt digital television. According to Rogers' model, awareness is closely related to mass media use because mass media play a key role to facilitate the awareness of a given technology, which in turn leads to the adoption of that technology. Based on this reasoning, this study develops the third hypothesis:

H3. Mass media use is positively related to the awareness of digital terrestrial television and digital cable, which in turn positively affects the intention to adopt digital terrestrial television and digital cable.

2.3. Adopters' characteristics

Based on the degree to which an individual adopts a technology relatively earlier than other members of a society, Rogers (1995, 2003) classifies all adopters into five types—innovators, early adopters, the early majority, the late majority, and laggards. He predicts that the five types of adopters differ from one another in terms of their demographics and personalities.

2.4. Demographics

Rogers' model predicts that when a technology is in its initial stages of diffusion, demographics are important predictors of adopters and non-adopters. Early adopters are generally younger, better educated, and more upscale than non-adopters (Atkin et al., 2003; Wei, 2001, 2006; Leung and Wei, 1998; Lin, 1998). However, once a new technology has passed through its critical mass, demographics play a much less significant role in distinguishing adopters from non-adopters (Atkin, 1995; Atkin and LaRose, 1994; Kang, 2002; Leung, 1998).

Li (2004a) found that Internet shopping was still in its initial stage of diffusion in Taiwan. In her study, age, sex, and education were therefore significant predictors of the intent to adopt. Chan-Olmsted and Chang (2006) found that when only 19% of their respondents were adopters of digital terrestrial television, education and income were positively correlated with the intention to adopt digital television in the US, whereas gender and income predicted knowledge of digital television. Similarly, Zhu and He (2002) discovered that, with China's Internet adoption rate at about 36%, age, sex and education were factors that could discriminate adopters from non-adopters. However, Atkin (1993) and LaRose and Atkin (1988) both discovered that most demographic variables became non-significant in predicting subscription to cable television after this technology had penetrated more than 60% of US homes. Similarly, Kang (2002) showed that after more than 50% of Americans had adopted digital cable, demographic variables could not be used to discriminate between adopters and non-adopters. The adoption processes of digital terrestrial television and digital cable in Taiwan have been slow, and their diffusions are still in the early stages. Therefore, this study expects that demographics will play a significant role in predicting the adoption of the two technologies. Based on this reasoning, the third hypothesis is stated as follows:

H4. Respondents who are younger, better educated, and more affluent are more likely to adopt digital terrestrial television and digital cable.

2.5. Innovativeness

Rogers' model has been criticized by scholars for its failure to take full account of the psychological dynamics that drive people to adopt technologies (Atkin et al., 2003; Rogers, 2003). Recent studies have tried to examine adopters' innovativeness to fill in this void left by the model (Li, 2004a; Lin, 1998, 2004; Lin and Jeffres, 1998). Innovativeness has been defined as an individual's tendency to accept new ideas and new technologies (Garitaonandia and Garmendia, 2009; Rogers, 2003). Lin (2004) found that the desire to take on new challenges and to learn new things was able to predict interest in adopting webcasting. Chan-Olmsted and Chang (2006) found that the intention to adopt digital television in the US was significantly correlated with respondents' innovativeness and adventurousness. Li (2004a) showed that the intention to adopt internet shopping and cable television shopping were both significantly correlated with innovativeness. Li (2004b) found that the intention to adopt interactive cable television in Taiwan was significantly related to innovativeness. Based on the literature review, the fourth hypothesis has been developed as follows:

H5. Respondents who are more innovative are more likely to adopt digital terrestrial television and digital cable.

3. Research methodology

3.1. Innovation attributes

This study conducted 12 intensive interviews in a pilot study to understand how Taiwan's people perceived the attributes of digital terrestrial television. The results of this pilot study were then used to construct a questionnaire for telephone interviews. In the pilot study, a snowballing sampling method was used because (1) it allowed this study to purposely select people for interviews, and hence, this study was able to collect a variety of responses from people of different backgrounds; (2) this study needed to interview both adopter and non-adopters of digital terrestrial television and adopters were difficult to find because this technology was still in its early stages of diffusion. Using a snowballing method, this study was able to find adopters for interviews. Eight males and four females, whose educational levels ranged from an elementary education to a doctoral degree, were interviewed. Among the 12 interviewees, seven were adopters of digital terrestrial television and the remaining five were non-adopters. The analysis of the responses of those interviewed yielded 19 questions regarding the attributes of digital terrestrial television, which were organized into a formal questionnaire.

3.2. Demographics and communication channels

Based on the literature review, age, sex, education, residence area, personal income, and family income were taken into consideration. Age was measured in terms of six age levels, the first level consisting of those ages 15–20 and the last of those ages 50 and older. Seven types of mass media use were examined in the study: television viewing, newspaper reading, magazine reading, radio listening, movie going, Internet use, and cable subscription.

3.3. Innovativeness

Lin (2004) has found that one dimension of innovativeness consists of the tendencies to learn new ideas, take challenges, and keep up with new technologies. In her study, these characteristics were significantly related to interest in adopting web-casting. This study used four questions (regarding willingness to learn new ideas, willingness to explore new technology, familiarity with new technology, and willingness to take risks) to measure an individual's degree of innovativeness.

3.4. Awareness and intent to adopt

In the telephone interviews, the respondents were first asked to indicate whether or not they knew about digital terrestrial television and digital cable. Regardless of the respondent's answer, the telephone interviewers would then explain to the respondents what digital terrestrial television and digital cable were. Next, the interviewers asked the respondents to indicate whether or not they had ever used digital terrestrial television or digital cable. If they had not, respondents were then asked to indicate, on a scale from 1 to 7, their intention to use digital terrestrial television and digital cable in the future (1 was unlikely, and 7 was very likely). Using the responses to the two questions, this study assigned 8 to the adopters. The responses also allowed the researcher to create an interval scale for measuring both the intention to adopt digital terrestrial television and the intention to adopt digital cable.

3.5. Telephone survey

A telephone survey was adopted because this method allowed this study to efficiently obtain a representative sample (Wimmer and Dominick, 2010). This study used computer assisted telephone interviews (CATI) to conduct a telephone survey. Using the stratified random sampling method, the telephone survey was administered in early 2010 and was supervised by the researcher. Twenty research assistants who were paid by how many hours and telephone calls they did during the survey conducted the telephone interviews. The most recent telephone number database for every city and county in Taiwan was used for the random sampling. After a number had been chosen from the database, a "one" was added to the number to avoid any bias existing in the telephone database (Chyu, 2000; Wimmer and Dominick, 2010). The telephone survey resulted in 1219 telephone calls, through which 753 valid questionnaires were obtained; this represents a response rate of 61.8%.

3.6. Factor analysis

The perceived attributes of digital terrestrial television were measured in this study using 19 questions, each of which was evaluated on a seven-point scale. Responses to the 19 questions were processed using SPSS software, which performed

Table 1
Factor analysis of perceived attributes of digital terrestrial television.

Variable	Factor 1	Factor 2	Factor3	Factor 4
Advantage–compatibility				
Good picture quality	**.664**		.156	
Very convenient	**.506**	.111	.125	−.235
Signals are stable	**.674**	.161		
I can have HDTV programs	**.659**	.142	.248	−.123
News information is sufficient	**.587**	.226	.105	.110
Ease of use				
The manuals for setting up digital TV are clear and understandable	.249	**.752**	.132	
It is easy to set up the equipment for digital TV	.374	**.720**		
A remote control for digital TV is easy to use	.336	**.762**	.155	
I have similar products, and hence no problem with setup or use.		**.652**	.352	
Observability				
News media report that digital TV is the future trend	.260		**.680**	−.171
Media reports regarding digital TV are positive	.314		**.535**	−.259
I heard from colleagues that digital TV is good	.122	.227	**.741**	.199
I saw opinions on the Internet that this technology is convenient		.115	**.794**	.146
It is easy to see the strengths and functions of digital TV	.342	.375	**.533**	.160
Content compatibility				
I prefer to view digital TV	−.155			**.598**
Content diversity is sufficient		−.285		**.580**
I do not feel inconvenienced when I need to buy equipment for viewing digital TV				**.627**
Eigenvalue	5.492	1.711	1.375	1.264
% Variance explained	15.79	13.89	13.53	8.59
Alpha	.707	.790	.772	.409

the factor analysis of principal components using a varimax rotation. Four factors were extracted from the 19 questions (see Table 1).

The first factor had five items that contained two of Rogers' attributes, namely, relative advantages and compatibility. It was thus referred to as advantage–compatibility. The second factor had five items, all of which were concerned with the benefits of digital terrestrial television as heard from the mass media or from friends. This factor was therefore referred to as observability. The third factor had four items concerned with the ease of using this technology, and was therefore referred to as ease of use. The fourth factor had three items, two of which were related to the preference for digital terrestrial television and the remaining one to content diversity. This factor was therefore referred to as content–compatibility. A reliability analysis was performed on each of the factors. The Cronbach alphas for the first three factors were all above .70, indicating a high degree of internal consistency. However, the fourth factor had a Cronbach alpha of .41, and was therefore excluded from further analysis.

4. Research findings

4.1. The sample profile

This study found that 46.4% of the 753 respondents were males and that approximately 33.4% of the sample had received an education through senior high school, 43.6% had received a college education, 10.1% a junior high school education, and 6.6% had received a graduate school education. The respondents were more or less equally distributed among the different age levels (from age 15 to more than 50), with those aged 50 years or older representing the highest share (27.9%). The profile of the sample was nearly congruent with that of Taiwan's population, the only exception being that the percentage of the

Table 2
Multiple regression analysis for the intention to adopt.

Predictor variables	Digital terrestrial Standardized beta	Digital cable Standardized beta
Demographics		
Age	−.025	.034
Education	.044	−.051
Personal income	.008	.005
Family income	.079	.049
Sex	.026	−.005
Residence area	−.054	−.073*
Multiple *R*	.085	.166
Adjusted *R* square	−.002	.020**
Increased *R* square	.007	.028
Mass media use		
Cable subscription	−.342***	.222***
TV viewing	.006	.030
Radio listening	.022	−.001
Newspaper reading	.024	−.038
Magazine reading	.005	−.005
Movie going	−.023	.038
Internet use	−.093*	.106*
Multiple *R*	.430	.278
Adjusted *R* square	.169***	.061***
Increased *R* square	.178	.050
Innovation attributes		
Advantage/compatibility	.034	.039
Ease of use	.158***	.019
Observability	.073	.143***
Multiple *R*	.493	.333
Adjusted *R* square	.24***	.091***
Increase *R* square	.058	.034
Innovativeness	.017	−.002
Multiple *R*	.493	.333
Adjusted *R* square	.224	.090
Increased *R* square	.001	.000
Awareness	.175***	.081*
Multiple *R*	.520	.342
Adjusted *R* square	.251***	.095*
Increased *R* square	.027	.006

* $p \leqslant .05$.
** $p \leqslant .01$.
*** $p \leqslant .001$.

sample who had completed a college education was higher than that of Taiwan's population (31.5%) (Monthly Report from the Executive Yuan of Taiwan, 2009).

4.2. Adoption intention

This study found that 19.3% of the respondents (145 persons) were adopters of digital terrestrial television and 15.2% of the respondents (112 persons) were adopters of digital cable. Two hierarchical regression analyses were conducted using the intention to adopt digital terrestrial television and the intention to adopt digital cable as the dependent variables. Demographics, mass media use, innovation attributes, innovativeness and awareness were used as independent variables. The results are summarized in Table 2.

The data in Table 2 show that, for digital terrestrial television, four of the 19 variables that were entered into the regression analysis were significant predictors of the intent to adopt. Awareness ($B = .175$), and the ease of use attribute ($B = .158$) were found to be positively correlated with the intent to adopt, whereas cable subscription ($B = -.342$) and Internet use ($B = -.093$) were negatively correlated with the intent to adopt. The results show that respondents who were aware of digital terrestrial television, felt more at ease using this technology, were not cable subscribers, and used Internet less frequently, were more likely to adopt digital terrestrial television. For digital cable, the data in Table 2 show that five of the 19 variables were significantly related to the intent to adopt. Cable subscription ($B = .222$), Internet use ($B = .106$), the observability attribute ($B = .143$), and awareness ($B = .081$) were found to be positively correlated with the intent to adopt, while residence area ($B = -.073$) was negatively correlated. Hence, this study discovered that people who were cable subscribers, used Internet more frequently, heard more from the mass media or friends about digital terrestrial television, were aware of digital terrestrial television, and lived near northern Taiwan, were more likely to adopt digital cable.

This study conducted a binary logistic regression analysis to understand the relationships among mass media use, demographics, innovation attributes, innovativeness and awareness. Binary logistic regression analyses have similar functions with multiple regression analyses except that the dependent variables of logistic regression analyses are dichotomous nominal data rather than interval data (Chyu, 2000; Dupagne and Driscoll, 2010). The results are summarized in Table 3.

The data in Table 3 indicate that five of the 17 variables were significant predictors of awareness. TV viewing ($B = .203^{***}$), radio listening ($B = .151^{***}$), and observability ($B = .045^{**}$) were discovered to be positively correlated with being aware of digital terrestrial television, while age ($B = -.163^{***}$) and cable subscription ($B = -.652^{**}$) were negatively correlated with awareness. Therefore, this study found that the respondents who were younger, watched more television, listened more radio, heard more from the mass media or friends about digital terrestrial television, and were not cable subscribers were more aware of digital terrestrial television.

The first hypothesis theorized that the perceived positive attributes of digital terrestrial television would be positively related to respondents' intent to adopt digital terrestrial television, but negatively related to their intent to adopt digital cable. The factor analysis resulted in the identification of three factors, namely, advantage–compatibility, observability and ease of use. The data analysis shows that ease of use was positively related to the intention to adopt digital terrestrial television, and that observability was positively related to the intention to adopt digital cable. Hence, H1 was partially supported by the findings.

Table 3
Logistic regression analysis for awareness.

Predictor	*B*	Wald	Exp (*B*)
Demographics			
Age	−.163	16.520***	.850
Education	.090	1.578	1.094
Personal income	.109	2.428	1.116
Family income	.088	1.924	1.092
Sex	.062	.147	1.064
Residential area	.064	.522	1.067
Media use			
Cable subscription	−.652	8.237**	.521
TV viewing	.203	13.543***	1.225
Radio listening	.151	12.050***	1.164
Newspaper reading	−.054	.759	.948
Magazine reading	.017	.076	1.017
Movie going	−.174	1.824	.841
Internet	.042	1.868	1.043
Innovation attributes			
Advantage/compatibility	−.005	.079	.995
Ease of use	.014	.556	1.014
Observability	.045	9.329**	1.046
Innovativeness	.015	.708	1.015

** $p \leqslant .01$.
*** $p \leqslant .001$.

The second hypothesis predicted that mass media use would be related to the intent to adopt for both digital terrestrial television and digital cable. This hypothesis was only partially supported by the findings because the results showed that the intention to adopt digital terrestrial television was negatively correlated with Internet use and cable subscription, while the intention to adopt digital cable was positively correlated.

The third hypothesis predicted that mass media use would be a positive predictor for being aware of digital terrestrial television, which in turn positively affected the intent to adopt digital terrestrial television and digital cable. This hypothesis was supported by the data in Tables 2 and 3, showing that television viewing, radio listening and cable subscription were significantly correlated with awareness that positively influenced the intent to adopt digital terrestrial television and digital cable.

The fourth hypothesis predicted that the respondents who were younger, better educated, and more affluent would be more likely to adopt digital terrestrial television and digital cable. This hypothesis was partially supported by the findings, showing that none of the six demographic variables was significantly correlated with the intention to adopt digital terrestrial television, and that only residence area was negatively related to the intention to adopt digital cable.

The fifth hypothesis predicted that innovativeness would be positively related to the intention to adopt digital terrestrial television and digital cable. This hypothesis was not supported by the data because the data in Table 2 show that innovativeness did not exert any significant effect on the intention to adopt either digital terrestrial television or digital cable.

5. Discussion

5.1. Innovation attributes

This study found that the respondents' intentions of adopting digital terrestrial television were positively correlated with the ease of use attribute, indicating that the respondents were attracted by the ease of using a set-top-box to receive digital terrestrial television signals. Furthermore, this study discovered that observability was not a concern for the respondents when deciding to adopt digital terrestrial television. However, this attribute was a positive predictor of the intention to adopt digital cable, which is contrary to the prediction made in H1. The attribute of observability contained five items, all of which were related to having heard about the benefits of digital terrestrial television from friends, colleagues, or the mass media. This attribute was expected to be a positive predictor of the intention to adopt digital terrestrial television. A possible explanation for this unexpected finding is that the benefits the respondents heard about were actually those of digital television. Furthermore, it is possible that the respondents regarded digital cable rather than digital terrestrial television to be the technology of the future. This possibility has been confirmed by several studies conducted in the past several years, in which it has been found that while the mass media frequently reported on the benefits of digital television, most media reports do not differentiate digital terrestrial television from digital cable (Tsai, 2010). This study therefore found that observability was positively related to the intention to adopt digital cable.

Moreover, with the rapid development of digital technology in Taiwan, all mass media are in the process of digitization. Thus, it may be that most people were familiar with the advantages of digital television and realized that it was an inevitable technology. This may explain why this study did not find that relative advantage and compatibility played a significant role in the intention to adopt either digital terrestrial television or digital cable. This study also found that two of Rogers' perceived attributes, namely, relative advantages and compatibility, were merged into one factor, which accords with the findings of several other studies. Moore and Benbasat (1991) and Wei (2006) both found that relative advantage and compatibility were not distinguishable from each other in empirical studies of technology adoption and suggested a revision of Rogers' five attributes (Zhou, 2008). The findings of this study verify the viewpoint that re-conceptualizing Rogers' five attributes is necessary to reach a better understanding of technology adoption.

5.2. Mass media use

This study found that the uses of mass media are the most powerful set of variables for predicting the intent to adopt for both digital terrestrial television and digital cable. For digital terrestrial television, cable subscription and Internet use negatively predicted the intention to adopt. However, for digital cable, these two types of media use positively predicted the adoption intention. These results indicate that respondents who were cable subscribers and Internet users were much less likely to adopt digital terrestrial television, but were much more likely to adopt digital cable. These findings confirm the viewpoint that digital cable and digital terrestrial television are two competing technologies in Taiwan, and that cable subscribers are more likely to adopt digital cable rather than digital terrestrial television. Hence, this study found cable subscription to have a negative effect on the intention to adopt digital terrestrial television.

This study found that Internet use had the opposite effects on the intent to adopt for both digital terrestrial television and digital cable. Internet use was found to have a positive effect on the intention to adopt digital cable, but it had a negative effect on the adoption of digital terrestrial television. Therefore, this study found that the respondents who used Internet more frequently were less likely to adopt digital terrestrial television, but were more likely to adopt digital cable. These findings are congruent with government data showing that in Taiwan, the penetration rates of Internet via cable modem

in Taiwan have been on the rise for the past 5 years because most people believed that, after digitization, a cable modem would be able to perform much more powerful functions than other means of Internet connection (FIND, 2011).

Digital terrestrial television and digital cable are in their initial stages of diffusion in Taiwan. This study found that mass media use played a significant role in differentiating adopters from non-adopters of both digital terrestrial television and digital cable. These results are congruent with Rogers' model (Rogers, 1995, 2003).

5.3. Awareness

This study found that mass media use including television viewing and radio listening were positively correlated with the awareness of digital terrestrial television, which is congruent with the assumption of Rogers' model that mass media play an important role as informing the public of a given technology. Furthermore, this study found that awareness is the second most powerful predictor of adoption ($B = .175^{***}$), showing that the respondents who were aware of digital terrestrial television were more likely to adopt this technology, which is congruent with the findings of past studies (Atkin et al., 2003). This study also found that awareness was a significant predictor of the intention to adopt digital cable. These findings confirm the viewpoint that it is essential to take into account a society's awareness of a given technology when this technology is in its early stages of diffusion. To better understand the factors that affect the diffusion of digital terrestrial television and digital cable in Taiwan, future studies should examine not only awareness about a given technology, but also a constituency's knowledge about the technology. Moreover, these findings suggest that the government needs to exert more efforts to educate people about digital terrestrial television and digital cable. Doing so will speed up the diffusion of these two technologies in Taiwan.

5.4. Demographics

For digital cable, only residence area was found to be a significant predictor of the intention to adopt, indicating that respondents who lived close to Taipei, the capital city, were more likely to adopt digital cable. A possible explanation for this finding is that Taiwan's Cable Television Law has divided the island into 51 franchise areas. Because each area is too small to be profitable, system operators have merged their operations in many areas to increase efficiency. Recent studies have shown that most of the areas have become characterized by a monopolistic market structure. The few areas that still have competition are located primarily in the greater Taipei area. These areas also have higher subscriber satisfaction rates because they had access to better consumer services (Li et al., 2007). This could explain why the respondents who lived close to Taipei were more likely to adopt digital cable.

For digital terrestrial television, this study found that none of the demographic variables were significant predictor. This study found that, for digital terrestrial television, 25% of the total variance could be explained by the five sets of variables and that demographic variables accounted for less than 0.01% of the variance. This is incongruent with the findings of past studies because Taiwan's digital terrestrial television was in its early stages of diffusion and demographics should play an important role for the adoption (Chan-Olmsted and Chang, 2006; Li, 2004a,b; Zhu and He, 2002). For digital cable, however, this study found that 9.5% of the total variance in adoption could be explained by the five sets of variables and that demographics accounted for almost 2% of the variance, which is more congruent with the prediction of Roger's model. These findings indicate that although digital television is an inevitable technology, Taiwan's people may not consider it necessary to have digital television via terrestrial television. Instead, they may prefer to have digital television via digital cable. Indeed, this study found that, compared with that of digital terrestrial television, the diffusion process of Taiwan's digital cable is more congruent with Rogers' model.

5.5. Innovativeness

This study found that innovativeness did not have a significant effect on the adoption of either digital terrestrial television or digital cable, which is incongruent with the findings of most past studies (Chan-Olmsted and Chang, 2006; Li, 2004a; Lin, 2004; Rogers, 1995). A possible explanation for the disagreement among these findings is that, although digital terrestrial television and digital cable are still in the early stages of diffusion, these two technologies are not new technologies because they have been available in Taiwan for several years. Their slow diffusion is due to the government's indecisive policy about digital conversion (Tsai, 2010).

6. Conclusions

This study adopted Rogers' model to compare the diffusion of digital terrestrial television with the diffusion of digital cable in Taiwan. Several conclusions can be drawn from the findings of this study. (1) This study found that digital terrestrial television and digital cable are competing technologies in Taiwan because the factors that affected people's intention to adopt digital terrestrial television differed widely from those that affected the intention to adopt digital cable. In particular, two types of media use, namely, cable subscription and Internet use, had contrasting effects on respondents' intentions to adopt the two technologies. For digital terrestrial television, cable subscription and Internet use had a negative effect on

adoption, while for digital cable, they had a positive effect. (2) The diffusion process of digital cable was generally in keeping with the prediction of Rogers' model, while the diffusion process of digital terrestrial television was not. These findings reveal one limitation existing in Rogers' model: its alleged pro-innovation bias. Rogers' model has been criticized for its assumption that people look favorably on all innovations without acknowledging that there are some innovations that people do not wish to adopt (Rogers, 1995, 2003). The respondents of this study may have considered digital cable, not digital terrestrial television, to be an inevitable technology, causing them look favorably on digital cable. As a result, this study found that the diffusion of digital cable was more congruent with Rogers' model than the diffusion of digital terrestrial television. (3) This study found that awareness played an important role in the adoption of digital television. In particular, awareness was found to be a powerful predictor of the adoption of digital terrestrial television. This study therefore suggests that, to accelerate digital conversion, the government in Taiwan should establish policies to educate people in the knowledge of digital television (Galperin, 2002). (4) This study found that, for digital terrestrial television, the five sets of variables explained 25% of the variance in the intention to adopt. However, for digital cable, the five sets of variables only accounted for 9.5% of the variance in the intention to adopt. A possible explanation for these findings is that this study only measured the innovation attributes for digital terrestrial television, and then used these attributes to assess the respondents' intentions to adopt digital cable. However, it may be that the perceived attributes of digital cable are more numerous than those used to measure digital terrestrial television. Empirical studies adopting Rogers' model have found that innovation attributes are the most powerful variable for predicting technology adoption (Rogers, 1995, 2003). To better understand the patterns of digital cable adoption in Taiwan, future studies should conduct interviews with participants to determine the attributes they perceive to characterize digital cable.

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