# The Influences of Evaluation Changes from Different World-of-Mouth Channels on the Acceptance Intention of ETC Policy by Highway Users in Taiwan


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**Abstract**

Word-of-mouth, as refer to the passing of information from person to person, is an important marketing strategy for product promotion. Besides, information disseminated through media is so common in nowadays' life and, thus, their comments of a commodity or service, as well as the information exchanged by face to face interaction, might affect people's final choice eventually. In this study we focus on how the contents disseminated through different word-of-mouth channels(face to face communication and electronic media which includes the conventional media and the Internet) about the electronic toll collection(ETC) system, a new toll collection service in Taiwan, affect the acceptance intention of highway drivers on it. Through the collected survey data about the evaluations of highway drivers before and after this system been implemented from different channels, we investigate how the evaluation changes influence their acceptance intention of the ETC system. After the estimation of structural equation models, we find that the evaluation changes by word-of-mouth from electronic media and face to face directly, and the "perceived easy to use" and "social norm" indirectly, affect the acceptance intention of ETC system on highway drivers in Taiwan. Accordingly, we suggest that, as pushing a new transportation policy, if the government could use the media and the word-of-mouth to raise people's evaluation of the policy well, which then might help its acceptance level.



**Keywords**: electronic media, word-of-mouth， electronic toll collection(ETC), structural equation model

## 1. Introduction

With the development of technology, information diffusion is no longer completely reliant on face-to-face communication or media dissemination. The various widely used electronic technologies also provide important channels for information diffusion. Unlike conventional TV or broadcasting media that deliver one-way messages to unspecific audience, these new channels allow users to deliver or exchange messages using electronic bulletin board (BBS), e-mail, personal website, and web forums etc. Because web browsers provide a powerful information search function, people in need of particular information can find necessary information from various sources on the Internet and even use it as a basis for their decisions.

According to a survey conducted by BIG research (2005), among the various sources of information that consumers refer to before making purchase decisions, word-of-mouth is the most influential one and followed by TV advertisements. This finding highlights the importance of word-of-mouth for consumer decisions. In earlier years when the Internet was still unheard-of, word-of-mouth was mainly spread via interpersonal contact. However, after the Internet was invented and became a part of our daily life, the search function s through the above-mentioned web browsers become available, information could be spread via multiple channels, including web forums, BBS, and personal websites because these new platforms offer the possibilities for exchange information each other. These channels offer users to access information without limitation of time and space and allow them to be anonymous as posting or revealing their opinions, so online word-of-mouth can disseminate information faster than the face to face way and gradually influence our life deeply.

Miller (1980) points out that all activities disseminated through media imply some kinds of potential persuasion. When a firm promotes a new product, it will use various channels to diffuse positive side information about this product, in hope of persuading consumers to buy the product and then to maximize its profit. But from the perspectives of consumers, they wish to obtain receive positive and negative side information about this new product at the same time so that they can make correct decisions. If consumers receive more positive than negative information about the product from all available channels, they might be more potential to buy the product, and thus the product could be more successfully marketed; on the contrary, less acceptance of the product might be the result.

According to Richins (1983), consumers will take the opinions from others, as so-called word-of-mouth, as important references while considering over adopting new products or services. Unlike information provided by marketing activities, the information from word-of-mouth might be negative and also important to consumers. Before the invention of Internet, negative word-of-mouth could only be spread through interpersonal interactions and the disseminating speed is much slower than the one of positive information revealed by the producers through the convention electronic media. But in nowadays, the network of Internet could accelerate the diffusion of both side information, and thus amplify the effects of information on consumers. Thus to discuss the influences of different word-of-mouth channels on transportation policies acceptance is an important issue. In Taiwan, the population of Internet users aged above 12 is growing year by year, from 57.23% in 2003 to 68.51% in 2008. People aged above 20 take up 67.19% of this population. Thus, a policy can be more successfully promoted if its information can be effectively diffused on the Internet.

In this paper we investigate the effects of evaluation changes of ETC policy from different word-of-mouth channels by highway drivers on their acceptance intention of it in Taiwan. This policy in Taiwan is not only a transportation management policy but also an industry development one. The enormous business behind the implementation of ETC is one of the main factors that why the government in Taiwan strives her hardest to promote it.

In Taiwan, the ETC system was constructed by built, operate, and transfer (BOT) model, which means the concession granted party transfers of a project(ETC system in this paper) back to the party granting the concession, either with or at no cost. Far Eastern Electronic Toll Collection Co. (FETC) bid the rights to design and develop on board unit(OBU), to construct the infrastructure, and to market the products and services related to ETC for 18 year and 4 months after the system begin its operation. For highway drivers, ETC system is like a new product and will evaluate it sufficiently before they make decision on installing OBU on their vehicles or not. However, due to adoption of BOT model, the development process of ETC policy in Taiwan was permeated with a great deal of political information. Most of the information are negative and are likely to influence the acceptance of the policy by highway drivers and prevent the OBU of ETC system from an ordinary product for them. Also, through the dissemination on Internet, such information might be searched and contacted by highway drivers and affect their final decisions on adopting ETC measures.

Because the communication channels of ETC-related information are not included as a factor influencing highway drivers' acceptance of ETC and therefore might indicate an insufficiency of existing research. Therefore, this paper focuses on the evaluation of ETC systems from before and after the implementation of ETC policy from different information channels, no matter the electronic media (including Internet) or from the word-of-mouth (including online and face to face), both are not included in the analysis of Chen et al. (2007). Then we will discuss how the evaluation changes of freeway drivers affect their acceptance intention on ETC policy. We further compare to the significance levels resulted from different channels according to our estimation results. In other words, this paper tries to find out whether different dissemination channels of information have different effects on the acceptance intention on the ETC policy.

The rest parts of this paper are as follows: the literature about the implementing experiences of ETC policy is reviewed in section 2; a short introduction about the development process of ETC policy in Taiwan is presented in section 3; section 4 shows our analysis framework, presumed hypothesis, and the designation of survey questionnaire; in section 5, the descriptive statistics and estimation results on structural equation models are list; finally, we offer our conclusions and propose some policy suggestions from our study results.

## 2. Literature Review

The meanings of the ETC policy are two-fold. In the one hand, due to ETC policy is a new transportation on for drivers, their use of ETC system represents their acceptance of the new policy. In the other hand, now that ETC system contains the OBU and the inherit services are new products of technologies, drivers' adoption of ETC system is like an action of innovation diffusion for firms involved in the ETC industry. In this paper, we only focus on studies related to the former topic in ETC policy.

Ogden (2001) discusses the impact of the ETC system on privacy of drivers, an issue also mentioned in Riley (2008). The two papers not only discuss highway ETC systems but also pricing of tolls for congested road sections. However, the effects of the privacy issue on users' acceptance of ETC are not mentioned in either paper. Ogden (2001) summarizes privacy issues concerning users of ETC of Australia's intelligent transport systems (ITS). ETC stores a large and accumulated amount of detailed information of its users, including their locations at a particular time. The author thus calls on the government to pay attention to privacy issues when setting up related policies and make them known to the public. Riley (2008) explores the reasons why the adoption rate of FasTrak, an ETC system adopted in Bay Area of California, is lower than similar systems in other urban areas of the United States, despite unceasing growth of economy and population. Prior research suggests that

drivers in urban areas of California have a higher acceptance of ETC because their willingness to pay for convenience of FasTrak exceeds the current cost of FasTrak. Riley's finding shows that slow progress of FasTrak is partially attributed to consumers' value of perceived privacy that outweighs the implicit value of convenience. Riley finally suggests that unless consumers' perceived reduction of privacy in the FasTrak system can be effectively reduced or an appropriate compensation can be offered to drivers in exchange for their perceived reduction of privacy, a significant increase of FasTrak usage cannot be achieved.

Adler and Cetin (2001) investigate the effects of redistribution effects by congestion pricing on highway drivers' choice of routes. Congestion pricing can be used to satisfy and mitigate the traffic demand during peak hours. However, congestion pricing is viewed as advantageous to only high-income road users, because they can afford higher tolls and benefit from reduction of travel time resulting from congestion pricing. The authors propose that if the pricing structure is reasonable or some subsidization can be offered to general travelers, congestion pricing can reduce the travel cost and waiting time of most travelers. As a result, travelers' acceptance of the pricing policy can be increased, and promotion of the ETC policy can be made easier.

Levinson and Chang (2003) examine the deployment of ETC and develop a model to maximize social welfare associated with a toll plaza. Through statistical estimation, they propose that delay, price, and cost of acquiring a transponder are factors affecting the proportion of users using ETC. Delay depends on the relative number of ETC and manual collection lanes, and price depends on the discount given to ETC users. Their analysis result indicates that the cost of acquiring a transponder is a key factor in the model. Once a traveler acquires the transponder, the cost of choosing ETC in the future will decline rapidly. Social welfare depends on the market share of ETC, decrease on travel delay and the consumption of gasoline, toll collection costs, and social cost such as air pollution. Their findings report that deployment of too many ETC lanes will cause excessive delay to users not equipped with a transponder.

Kim and Hwang (2005) analyze the impact of pricing schemes on urban expressways in Seoul and examine the efficiency and equity issues associated with various road pricing strategies. They suggest that ETC systems should be adopted for high occupancy toll lane (HOT lane) systems because they offer the most value for citizens. Chen et al. (2007) discuss the factors affecting the low market share of ETC in Taiwan. Based on a framework consisting of Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) Model, they propose that highway drivers' intention to accept ETC is affected by not only perceived usefulness and perceived ease of use of the system but also individual factors, organizational members, communication channels, and social systems. Their findings indicate that highway drivers' attitude, subjective norms, and perceived behavioral control positively influence their intention to adopt the ETC system.

Lee et al. (2008) discuss the design and implementation of a VPS-based (vehicle positioning system) ETC system. Conventional ETC systems are based on DSRC (dedicated short range communication). In recent years, area wide integrated MLFF (multilane free flow) toll collection systems have been developed and expected to replace the DSRC-based ETC systems. VPS-based ETC is a location based service, which charges drivers only when they move into charging zones. This technology has been viewed as a solution to DSRC-based ETC, because it achieves the goal of electronic payment or electronic toll collection using a totally different scheme compared with DSRC-based ETC systems. The authors finally use the VPS-ETC system adopted in Taiwan's highway systems as an example to analyze and compare the advantages and disadvantages of this system with

conventional ETC systems.

This section reviews studies on ETC related issues. In these studies, communication channels of ETC-related information are not included as a factor affecting highway drivers' acceptance of ETC. This is an insufficiency of the existing research. Especially in the modern age where the Internet is widely prevalent, in addition to media reports and word-of-mouth, information diffused on the Internet may also have a considerable effect on potential users of ETC. Therefore, this paper includes communication channels of ETC related information as a factor into the present model and analyzes its effect before and after implementation of the ETC policy using Bass forecasting model (BFM). This model allows us to understand the effects of different communication channels before and after policy implementation and analyze whether the difference in the effects of different communications channels should be considered in the promotion of other transportation policies.

## 3. Development process of Taiwan's ETC Policy

Considering the rapid increase of traffic flows on national highways, Taiwan's National Highway Bureau (TANFB) has been actively engaged in the promotion of an ETC program. ETC allows road users pay highway tolls without stopping their vehicles and paying cash, so this program is expected to increase the capacity of toll stations, reduce toll collection time, save hardware and toll management cost, and reduce air pollution. In the beginning, TANFB signed a contract on "construction and operation of a highway toll collection system" with Chunghua Telecom Co. (CHT) 1n April, 2001 and commissioned CHT to be responsible for construction and operation of the ETC system. However, the budget for procurement of related hardware was disapproved by the legislators in the first session of 2002. Therefore, TANFB launched another program called "Private Participation in Construction and Operation of Highway ETC System".

"Private Participation in Construction and Operation of Highway ETC System" program was proposed in pursuant to "Act for Promotion of Private Participation in Infrastructure Projects". A bid was announced in August, 2003, and 7 companies participated in the bid. Through a preliminary review of the participants in December, 2003, 3 companies quantified for the bid application. TANFB then began a series of negotiations with the qualified participants. In April, 2004, TANFB decided to establish a contract with Far Eastern Electronic Toll Collection Co. Considering that roads users of this system might be low in the beginning, the policy was designed to be implemented in two stages. In the first stage starting from January, 2006, two ETC lanes (one for light vehicles and the other for large vehicles) will be opened on two sides of each station. Both manual toll collection and ETC will be available to road users. In the second stage starting from July 2010, ETC will be adopted on all lanes. Tolls will be charged by mileage to fulfill the equity goal of "pay as much as you use". The official operation of ETC came from Feb 10, 2006.

Providing highway ETC service was expected to be the first step to developing an intelligent highway transportation system. Through promotion of ETC, the government aimed to integrate ETC and transportation management into an Electronic Toll & Transportation Management (ETTM) system, which can be a foundation for developing an Intelligent Transportation System (ITS). ITS is a flagship program in our national development, in which Electronic Payment System & Electronic Toll Collection (EPC&ETC) is one of the six main projects[1]. ETC can help relieve congestion at toll

[1] Other projects include Advanced Traffic Management Systems(ATMS), Advanced Traveler Information Systems(ATIS), Advanced Public Transportation Systems(APTS), Commercial Vehicle Operations(CVO), and Emergency Management System(EMS). The six

stations and also accelerate recovery of investment in transportation infrastructure. Therefore, our government followed the steps of foreign nations to develop ETC as an initial application of ITS.

ETC was planned to be a BOT project, so many controversies arose during construction of the system, such as the controversy over adoption of either an infrared system or a microwave system. As mentioned earlier, business opportunities created by this project are enormous, including construction of equipment for toll collection lanes on all national highways, production of OBUs for more than 5.50 million vehicles, IC card value-adding service, and other value-added services. ETC is a part of ITS. It is expected to provide high-quality transportation services and promote development of domestic industries. Statistics show that development of ETC can lead development of many industries, including ITS communication, global positioning system, and information service industries, which can create a production value of NT$1 trillion and 350 thousand job opportunities. By developing ETC related applications, Taiwan can even become a major supplier of this technology. For this reason, in the planning of the ETC system, TANFB's choice of the sensor system drew much attention of interest groups from suppliers of the microwave system and suppliers of the infrared system. Both groups of suppliers used various channels and means to influence the reviewers' final choice, thus causing many disputes in the beginning.

The bidding for the ETC BOT project was held in 2003, and controversies surrounding ETC appeared one after another. At that time, seven corporate groups participated in the bidding. The competition was intense and accompanied by rumors and blackmails. The investigation and prosecution agencies also intervened to investigate all the accusations. This BOT project then gave the general public an adverse impression before it was available for use. Later, legislators from both the ruling and opposition parties and many people began to criticize the pricing of OBU. An email widely forwarded on the Internet accused that FETC and OBU manufacturers could obtain enormous profits and called on people to use their collective power to make FETC and OBU manufacturers beg them install OBU. A strong anti-corporate and anti-ETC sentiment permeated the entire nation. TV media constantly broadcast reports and criticisms about ETC, and the Internet also played an important role in disseminating and discussing ETC-related issues.

Table 1. Effectiveness of the ETC policy in Taiwan

| 項目 \ 年度 | 2006 | 2007 | 2008 | 2009(Jan.-Oct.) |
|---|---|---|---|---|
| Equipped number of OBU | 249,542 | 166,919 | 289,017 | 231,060 |
| Dis-equipped number of OBU | 2,429 | 664 | 20 | 14 |
| Net number of OBU | 247,113 | 166,255 | 288,997 | 231,046 |
| Traffic Volume (Manual +ETC) (Vehicle) | 545,543,675 | 526,659,541 | 500,283,517 | 424,716,576 |
| Traffic Volume of ETC(Vehicle) | 53,819,632 | 100,566,116 | 141,279,763 | 142,922,445 |
| ETC utility rate(%) | 11.16% | 19.10% | 28.44% | 33.26% |

Resource: data in 2006~2008 is from Taiwan National Freeway Bureau(2008), and the data in 2009 is from the webside http://www.freeway.gov.tw/Publish.aspx?cnid=1472&p=488.

Affected by ETC-related information broadcasted on traditional and new media, OBU was not widely accepted among highway road users in the beginning. Only 32,925 vehicles

projects cover several professional areas, including telecommunication, transportation, and electronics. Through promotion of the ITS flagship program, the government expected to attain the goals of safety, environment conservation, efficiency, and economy.

(about 4% of all registered vehicles) were equipped with an OBU as of Feb 10, 2006[2]. As shown in Table 2, the ETC utility rate was 11.16% in 2006 and reached only 33.26% in October 2009. Apparently, this policy was not highly accepted among highway road users in Taiwan, despite gradual increases in ETC utility rate and the number of vehicles equipped with an OBU. This low utility rate then became a blocking stone of other policies originally designed by Ministry of Transportation and Communications (MOTC) and also slowed down the development of ETC-related industries. For the government, its impact on development of other transportation management policies and related industries is considerable and cannot be overlooked.

Based on this observation, this paper attempts to understand the effects of ETC-related information diffused by various channels (including TV, radio, the Internet, and the online and face to face word-of-mouth) on highway drivers' impression and their acceptance of ETC policy. The focus of this paper will be particularly placed on the effect of the new communication medium – the Internet. This research is expected to help us understand the diffusion effect of this new communication medium and help businesses analyze the impact of the Internet on consumers' information seeking behavior. Moreover, it is expected to help the government recognize the importance of utilizing new communication media to promote new transportation policies.

## 4. Research Methods

### 4.1 Research Model

The main issues discussed in this paper include: whether positive and negative information about ETC diffused by communication media (including traditional media and the Internet) affect highway highway drivers' intention to accept ETC before official operation of ETC and whether interpersonal word-of-mouth and online word-of-mouth about ETC affect highway drivers' intention to adopt ETC after official operation of ETC. In other words, this paper will investigate if factors affecting highway drivers' intention of ETC adoption before and after official operation of ETC are different.

As mentioned earlier, the effect of information communication channels is not included in the model proposed by Chen et al(2007) . Their model needs to be extended before it can be used to analyze the effects of different communication channels on highway drivers' intention to accept or adopt ETC. According to Rogers (2003), sources of channels by which decision making units access innovation-related information can be divided into interpersonal communication and mass media. These channels allow decision making units to recognize innovations and will persuade them to change their attitude toward innovations Mass media channels include radio stations, TV, and newspapers. These media can quickly deliver information to a large audience, create knowledge and diffuse information, and change the audience' preconceptions to a certain extent. Interpersonal communication channels refer to face-to-face interactions between two or among multiple decision making units. Face-to-face interactions provide two-way communications, thus allowing one to relieve the psychological barriers in decision making units and influence or strengthen their attitude (Rogers, 2003, p.205).

Rogers further applies Bass forecasting model(BFM; Bass, 1969; Bass, 1980) to analyze the effects of mass media and interpersonal communications on decision making units' acceptance of innovations. The basic concept of BFM is illustrated in Figure 1. In Figure 1, p(t)m+q(t)m denotes the number of decision making units accepting an innovation at *t*, p(t)m denotes the number of decision making units accepting an innovation under

[2] See Taiwan Area National Highway Bureau: http://www.highway.gov.tw/UserFiles/File/2006.pdf。

influence of mass media at *t*, q(t)m denotes the number of decision making units accepting an innovation under influence of interpersonal communications at *t.* BFM proposes that with the progress of time, the number of potential adopters of an innovation turning into adopters of the innovation varies with the diffusion of information about this innovation by mass media and interpersonal communications. In the diffusion of an innovation, early adopters are mainly affected by mass media, and late adopters are mostly affected by interpersonal communications. In other words, different information diffusion channels have different effects before and after release of a product.

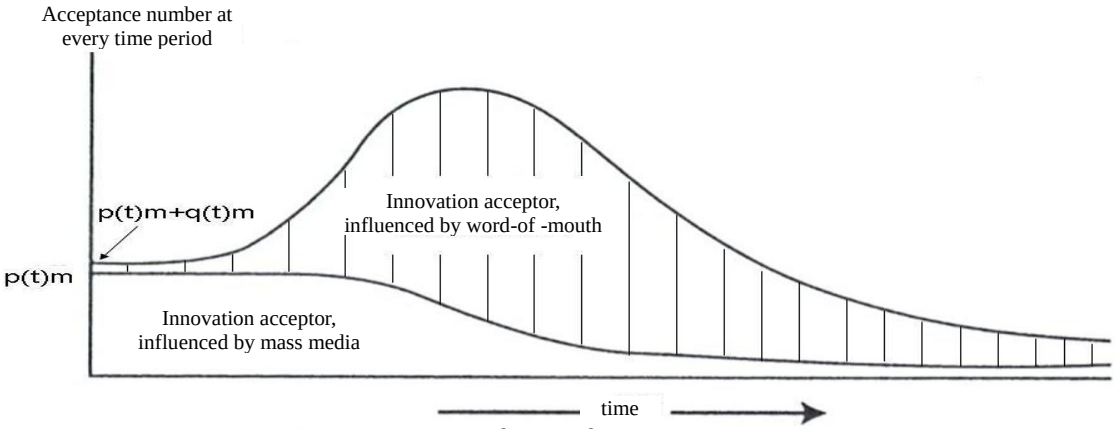


Figure 1. The basic concept of Bass forecasting model (BFM)

Rogers(2003, p.211) clearly states that mass media are more influential than interpersonal communications to early adopters of an innovation, and interpersonal communications are more influential than mass media to late adopters of an innovation. In this paper, we do not use BFM to forecast the number of ETC adopters because we expect to use it to mainly explore factors affecting highway drivers' acceptance of ETC and also because the gap between the number of current adopters and the number of potential adopters of ETC is too large. Our research model is built on the basis of Chen et al(2007) and incorporated with two additional factors, including "evaluation changes in media comments" and "changes in word-of-mouth", shown on the bottom left of Figure 2.

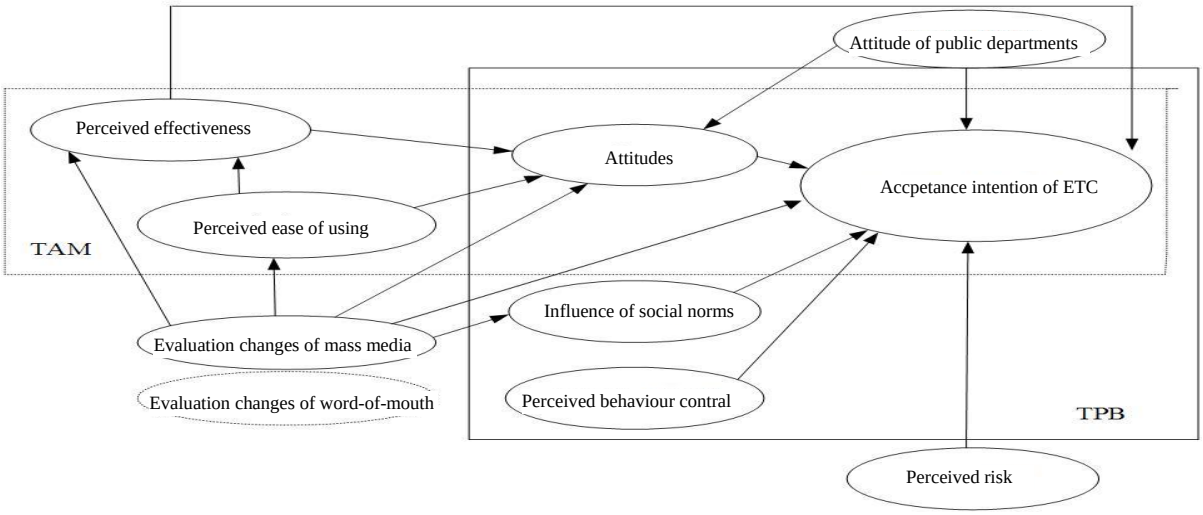


Figure 2: The research model (an extension of Chen et al(2007) )

In Figure 2, arrows represent the direction of influence between factors (whether the influence is positive or negative depends on questions to be analyzed). In Chen et al's (2007) model, media communication is not listed as a factor affecting highway drivers' "attitude" and "subjective norms", mainly because their model is an extension of the model introduced by Armitage and Canner (2001). Chen et al.'s (2007) model is intended to explore the antecedents of highway drivers' intention to adopt ETC using TAM (within the dotted line) and TPB (within the real line). According to TAM proposed by Davis (1989) and Davis et al. (1989), perceived usefulness and perceived ease of use of ETC affect highway drivers' attitude toward the ETC policy, and their attitude formed under influence of these two factors will ultimately determine their intention to accept and adopt ETC. According to TPB, highway drivers' attitude, subjective norms, and perceived behavior control are main factors affecting their intention to accept ETC.

In our model, BFM is incorporated to further discuss the effect of media communications and word-of-mouth on highway drivers' intention to accept ETC. Based on the analysis framework in Figure 2, we propose that diffusion of ETC-related information by mass media and word-of-mouth affect highway drivers' intention to accept ETC. In this framework, mass media include traditional media and the Internet, and word-of-mouth includes word-of-mouth in social networks and online word-of-mouth to highlight the significant influence of the Internet on people's behavioral decisions. According to BFM, diffusion of ETC-related information by mass media (including the Internet) is more influential to road users before official operation of ETC, and diffusion of ETC-related information by word-of-mouth becomes more influential to road users after official operation of ETC.

### 4.2 Research Hypotheses

As shown in Figure 2, we aim to test not only hypotheses proposed by Chen et al. (2007) but also hypotheses about diffusion effect of mass media and word-of-mouth. Hypotheses proposed by Chen et al. (2007) are first summarized as follows:

H1: The higher the "attitude" of a highway driver toward ETC, the higher his/her acceptance intention of ETC.

H2: The higher the "perceived behavioral control" of a highway driver toward ETC, the higher his/her acceptance intention of ETC .

H3: The higher the "perceived usefulness" of a highway driver, the higher his/her "attitude" toward ETC.

H4: The higher the "perceived ease of use" of a highway driver, the higher his/her "attitude" toward ETC.

H5: The higher the "perceived usefulness" of a highway driver toward ETC, the higher his/her acceptance intention of ETC.

H6: The higher the "perceived ease of use" of a highway driver, the higher his/her "perceived usefulness" toward ETC.

H7: The higher the "influence of social norms" of a highway driver toward ETC, the higher his/her acceptance intention of ETC.

To understand the evaluation changes of highway drivers and the inherent acceptance intention with respect to the information about the ETC policies diffused by various media, we propose the following hypotheses:

H8: The more positive the evaluation changes on ETC after the information about the ETC policies diffused by mass media (word-of-mouth) of a highway driver, the higher his/her "perceived usefulness" toward ETC.

H9: The more positive the evaluation changes on ETC after the information about the ETC policies diffused by mass media (word-of-mouth) of a highway driver, the higher his/her "perceived ease of use" toward ETC.

H10: The more positive the evaluation changes on ETC after the information about the ETC policies diffused by mass media (word-of-mouth) of a highway driver, the higher his/her "attitude" toward ETC.

H11: The more positive the evaluation changes on ETC after the information about the ETC policies diffused by mass media (word-of-mouth) of a highway driver, the higher his/her "social norm" toward ETC.

H12: The more positive the evaluation changes on ETC after the information about the ETC policies diffused by mass media (word-of-mouth) of a highway driver, the higher his/her acceptance intention of ETC.

H13: The higher the "attitude of public departments" of a highway driver, the higher his/her "attitude" toward ETC.

H14: The higher the "attitude of public departments" of a highway driver toward ETC, the higher his/her acceptance intention of ETC.

H15: The higher the "perceived risk" of a highway driver toward ETC, the higher his/her acceptance intention of ETC.

### 4.3 Questionnaire Design

A structured questionnaire was adopted to collect and measure the research data. The items in this questionnaire were designed using positive descriptions and Likert scales. This questionnaire consists of four sections. The first section explores how road users access information related to ETC and measures their evaluation on the information using an 11-point Likert scale, including 5 negative points, 1 neutral point, and 5 positive points. This section also measures highway drivers' current usage of ETC using choice questions. Based on BFM, 10 items were designed to measure the diffusion effect of communication channels (6 for traditional media and 4 for the Internet). The dimension of "word-of-mouth" consists of 5 items. The first 4 items are the above-mentioned 4 items for the Internet. These 4 items measure the effect of online word-of-mouth. The last item measures the effect of interpersonal word-of-mouth. All these items also use an 11-point Likert scale, including 5 negative points, 1 neutral point, and 5 positive points. The second section measures the effect of each factor on highway drivers' intention to accept ETC. Factors to be measured include perceived usefulness, perceived ease of use, attitude, social norm, attitude of public departments, perceived behavioral control, perceived risk, and intention to accept. Items used to measure their effects were designed using a five-point Likert scale from strongly disagree, disagree, neutral, agree to strongly agree. The third section adopts the same five-point scale to evaluate highway drivers' acceptance of the toll collection policy and

route choice. The fourth section surveys highway drivers' basic data, including gender, age, education, monthly income, number of light vehicles possessed, number of vehicles equipped with an OBU, total mileage of vehicles equipped with an OBU, frequency of using highways per week, and frequency of passing through toll stations per week.

Because the aim of this paper is to understand the information diffusion effect of various media on highway drivers' intention to accept or adopt ETC, the research subjects are drivers of light vehicles on national highways. The subjects should hold a driving license of light vehicle and but not necessarily own a light vehicle. Considering that only a specific group could access online questionnaires, we distributed questionnaires face to face to increase the representativeness of the obtained sample.

Besides, we also limited the subjects to non-users of ETC to investigate the tendency of acceptance of ETC. The survey was conducted in Chin-Shui rest area where an ETC service station is located. A total of 159 respondents were collected, and 143 valid respondents were obtained.

The collected data were analyzed using the following instruments and methods: (a) Descriptive statistics of the data were analyzed on SPSS to find distribution of various sample characteristics; (b) Through construction of a linear structural equation on AMOS 7.0, confirmatory factor analysis, reliability analysis, convergent validity test, and discriminant validity test were performed. After the fit of the model to the data was ensured, the structural model and direct effects were tested to validate the proposed hypotheses.

## 5. Data Analysis

This chapter mainly presents the analysis result. The first section provides an analysis of the demographic characteristics of the sample and basic statistics of responses. The second section measures validity and reliability of the questionnaire. Convergent validity and discriminant validity of the scale are tested using CFA. After the validity and reliability of the scale are ensured, the relationships between aspects are tested in the third section. In other words, hypotheses proposed in the preceding chapter are validated in this section. The final section concludes and discusses the validation result.

Demographic characteristics of the respondents and descriptive statistics of their responses are analyzed using SPSS.

### 5.1. Basic Analysis of the Sample

Through the questionnaire, we measured respondents' reaction to ETC-related information diffused by each kind of media, including TV, radio, the Internet, email, and discussion with families and friends before and after official operation of ETC on an 11-point Likert scale. The average ratings and difference of the ratings before and after operation of ETC are presented in Table 2. As shown in Table 2, the average ratings for ETC-related information diffused by all communication channels increase after official operation of ETC. However, except for information diffused by TV news reports, TV talk shows, and web forums, all the rating differences before and after operation of ETC do not reach the significance level.

To highlight and enlarge the scales of the difference in each index before and after official operation of ETC, we have to transform each respondent's responses in all channels. 4 points were given to responses that were positive before and after operation of ETC; 3 points were given to responses that turned from negative to positive; 2 points were given to responses that turned from positive to negative; 1 point was given to responses that were negative before and after operation of ETC. After this transformation, the 11 items in Table 2 were defined as questions items for the dimension of "media communication", where Z1~Z6 were items for "traditional media" and Z7~Z10 were items for "the Internet". Besides, Z9~Z11 were defined as items for "word-of-mouth". According to Dean et al.

(2008), Z9~Z10 were classified as items for "online word-of-mouth"[3] and Z11 as an item for "interpersonal word-of-mouth".[4]

Table 2. The evaluation ratings and differences before and after the implemention of ETC policy

| media | | symbol | Average rating before implemention | Average rating after implemention | Changes (after-before) |
|---|---|---|---|---|---|
| Television | Advertisement | Z1 | 6.6 | 6.8 | 0.2 |
| | News reports | Z2 | 6.3 | 6.6 | 0.3** |
| | Talking shows | Z3 | 5.8 | 6.0 | 0.2* |
| Broadcast | Advertisement | Z4 | 6.3 | 6.5 | 0.2 |
| | News reports | Z5 | 6.2 | 6.3 | 0.1 |
| | Talking shows | Z6 | 6.0 | 6.1 | 0.1 |
| Internet | Advertisement | Z7 | 6.2 | 6.3 | 0.1 |
| | News reports | Z8 | 6.0 | 6.2 | 0.2 |
| | Forums | Z9 | 5.8 | 6.1 | 0.3** |
| E-mail | | Z10 | 6.0 | 6.1 | 0.1 |
| Discussion with friends and relatives | | Z11 | 6.4 | 6.5 | 0.1 |
| Total average | | | 6.1 | 6.3 | 0.2 |

Table 3. Socioeconomic characteristics of **the** highway drivers

| Socioeconomic characteristics | | numbers | (%) | Socioeconomic characteristics | | numbers | (%) |
|---|---|---|---|---|---|---|---|
| education | junior high school and under | 1 | 0.7 | Number of car ownership | 0 | 18 | 12.6 |
| | Senior high school | 27 | 18.9 | | 1 | 109 | 71.3 |
| | University | 79 | 55.2 | | 2 | 21 | 13.3 |
| | Graduate school and above | 36 | 25.2 | | 3 | 4 | 2.8 |
| Average income (monthly) | Under 20 thousands | 27 | 18.9 | Using duration of the most used motor | Less than 1 year | 2 | 1.4 |
| | 20 thousands~ 50 thousands | 64 | 44.8 | | 1~5 year | 51 | 35.7 |
| | 50 thousands~100 thousands | 37 | 25.9 | | 6~10 year | 58 | 40.6 |
| | 100 thousands~200 thousands | 9 | 6.3 | | 11~15 year | 19 | 13.3 |
| | 200 thousands~300 thousands | 3 | 2.1 | | 16~20 year | 12 | 8.4 |
| | above 300 thousands | 3 | 2.1 | | Above 20 year | 1 | 0.7 |
| Frequency of driving on highway (weekly) | Less than 1 | 28 | 19.6 | Frequency pass the toll collection station (weekly) | Less than 1 time | 30 | 21 |
| | 1~5 times | 78 | 54.5 | | 1~5 times | 86 | 60.1 |
| | 6~10 times | 23 | 16.1 | | 6~10 times | 16 | 11.2 |
| | 11~20 times | 13 | 9.1 | | 11~20 times | 8 | 5.6 |
| | 21~30 times | 1 | 0.7 | | Above 21 times | 3 | 2.1 |
| age | 18-30 years old | 45 | 30.5 | Driving distance of the most use car (km) | 10000 and under | 18 | 12.6 |
| | 31-40 years old | 55 | 38.5 | | 10001~50000 | 28 | 19.6 |
| | 41-50 years old | 34 | 24.2 | | 50001~100000 | 40 | 28.0 |
| | Above 51years old | 15 | 6.8 | | 100001~150000 | 28 | 19.6 |
| gentle | male | 115 | 80 | | 150001~200000 | 20 | 14 |
| | female | 28 | 20 | | 200001~400000 | 9 | 6.3 |

[3] Dean et al. (2008) propose that online word-of-mouth includes product reviews, discussion boards, chat rooms, blogs, wikis, and other discussions.

[4] We originally use the difference of ratings after and before to represent the evaluation changes in SEM models in next section. But the results are not acceptable. Thus we transform and rescale them by the method introduced in this paragraph. One referee reminds us that this might limit the reliability of the measurement in SEM. But according to Muthén and Muthén (2007), they show that the scale of the independent variables does not affect model estimation in SEM. Therefore, this transformation of variables is acceptable in SEM estimation.

Table 3 shows descriptive statistics of socioeconomic variables. The sample comprises of mainly male drivers (80%). Respondents with a college/university background constitute the largest group (55.2%), and those with a graduate school background constitute the second largest group (25.7%). The majority of the respondents are mid-age males with a college/university background. The average monthly incomes concentrate in the range between $20,000~50,000 (44.8%). Most respondents (54.5%) use the national highways 1~5 times per week. In terms of age, 31~40 is the largest group (38.5%) followed by 18~30 (19.6%). The majority of them own only one light vehicle (71.7%). 40.6% have used their main vehicles for 6~10 years, and 35.7% have used their main vehicles for 1~5 years. In terms of frequency of passing through toll stations, those passing through toll stations 1~5 times per week comprise the largest group (60.1%). In terms of total mileage of the main vehicle, 50,000~100,000km has the largest group of respondents (28%).

Table 4 shows statistics of the reasons why the respondents have not installed an OBU on their vehicles. As shown in Table 4, the majority (36.7%) reported that they seldom need to use it, followed by those who said that an additional cost is required (23.3%). The remaining reasons sorted by the above order are refusing to profit corporate groups; the time difference between manual toll collection and electronic toll collection is small; others; paying is inconvenient; and ETC-related information is unheard-of. The reasons in the "others" choice include the OBU is too expensive; the OBU is not good-looking; slowing down is required when passing through the sensor gate; the sensor may not detect my OBU if I drive too fast; there is no price difference between manual toll collection and electronic toll collection; I have no time to apply for it; and the manual toll collectors will lose their jobs. As shown above, the respondents' reasons for not adopting ETC are widely varying.

Table 4. Reasons for not installing an OBU on the vehicle

| Reasons | Numbers | percentage | Reasons | Numbers | Percentage |
|---|---|---|---|---|---|
| Few usage opportunity | 88 | 36.7 | Others | 21 | 8.8 |
| Additional cost on buying OBU | 56 | 23.3 | Not easy to pay the fee | 17 | 7.1 |
| Don't help FETC to earn money | 34 | 14.2 | Never heard about it | 2 | 0.8 |
| No difference from manual way | 22 | 9.2 | | | |

In addition to reaction to information diffused by media, our research model includes seven other dimensions. The average score for each item is presented in Table 5. As shown in Table 5, "perceived usefulness" has four items, with an average score between 3.4~3.9; "perceived ease of use" has two items, with average scores 3.3 and 3.2, respectively; "attitude" has four items with an average score between 3.1~3.4; "social norm" has only one item, and its average score is 3.4; the three items in "perceived risks" have an average score between 3.0~3.4; the two items in "intention to accept" have an average score of 2.6.

Table 5. Average score for each item

| Aspects | Symbols | Survey questions | Average rating |
|---|---|---|---|
| **Perceived effectiveness** | A1 | Faster passing the toll collection station with the usage of ETC | 3.9 |
| | A2 | Fluently diving on highway with the usage of ETC | 3.7 |
| | A3 | Easier to pay the toll with the usage of ETC | 3.8 |
| | A4 | Faster to arrive the destination or more controllable of driving time on highway with the usage of ETC | 3.4 |
| **Perceived ease to use** | B3 | I think that it's easy to operate the OBU of ETC | 3.3 |
| | B2 | I think that it's easy to store values on ETC's paying card. | 3.2 |
| **Attitudes of public departments** | C1 | I think that the bidding process of ETC held be government is open, fair, and just. | 2.7 |
| | C2 | I think that the attitudes of government on promoting OBU of ETC is proactive | 3.2 |
| | C3 | I think that the attitudes of government on asking FETC to lower the price of OBU is tough | 3.0 |
| | C4 | Overall, I think that the government have tried hard to promote the ETC policy | 3.1 |
| **Attitudes** | D1 | I think that I will like to use ETC | 3.3 |
| | D2 | I think that to use ETC is correct | 3.1 |
| | D3 | I think that touse ETC would be a good experience | 3.4 |
| | D4 | I think that the ETC policy is a good measurement | 3.1 |
| **Social Norm** | Q1 | There are some important persons in my life and most of them think that I have to equip the OBU of ETC | 2.9 |
| **Perceived behavior control** | F3 | I am able to pay the charges related to the OBU of ETC | 3.4 |
| **Perceived risk** | G1 | Overall, I think that to equip the OBU of ETC is some kind of loss (in money or in time) | 3.0 |
| | G2 | Generally speaking, it's risk to offer my personal information to an enterprise is very dangerous | 3.4 |
| | G3 | The usage of ETC system might invade my personal privacy (eq tracking or monitoring on driving) | 3.3 |
| **Acceptance intention** | L1 | I am going to equip and use the ETC system | 2.6 |
| | L2 | I am going to recommend my friends and relatives to equip and use the ETC system | 2.6 |

## 5.2 Reliability and Validity Tests

A. Reliability

In this paper, the model reliability was measured using Cronbach's α. Reliability is a measure of consistency of test results. Higher reliability indicates higher stability and consistency. According to Fornell and Larcker (1981), composite reliability should be above 0.6. Table 6 presents the result of reliability of each dimension. All the dimensions have a Cronbach's α above 0.6, indicating a high reliability of the items and dimensions.

B.Convergent Validity

Convergent validity is to evaluate the factor loading of measurement variables on a latent variable and test that all factor loadings are statistically significant. As shown in Table 6, all factor loadings are above 0.5 and statistically significant. The results comply with the standard suggested by Hair et al., 1998. We further test convergent validity of the aspects using average variance extracted (AVE). AVE is a measure of the amount of variance in a latent variable explained by the measurement variables. Higher AVEs indicate higher convergent validity and discriminant validity of latent variables. Fornell and Larcker (1981) suggest that AVE should be greater than 0.5. As shown in Table 6, AVE is greater than 0.5 in most aspects, indicating that the items and aspects in our scale are developed with convergent validity.

Table 6. The CFA results(Evaluation changes from mass media)

| Aspects | Symbol | coefficients | Standardized coefficients (a) | t-value | AVE | Cronbach Alpha |
|---|---|---|---|---|---|---|
| **Perceived effectiveness** | A1 | 1 | 0.956 | - | 0.6119 | 0.876 |
| | A2 | 0.959 | 0.787 | 12.228** | | |
| | A3 | 0.791 | 0.687 | 9.953** | | |
| | A4 | 0.82 | 0.665 | 8.958** | | |
| **Perceived ease to use** | B3 | 1 | 0.736 | - | 0.5719 | 0.734 |
| | B2 | 0.969 | 0.776 | 6.577** | | |
| **Attitudes of public departments** | C1 | 1 | 0.564 | - | 0.5011 | 0.759 |
| | C2 | 1.244 | 0.734 | 5.778** | | |
| | C3 | 1.371 | 0.804 | 5.5** | | |
| **Attitudes** | D1 | 1 | 0.857 | - | 0.654 | 0.876 |
| | D2 | 0.975 | 0.864 | 14.617** | | |
| | D3 | 0.924 | 0.857 | 15.141** | | |
| | D4 | 0.735 | 0.633 | 9.029** | | |
| **Social Norm** | Q1 | 1 | 1 | - | - | - |
| **Perceived behavioral control** | F3 | 1 | 1 | - | - | - |
| **Perceived risk** | G1 | 1 | 0.51 | - | 0.5236 | 0.746 |
| | G2 | 1.302 | 0.798 | 6.06** | | |
| | G3 | 1.561 | 0.821 | 5.709** | | |
| **Evaluation changes from mass media** | Z4 | 1 | 0.794 | - | 0.5021 | 0.924 |
| | Z3 | 1.269 | 0.821 | 10.507** | | |
| | Z2 | 0.971 | 0.688 | 8.218** | | |
| | Z1 | 0.957 | 0.769 | 9.915** | | |
| | Z5 | 1.013 | 0.783 | 13.762** | | |
| | Z6 | 1.045 | 0.791 | 10.314** | | |
| | Z7 | 0.761 | 0.599 | 7.984** | | |
| | Z8 | 0.733 | 0.548 | 6.5** | | |
| | Z9 | 0.876 | 0.648 | 7.704** | | |
| | Z10 | 0.764 | 0.606 | 7.3** | | |
| **Acceptance intention** | L1 | 1 | 0.861 | - | 0.7775 | 0.893 |
| | L2 | 1.071 | 0.902 | 12.871** | | |

Statements: (a) standardized coefficients is the factor loading of that question. (b)**represents at 95% significant level.

C.Discriminant Validity

Evidence of discriminant validity occurs when square root of the AVE for each variable exceeds the correlation between variables in pair (Fornell and Larcker, 1981). If the correlation between a pair of variables is greater than the AVE for any of the variables, we can infer that the measurement items for one variable may also be used to measure the other (Anderson and Gerbing, 1998). According to Anderson and Gerbing (1998), discriminant validity is confirmed if the minimum AVE among all aspects is greater than the square of the maximum value in the correlation matrix. Table 7 shows the correlation coefficients between aspects. The coefficient between “attitude” and “perceived usefulness” is the largest (0.702). Its square (0.4928) is still smaller than the AVE for media communications (0.501). Therefore, the items were developed with sufficient discriminant validity.

Table 7. Correlation between aspects(with mass media)

| | PATT | RISK | MD | PEOU | PU | PBC | SN | ATT | INT |
|---|---|---|---|---|---|---|---|---|---|
| PATT | **1** | | | | | | | | |
| RISK | 0 | **1** | | | | | | | |
| MD | 0 | 0 | **1** | | | | | | |
| PEOU | 0 | 0 | 0.289 | **1** | | | | | |
| PU | 0 | 0 | 0.207 | 0.364 | **1** | | | | |
| PBC | 0 | -0.133 | 0 | 0 | 0 | **1** | | | |
| SN | 0 | 0 | 0.255 | 0.074 | 0.053 | 0.224 | **1** | | |
| ATT | -0.061 | 0 | 0.355 | 0.309 | 0.588 | 0.233 | 0.458 | **1** | |
| INT | 0.156 | -0.321 | 0.374 | -0.026 | 0.245 | 0.292 | 0.455 | 0.43 | **1** |

Statements: RISK- Perceived risk, MD- Evaluation changes after the dismission of mass media, PEOU- Perceived ease to use, PU-Perceived effectiveness, PBC- Perceived behavioral control, PATT- Attitude of public departments, SN- Social Norm, ATT- Attitudes, INT- Acceptance intention.

The parameters for model calibration and estimation are listed in Table 8. To demonstrate the importance of the proposed model, we also compared the estimation results using Chen et al.'s (2007) model[5]. Some parameters had an insignificant correlation coefficient in the first estimation. These parameters were deleted and optimal results were reserved. In terms of model fit, $x^2/df$ is very small, indicating the fit of the proposed model is favorable. RMSEA is below 0.08, and CFI is higher than 0.9, indicating that the fit of the model to the data is good. However, GFI is only 0.08, which is lower than the optimal value 0.9. The goodness of fit of the model is slightly insufficient. The optimal path estimation results in Table 8 are illustrated in Figure 3. These results will be used for subsequent analysis.

Table 8. Path coefficients of the hypothesized model

| **Hypothesis** | **path** | **Model of Chen et al (2007)** | **Basic model** | **Best model** |
|---|---|---|---|---|
| H1 | ATT → INT | 0.22** | 0.145(1.128) | 0.326(3.749)** |
| H2 | PBC → INT | 0.36** | 0.137(2.109)** | 0.133(2.421)** |
| H3 | PU → ATT | 0.58** | 0.526(6.097)** | 0.891(8.711)** |
| H4 | PEOU → ATT | 0.38** | 0.061(0.589) | |
| H5 | PU → INT | 0.120 | 0.181(1.58) | |
| H6 | PEOU → PU | 0.61** | 0.38(2.908)** | 0.511(4.406)** |
| H7 | SN → INT | 0.23** | 0.243(3.218)** | 0.209(3.089)** |
| H8 | MD → PU | | 0.105(1.106) | |
| H9 | MD → PEOU | | 0.237(2.53)** | 0.345(4.051)** |
| H10 | MD → ATT | | 0.221(2.48)** | 0.237(3.379)** |
| H11 | MD → SN | | 0.298(2.974)** | 0.29(3.078)** |
| H12 | MD → INT | | 0.208(2.123)** | 0.243(3.078)** |
| H13 | PATT → ATT | | -0.083(-0.679) | |
| H14 | PATT → INT | | 0.228(1.72) | |
| H15 | RISK → INT | | -0.488(-3.418)** | -0.339(-2.564)** |
| Goodness of fit | $x^2/df$ | 2.510 | 1.464 | 1.152 |
| | RMSEA | 0.077 | 0.057 | 0.033 |
| | CFI | 0.970 | 0.944 | 0.985 |
| | GFI | 0.880 | 0.823 | 0.877 |

Statements: values in parentheses are t-values; **represents at 95% significant level; df=degree of freedom.

One of the differences between the model of Chen et al.(2007) and ours lies in the inclusion of changes in media comments on ETC in our model. We will first discuss the effect of this dimension on highway drivers' intention to accept ECT. Changes in media comments on ETC (from negative to positive) have a significant and positive influence on highway drivers' intention to accept ETC (H12), indicating that if ETC-related reports and information

[5] As for the estimated results of Chen et al. (2007) in Table 8, we use our data to re-estimate their model for the possibility of comparison.

diffused on media can positively affect highway drivers' impression of the ETC policy, road users will have a higher intention to accept ETC. Besides, changes in media comments on ETC (from negative to positive) also increase the perceived ease of use of ETC (H9) and the social norm toward ETC (H11), which indirectly influences highway drivers' intention to adopt ETC. Media comments on ETC can indirectly affect road users through three paths. First, media comments affect perceived ease of use, and with the increase of perceived ease of use, perceived usefulness will increase. Perceived ease of use and perceived usefulness of ETC affect highway drivers' attitude toward ETC and finally influence their intention to accept it (H9×H6×H3×H1). Second, media comments affect highway drivers' intention to accept ETC through attitude (H10×H1). Third, media comments affect highway drivers' intention to accept ETC through social norms (H11×H7). From the above discussion, we can infer that increase of positive media comments on ETC can directly and indirectly influence highway drivers' intention to adopt ETC.

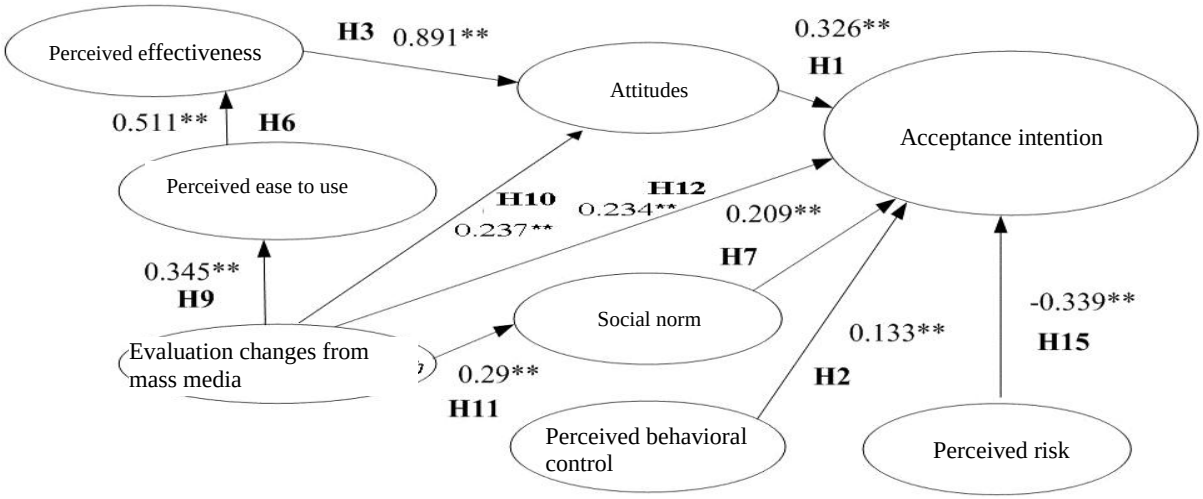


Figure 3. Estimated results with the effect of evaluation changes from mass media

The other difference between Chen et al.(2007) and our model is our consideration of the effect of social norm on intention of ETC adoption. The estimation result suggests that road users have a significantly higher intention to adopt ETC if people important to them consider using ETC as necessary (H7). Besides, in the aspect of perceived behavioral control, we also discovered a significant correlation between perceived behavioral control and intention of ETC adoption. In other words, road users have more intention to use ETC if they can better understand regulations for and instructions of using ETC. In the aspect of perceived risks, a negative relationship between perceived risks and intention of ETC adoption (H15) was found. This relationship suggests that road users have lower intention to accept ETC if they perceive a higher risk of using it.

In a comparison of Figure 2 and Figure 3, we can find the path between changes in media comments (H8), the path between perceived ease of use and attitude (H4), the path between perceived usefulness and intention to adopt ETC (H5), the path between attitude of public departments and highway drivers' attitude toward ETC (H13), and the path between attitude of public departments and intention to adopt ETC (H14) are absent in Figure 3. To our surprise, the effect of the attitude of public departments on highway drivers' intention to accept ETC is not significant. This is probably a result of the government's inability to react to demand of the general public that ETC-related costs should be reduced. However, this inference should be further validated. Besides, the relationship between changes in media comments and perceived usefulness of ETC is not significant. A plausible explanation is that road users have the impression that they also need to slow down when passing through ETC lanes. Such impression is the reason why perceived usefulness of ETC does not

significantly influence highway drivers' intention to adopt ETC. This is another point that makes this paper distinct from Chen et al (2007).

In the following section, we will further analyze and discuss the effects of changes in word-of-mouth comments on non-adopters after official operation of ETC. The change in media comments in Figure 2 is first changed into the change in word-of-mouth comments for subsequent model estimation. The estimation result is presented in Table 9, Table 10, and Table 11.

Table 9. The CFA results(Evaluation changes from word-of-mouth)

| Aspects | Symbol | coefficients | Standardized coefficients (a) | t-value | AVE | Cronbach Alpha |
|---|---|---|---|---|---|---|
| **Perceived effectiveness** | A1 | 1 | 0.929 | - | 0.6398 | 0.876 |
| | A2 | 0.986 | 0.808 | 12.605** | | |
| | A3 | 0.883 | 0.754 | 11.469** | | |
| | A4 | 0.859 | 0.689 | 9.622** | | |
| **Attitudes of public departments** | C1 | 1 | 0.65 | - | 0.5148 | 0.759 |
| | C2 | 1.038 | 0.748 | 6.769** | | |
| | C3 | 1.077 | 0.75 | 6.845** | | |
| **Perceived ease to use** | B3 | 1 | 0.777 | - | 0.5999 | 0.734 |
| | B2 | 0.944 | 0.772 | 6.041** | | |
| **Attitudes** | D1 | 1 | 0.881 | - | 0.7031 | 0.876 |
| | D2 | 0.96 | 0.882 | 14.386** | | |
| | D3 | 0.935 | 0.886 | 14.897** | | |
| | D4 | 0.755 | 0.688 | 9.479** | | |
| **Social Norm** | Q1 | 1 | 1 | - | - | - |
| **Perceived behavioral control** | F3 | 1 | 1 | - | - | - |
| **Perceived risk** | G1 | 1 | 0.53 | - | 0.5209 | 0.746 |
| | G2 | 1.388 | 0.79 | 5.84** | | |
| | G3 | 1.572 | 0.811 | 5.869** | | |
| **Evaluation changes of word-of-mouth** | Z11 | 1.204 | 0.783 | 7.307** | 0.5878 | 0.793 |
| | Z10 | 1.1 | 0.822 | 8.062** | | |
| | Z9 | 1 | 0.689 | - | | |
| **Acceptance intention** | L1 | 1 | 0.89 | - | 0.8714 | 0.893 |
| | L2 | 1.12 | 0.975 | 11.569** | | |

Statements: (a) standardized coefficients is the factor loading of that question. (b)**represents at 95% significant level.

Table 10. Correlation between aspects (with word-of-mouth)

| | RISK | WOM | PEOU | PU | PBC | SN | ATT | INT |
|---|---|---|---|---|---|---|---|---|
| RISK | **1** | | | | | | | |
| WOM | 0 | **1** | | | | | | |
| PEOU | 0 | 0.31 | **1** | | | | | |
| PU | 0 | 0.191 | 0.425 | **1** | | | | |
| PBC | 0 | 0 | 0 | 0 | **1** | | | |
| SN | 0 | 0.274 | 0.452 | 0.504 | 0.217 | **1** | | |
| ATT | 0 | 0.247 | 0.53 | 0.734 | 0.145 | 0.628 | **1** | |
| INT | -0.386 | 0.483 | 0.35 | 0.407 | 0.217 | 0.506 | 0.509 | **1** |

Statements: RISK- Perceived risk, WOM-evaluation changes from word-of-mouth, PEOU- Perceived ease to use, PU-Perceived effectiveness, PBC- Perceived behavioral control, PATT- Attitude of public departments, SN- Social Norm, ATT- Attitudes, INT- Acceptance intention.

Results in Table 9 and Table 10 also indicate a good level of validity and reliability of the model. All the indicators are at the required significance level. Where we have to emphasize here is the estimated coefficients of indicators in word-of-mouth aspect. The

coefficients of the former two indicators are much higher than the one of the third indicator which represents the face to face communication. Thus the power from online word-of-mouth should be higher than the face to face one.

Correlations significant in Table 8 are also found significant in Table 11.Therefore, the final model calibration was performed using the simplest model. As shown in Table 11, all the indexes are good, except GIF whish is slightly lower than 0.9. The coefficients of significant paths are consistent across both Table 8 and Table 11. Thus, we only discuss the effect of changes in word-of-mouth comments on non-adopters' acceptance of ETC.

According to Table 11, evaluation changes in word-of-mouth comments (from negative to positive) have positive influence on highway drivers' intention to accept ETC (H12). This finding reveals that if ETC-related reports and feedbacks diffused by word-of-mouth can positively affect highway drivers' impression of the ETC policy, road users will have a higher intention to accept ETC. Besides, changes in word-of-mouth comments on ETC (from negative to positive) also increase the perceived ease of use of ETC (H9) and the social norm toward ETC (H11), which indirectly influences highway drivers' intention to adopt ETC. Word-of-mouth comments on ETC can indirectly affect highway drivers' intention to accept ETC through three paths. First, word-of-mouth comments affect perceived ease of use, and with the increase of perceived ease of use, perceived usefulness will be increased. Both perceived ease of use and perceived usefulness of ETC affect highway drivers' attitude toward ETC and finally influence their intention to accept it (H9×H6×H3×H1). Second, through perceived ease of use, word-of-mouth comments affect attitude and attitude further affects intention to accept ETC (H9×H4×H1). Third, word-of-mouth comments affect highway drivers' intention to accept ETC through social norms (H11×H7). From the above discussion, we can infer that increase of positive word-of-mouth about ETC can directly and indirectly influence highway drivers' intention to adopt ETC. The estimation result is illustrated in Figure 4.

Table 11. Path coefficients of the hypothesized model incorporated with evaluation changes in word-of-mouth on ETC

| Hypothesis | path | Model of Chen et al (2007) | Basic model | Best model |
|---|---|---|---|---|
| H1 | ATT → INT | 0.22** | 0.214(1.718)** | 0.275(2.935)** |
| H2 | PBC → INT | 0.36** | 0.139(2.228)** | 0.145(2.215)** |
| H3 | PU → ATT | 0.58** | 0.703(7.339)** | 0.742(7.581)** |
| H4 | PEOU → ATT | 0.38** | 0.307(2.845)** | 0.252(2.302)** |
| H5 | PU → INT | 0.12 | 0.089(0.722) | |
| H6 | PEOU → PU | 0.61** | 0.432(3.454)** | 0.528(4.23)** |
| H7 | SN → INT | 0.23** | 0.182(2.323)** | 0.167(2.105)** |
| H8 | MOU → PU | | 0.065(0.665) | |
| H9 | MOU → PEOU | | 0.288(2.814)** | 0.21(2.272)** |
| H10 | MOU → ATT | | 0.058(0.688) | |
| H11 | MOU → SN | | 0.342(2.943)** | 0.284(2.656)** |
| H12 | MOU → INT | | 0.404(4.333)** | 0.39(4.17)** |
| H13 | PATT → ATT | | 0.069(0.619) | |
| H14 | PATT → INT | | 0.18(1.738) | |
| H15 | RISK → INT | | -0.655(-3.888)** | -0.532(-3.243)** |
| Goodness of fit | $x^2/df$ | 2.510 | 1.007 | 1.047 |
| | RMSEA | 0.077 | 0.007 | 0.018 |
| | CFI | 0.970 | 0.999 | 0.996 |
| | GFI | 0.880 | 0.917 | 0.909 |

Statements: values in parentheses are t-values; **represents at 95% significant level; df=degree of freedom.

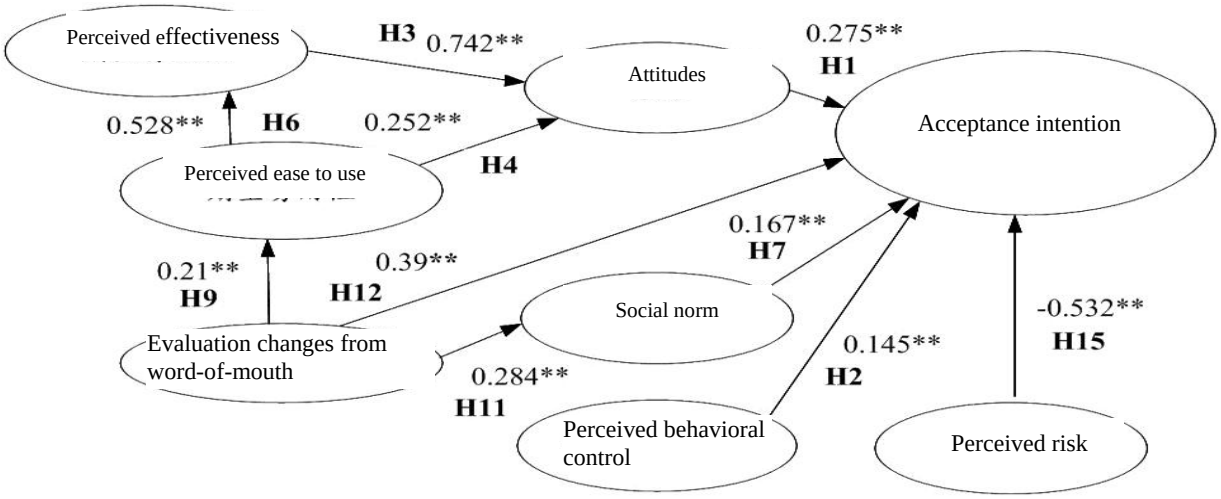


Figure 4. Estimated results with the effect of evaluation changes from word-of-mouth

Finally, based on the above estimation results, we discuss the factors affecting diffusion of innovations proposed by Rogers (2003). Rogers (2003) proposes that media are more influential before official release of an innovation, and interpersonal word-of-mouth become more influential than media after official release of an innovation. To discuss this argument, we compare the effects of "changes in media comments" and "changes in word-of-mouth comments" on highway drivers' intention to accept ETC. Their direct and indirect effects are listed in Table 12.

Table 12. Direct and indirect effects of evaluation changes from media and word-of-mouth on acceptance intention of ETC adoption

| Effects | channel | parameters | media | Word-of-mouth |
|---|---|---|---|---|
| Direct | MD(WOM)→INT | H12 | 0.361 | 0.462 |
| Indirect(1) | MD(WOM)→ PEOU →PU→ ATT → INT | H9×H6×H3×H1 | 0.02829 | 0.04448 |
| Indirect (2.1) | MD(WOM)→ ATT → INT | H10×H1 | 0.03849 | -- |
| Indirect (2.2) | MD(WOM)→ PEOU → ATT → INT | H9×H4×H1 | -- | 0.03821 |
| Indirect (3) | MD(WOM)→SN→ INT | H11×H7 | 0.05129 | 0.07260 |
| total | | | 0.47907 | 0.61729 |

As shown in Table 12, whether in terms of direct effects or indirect effects, changes in media comments on ETC are less influential to highway drivers' intention to accept ETC than changes in word-of-mouth comments. In terms of total effects, changes in word-of-mouth comments are significantly more influential to highway drivers' intention to accept ETC. Thus, the result here could be referred that the online word-of-mouth might have deep influences on the acceptance intention of highway drivers in Taiwan.

## 6. Conclusions and Suggestions

In this paper, we extended Chen et al.'s (2007) model by including two dimensions, namely changes in media comments and changes in word-of-mouth comments to investigate the information diffusion effects of the two main types of communication channels on highway drivers' impression and acceptance of ETC. Our empirical findings indicate that changes in media comments and word-of-mouth comments will directly affect highway drivers' intention to accept ETC, and increase of positive comments diffused on the two communications channels can induce highway drivers' intention to accept ETC. Besides, changes in media comments and word-of-mouth comments can also indirectly

affect highway drivers' intention to accept ETC through perceived ease of use and social norm. In other words, if promoters of an innovation can change the comments about the innovation diffused by media or word-of-mouth, they can directly and indirectly influence potential users' intention to accept the innovation.

Attitude and social norm have direct effects on highway drivers' intention to accept ETC. Perceived ease of use of ETC affects perceived usefulness of ETC, which further affects highway drivers' attitude toward ETC and intention to adopt ETC. In the model of changes in word-of-mouth comments, perceived ease of use also indirectly affects highway drivers' intention to accept ETC through attitude. However, this correlation path is absent in the model of changes in media comments. Besides, higher perceived behavioral control can lead to higher intention to accept ETC. The estimation result also supports Rogers' (2003) theory about diffusion of innovations: word-of-mouth is more influential to media after official release of an innovation.

Our results confirm that integrating TAM, TPB, media and word-of-mouth to forecast highway drivers' intention to accept ETC is suitable. This integration provides more complete explanations and also helps us understand the importance of changes in media and word-of-mouth comments for government departments to promote new policies. As suggested by our empirical findings, if the government can simultaneously influence the media and word-of-mouth to increase more positive comments about a new policy, it can significantly enhance people's intention to accept the policy and likelihood of its success.

Empirical findings also indicate that the relationship between attitude of public departments and intention to accept ETC is not significant. H12 and H13 are not supported. A plausible explanation is that respondents did not have a clear understanding of the ETC program and its propaganda, so that they were not significantly affected by the attitude of public departments. Besides, the effect of perceived risks on intention to accept ETC is significantly negative, indicating that the road users are less likely to accept ETC if they perceive a high level of risks of using ETC. Although public departments' attitude is not directly influential to highway drivers' attitude and intention to accept ETC, there are still actions that public departments can take to promote ETC. As empirically validated, changes in media or word-of-mouth comments on ETC can significantly enhance highway drivers' intention to accept ETC. If government departments make use of various media to convey more positive information about ETC, they can enhance highway drivers' impression about this policy and intention to accept and use ETC. If all ETC-related policies can be developed as expected, all related industries can be benefited. Therefore, government departments should make a good use of media in the promotion of new policies.

Since the mutual influences between the changes in media and in word-of-mouth are not estimated together in SEM model, the mutual effects of these two variables were not taken into account in this study. It shall be noted that this point could be considered in the future research.

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