

# Adopting the Food Traceability System in Vietnamese Agriculture and its Effects on Customer Behaviors

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**Abstract:** Vietnam has various advantages in agricultural production. Many Vietnamese agricultural products are not only sold in the domestic market, but are also exported to other countries. Despite the quality taste, most Vietnamese products are suffering from low prices. Moreover, Vietnam also has difficulty in looking for external markets, because of the setbacks from a series of food-related mishaps, and the struggle to meet stringent requirements of potential markets. To deal with this, the Food Traceability System (FTS) has been introduced in Vietnam. However, the effect is not noticeable as expected. The main purpose of this study is to determine the impacts of reducing uncertainty on the attitude and perception of customers toward the FTS, and to provide implications about the adoption in the Vietnamese agriculture. This study fulfills these objectives by applying the modified model of Pavlou et al. (2007) on data obtained through a survey questionnaire of Vietnamese consumers. The findings of the study showed that the reduced uncertainty leads to an increased level of purchase intention and customer loyalty. Furthermore, the study also found that Vietnamese customers are willing to buy more traceable products and are eager to repeat their purchase, but with the condition of reasonable prices. Finally, the present study suggested that a web-based system should be created to facilitate principal-agent relationship and provide consumers with credible detailed information.

**Keywords:** Food Traceability System, Vietnamese agro-products, purchase intention, price premium, loyalty.

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## 1. INTRODUCTION

### 1.1 Background of the Food Traceability System and Vietnamese agricultural system:

The Food Traceability System (henceforth the FTS) is defined as a system collecting, compiling, maintaining and applying the food-related information to provide all participants of the food chain with the assurance of the origin, location and life history of a product and support in management in case of safety and quality incidents (Opara, 2003). The relevant information in this system is stored in a web-based format and can be extracted anytime via Internet by all participants including the end users (Choe, Park, Chung, & Moon, 2009).

The FTS brings many advantages to the food management system. For example, this system increases the transparency of the supply chain by using demonstrable records and labeling, and enhances the value of the overall quality management system with the ability to identify, verify and separate sources of products that do not meet mandatory standards and consumer requirements (Opara, 2003). Consequently, consumers gain a greater control over the food they eat, and feel secure about the food safety and quality.

Vietnam is endowed with numerous natural advantages for agricultural production, a variety of agro-products not only satisfy domestic consumption but are also exported to international markets. Many of Vietnamese agricultural exported products are ranked top of the world. In 2013 the total turnover of all agricultural exports reached US\$19.853 billion, contributing more than 20% to the GDP. Labor in agriculture, forestry and fisheries sectors made up 47.4% of the whole

population. The two most well-known exported products of Vietnamese agriculture worldwide are rice and coffee (VIETRADE, 2013). Despite the quality taste, most Vietnamese agro-products suffer from low prices. Vietnam is completely relying on the world markets on account of price uncertainties, and thus it is self-evident that Vietnamese agro-product prices are commonly lower than the world average prices (Huong, 2014).

Until now, as much as the government have been enacting several policies to encourage the FTS's development, the FTS has still not been widely adopted in Vietnam. In recent years, new electronic traceability technologies, such as barcodes and radio-frequency identification (RFID), have been introduced to replace inefficient paper-based traceability methods. Having many advantages over barcodes, RFID system became one of the best selection of Vietnamese traceability system. Nonetheless, the greatest barriers to widely implement RFID-enabled system in Vietnam are the high initial cost and maintenance fees. As a result, until now many producers are not willing to implement the RFID-enabled system and it is more difficult than expected to employ this system with low-price products like fruit, vegetables and milk.

### **1.2 Research motivation and objectives:**

Since the FTS has been employed over a few decades in many countries, it is likely that this system has brought quite a few advantages. Aside from that, the next question will then be to what extent this system affects producers and customers. Pavlou, Huigang, and Yajiong (2007) demonstrated that customers are more than willing to buy products managed by the FTS. Also, Choe et al. (2009) suggested that producers can build customer's trust by meeting the international qualification assessment standards through the adoption of the FTS.

In Vietnam, on the other hand, it may not be the case. One reason is that the technology barriers result in producer's struggles to meet international qualification assessment standards and to enter strict yet potential markets. Another reason is that a series of food-related mishaps, such as H5N1 bird flu disease, blue-ear pig disease, soybean sauce with an excess of 3-MCPD, vegetables and fruits with an excess of plantation pesticides and other medicals, have led to a massive loss of customer faith in the quality and safety of the products. After a series of problems, the customers have gradually become more concerned about the safety as well as the quality of the food they consume, increasing the fears of seller opportunism. On the other hand, producers suffer from low prices, have difficulty in selling their products and regaining customer trust. What is worse, it is less likely that customers have an easy access to the benefits of the FTS considering that many of them are said to have a few chances to use high-tech devices to extract relevant information.

Different from the previous studies, the current study aims to investigate the effects of the FTS on customer behavior in Vietnam. In particular, the study puts the emphasis on three main areas, namely the willingness of customers to purchase FTS-labeled products, their inclination to pay more for the traceable products, and their loyalty to the products. To untangle the complexities, the model of Pavlou et al. (2007) is used to examine the interactions between the FTS and customer behavior. The findings of this study might provide several helpful implications to adopt the FTS in Vietnamese agriculture.

Specific objectives of the current study are: to determine the influence of reduced uncertainty on customer behavior in terms of purchase intention, price premium and loyalty; to identify mitigators affecting the perceived uncertainty and to provide some implications about the adoption of the FTS in Vietnamese agriculture.

## **2. LITERATURE REVIEW**

This section presents several theories and models applied in research relevant to the FTS, namely the Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM) and the model of Pavlou et al. (2007) with the principal-agent perspective. Among them, the model designed by Pavlou et al. (2007) integrated with the principal-agent perspective is chosen as the most appropriate model to fulfill the research objectives of the present study.

### **2.1 The Theory of Planned Behavior:**

The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action (Ajzen, 1991). Ajzen (1991) postulated that the behavior of a person is determined by his intention to perform that behavior, also the person's behavioral intention depends on his attitude toward the behavior and subjective norms ( $BI = A + SN$ ). This is to say, the best predictor of behavior is intention. In psychology, the TPB is a theory linking beliefs and behavior, which suggests that a particular behavior can be predicted by the person's intention to perform that behavior (Ajzen, 1991). Based on the TPB, behavior is guided by the evaluation of the behavior (attitudes toward the behavior), perceived social pressure (subjective norms) and perceived ability to perform the behavior (perceived behavioral control, PBC).

Menozzi, Halawany-Darson, Mora, and Giraud (2015) stated the importance of traceability system in management of food processing. They proposed a model related to technology acceptance in the area of Management Information System (MIS), Theory of Planned Behavior (TPB) to explain the intention toward purchasing traceable food. The TPB has evidenced to be a successful analysis method for eating behavior regarding health-related actions (Lobb, Mazzocchi, & Traill, 2007). Since the FTS is linked to product quality along with perceptions of food safety, and health (Vab Rijswijk, Frewer, Menozzio, & Faioli, 2008), the theory was adopted to predict purchase intention.

Menozzi et al. (2015) first adopted the original TPB model using attitudes, subjective norms and perceived behavioral control to examine the intention toward a behavior. Next, the model was extended by including other variables (i.e. habits, trust, past behavior and socio-demographic variables) as predictors of the purchase intention, as displayed in Figure 1.

However, this study still had a limitation on actual behavior, for example traceable food purchase is not introduced. Although intentions may play important roles in actual behavior, further research suggested to investigate traceable food purchase behavior via in-store observations. Another limitation is that emotional variables such as threat, fear, mood and negative or positive feeling were also overlooked in TPB (Menozzi et al., 2015).

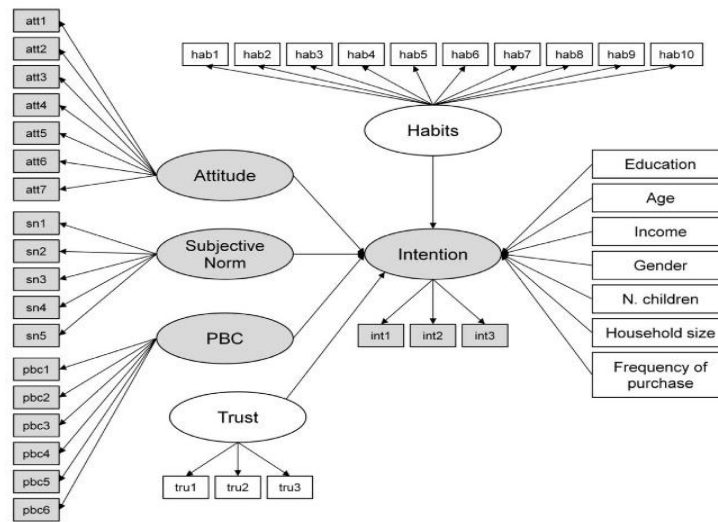


Figure 1: The model structure based on the Theory of Planned Behavior

2.2 Technology Acceptance Model:

Technology Acceptance Model (TAM) is also an extension from Ajzen and Fishbein’s (1975) Theory of Reasoned Action (TRA), suggesting that people’s acceptance of a technology is determined by perceived usefulness (PU) and perceived ease of use (PEOU). The original model comprises perceived usefulness (PU), perceived ease of use (PEOU), attitude (ATT), and intention to use (ITU) (Tsai, Hong, Yeh, & Wu, 2014). TAM and its extended forms are expected to become effective models to predict people’s acceptance of information system (IS) and test the factors in forming consumers’ attitude and intention to use toward the acceptance of the FTS.

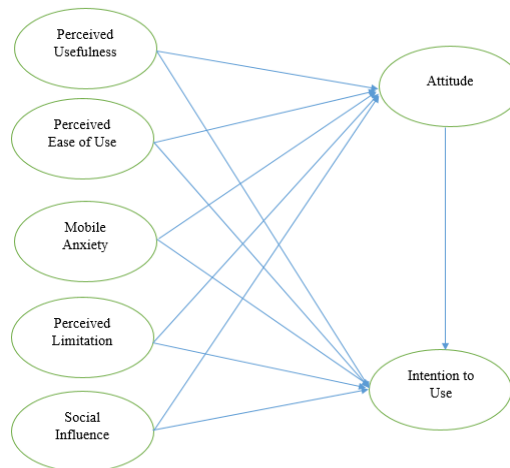


Figure 2: The proposed consumer’s acceptance model for Taiwan Agriculture and Food Traceability Model

Tsai et al. (2014) adopted TAM model to study consumer’s acceptance of traceability. The core constructs of perceived usefulness, perceived ease to use, attitude and intention to use in TAM was modified by adding three constructs of mobile anxiety (MA), social influence (SI) and perceived limitations (PL), as demonstrated in Figure 2.

Nevertheless, Chuttur (2009) indicated the limitation of TAM model that intention may not result in the actual behavior. This may be attributed to the idea that uncertainties and other factors could arise during the time gap between intention and actual behavior, and influence a person’s decision to adopt a technology. For instance, a person can recognize and even accept that PU or attitudes are favorable criteria for deciding to act, but have no desire to act and even obviously decide not to take actions.

**2.3 The model of Pavlou et al. (2007) with the principal-agent perspective:**

The principal-agent perspective is a diverse theory which has been applied to various relationships. However, the current study is only on the principal-agent perspective in buyer-seller relationship, which is closely related to the FTS. In this relationship, the buyers (i.e. principals) delegate authority to sellers (i.e. agents). The agents are supposed to deliver a promised product in a timely manner to the principals (Pavlou et al., 2007). What is more, the both parties are motivated by their self-interest in goal incongruence; nevertheless, the principals cannot perfectly monitor all actions or performances of the agents.

Hidden information and hidden actions constantly exist in this kind of relationship. Hidden information occurs when the agents pre-contractually hide the characteristics of their own (i.e. seller quality uncertainty) and their product quality (i.e. product quality uncertainty) to reap unfair profits (Hoffman, Novak, & Peralta, 1999). Even if the principals overcome this problem by selecting high-quality sellers, they may face hidden actions since the agents are likely to post-contractually ignore the quality of themselves. Having said that, hidden actions post-contractually arise when the principals delegated responsibility to agents who may deceive them (i.e. seller quality uncertainty) by mitigating the promised product quality (i.e. product quality uncertainty) (Pavlou et al., 2007).

In summary, there are two kinds of agents (sellers): high-quality and low-quality ones. On one hand, high-quality agents frequently provide the principals with high quality products in a timely fashion. On the other hand, low-quality agents tend to purposefully misrepresent their own characteristics and tamper with their product quality to confuse the principals (George, 2002).

In brevity, the principal-agent perspective is regarded as a useful method to understand and reduce perceived uncertainty in mutual relationship. First, the uncertainty sources can be detected through the definitions of hidden information and hidden action. Second, the assumptions of information asymmetry and fears of opportunism are appropriate to buyer-seller relationships. Third, the principal-agent perspective suggests certain solutions to the concern of uncertainty. Finally, the perceived uncertainty could be possibly downplayed by properly using information system (Pavlou et al., 2007).

Moreover, two integral sources causing perceived uncertainty in buyer-seller relationships are located. First, perceived information asymmetry arises from the separation of time and space among buyers and sellers (Pavlou et al., 2007). Second, the fears of seller opportunism results from the goal incongruence and temporal separation between payment and shipping.

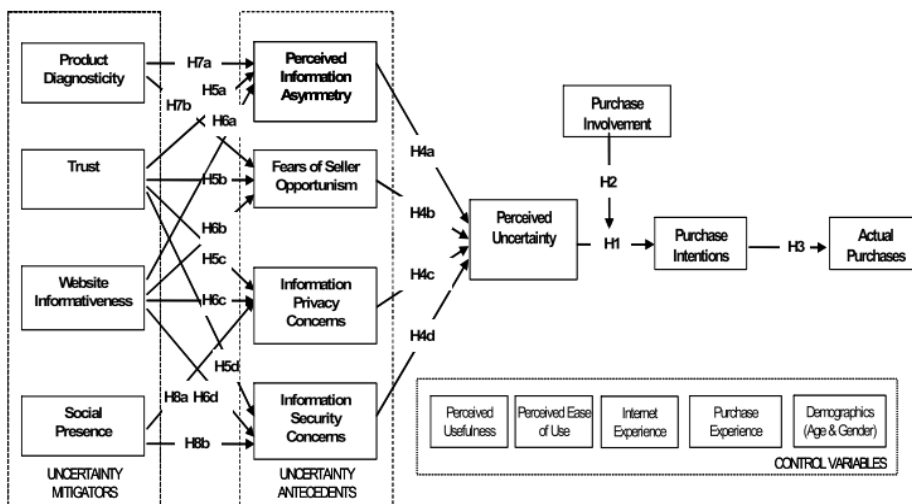


Figure 3: The research model of Pavlou et al. (2007)

Figure 3 shows the model of Pavlou et al. (2007) with the integration of the principal-agent perspective. Pavlou et al. (2007) designed this model to better understand the nature of uncertainty and decrease the level of its potential effects on B2C e-commerce adoption.

Peupert and Theuvsen (2003) indicated that the traceability system relies on the storage and transfer of detailed and credible information via the Internet throughout the food chain, thus the problems are related to tracking and tracing. Given that the principal cannot monitor all actions of the agent, this system needs to be designed to defend against the perceived uncertainties of information asymmetry and fears of seller opportunism. While the Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM) described above explain the customer behavior associated with the FTS, both of which do not ascertain the sources of perceived uncertainties and propose a solution, and thus they are not considered as optimal models. The model of Pavlou et al. (2007) with principal-agent perspective not only evaluates effects of the FTS on customer behavior in terms of purchase intention, but also identifies the uncertainty stemming from information asymmetry and fears of seller opportunism. What is more, this model also shed the light on perceived uncertainty by introducing mitigators such as product diagnosticity, informativeness, trust and social presence (Pavlou et al., 2007). To sum up, the model of Pavlou et al. (2007) is indeed the best choice to fulfill our research objectives.

### 3. DATA AND METHODOLOGY

#### 3.1 Research model:

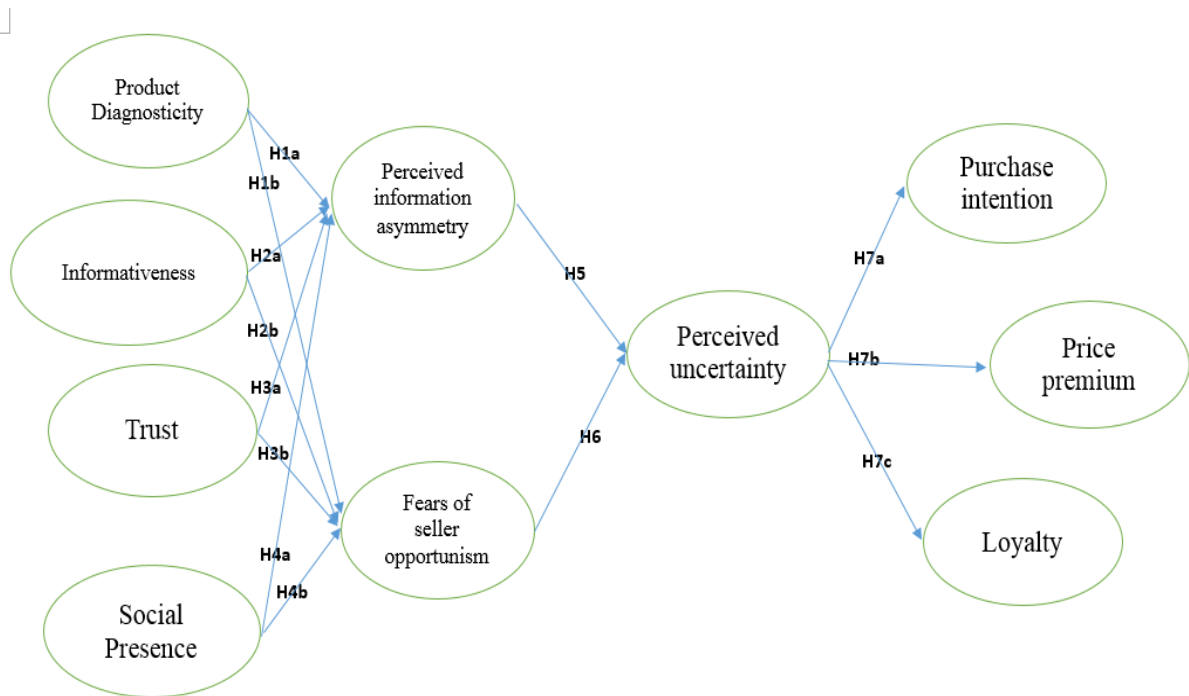


Figure 4: Research model and hypothesized relationship

Figure 4 shows the research model and hypotheses of the current study. The model we have utilized is modified from the original model of Pavlou et al. (2007) in order to detect perceived uncertainties and mitigate them in B2C ecommerce. Different from the original model of Pavlou (2007), two uncertainty antecedent, namely information privacy concerns and information security concerns, are overlooked for the modified model given that the FTS does not require user identity (Choe et al., 2009). In addition to that, price premium and loyalty are included as customer behavior since the current study aims to investigate diverse effects of the FTS on customer behavior, not only in terms of purchase intention.

Price premium is considered as an important criterion to evaluate the effects of the FTS on customer behavior, since what customers concern is not only a product quality but also its price. Obviously, rising prices when adopting the FTS is inevitable on account of its high implement costs and maintenance fees. Loyalty also plays a vital part in examining customer behavior towards the FTS. Until now customer loyalty has commonly been seen as a compulsory goal in marketing strategies due to its long-term benefits.

### **3.2 Research variables and hypothesis development:**

#### **3.2.1 Product diagnosticity:**

Product diagnosticity is defined as the extent to which this system is believed to be helpful to evaluate a product quality and performance (Kempf & Smith, 1998). By providing a real feel and appropriate assessment of product's properties, sellers can convey the information associated to the true quality of the products. Product diagnosticity helps to overcome barriers due to lack of production inspection, thereby enabling customers to accurately evaluate a product quality. Product diagnosticity compels a seller to provide a buyer with more relevant information, thus mitigating the selection of low quality or incorrect products and reducing product-related information asymmetry (Kempf & Smith, 1998). Being provided relevant information, the buyers have more confidence in making purchasing decisions, and thus reduce the fears of the seller opportunism. The two hypotheses related to product diagnosticity are proposed:

**H1a: Product diagnosticity mitigates a buyer's perceived information asymmetry**

**H1b: Product diagnosticity mitigates a buyer's fears of seller opportunism**

#### **3.2.2 Informativeness:**

In the FTS, informativeness is defined as the extent to which the information the buyers received is believed to be helpful (Luo, 2002). The information provided for consumers can be anything valuable to them, such as inputs, origin, used medicals, processing system, among others. When the sellers provide the buyers with more product-related information, the information asymmetry will be mitigated. The more useful and reliable information is, the more confidence the consumers have to make wise shopping decisions. When the buyers receive useful and credible information from the sellers, they feel more comfortable predicting that the sellers will not act opportunistically, and thus reducing the fears of seller opportunism. In this sense, two hypotheses about informativeness of the FTS are developed:

**H2a: Informativeness mitigates a buyer's perceived information asymmetry**

**H2b: Informativeness mitigates a buyer's fears of seller opportunism**

#### **3.2.3 Trust:**

Trust is defined as the buyer's intention to accept the vulnerability of transactions derived from the belief that the sellers will meet their expectations (Pavlou & Gefen, 2004). When the buyers have difficulty in making wise shopping decisions due to information deficiency, they need other approaches and trust is regarded as a substitution. Trust facilitates information asymmetry by making buyers simply accept relevant information derived from the signals of reliable sellers. Repeated sales, price premium and third-party institutional guarantees are outstanding incentives to prevent the sellers from acting opportunistically. As a result of these incentives, high quality sellers are attracted by long-term profits and hardly ever ruin their reputation and profits by opportunistic behavior. Comprehending this factor, buyers are more likely to trust these high-quality sellers and accept vulnerability when purchasing their products. In contrast, low-quality sellers will acquire less buyer's trust due to the doubts that they will act opportunistically. Therefore, there are two proposed hypotheses associated with trust:

**H3a: Trust mitigates a buyer's perceived information asymmetry**

**H3b: Trust mitigates a buyer's fears of seller opportunism**

#### **3.2.4 Social presence:**

Social presence is defined as the extent to which the buyers perceive that the online environments effectively convey the presence of sellers (Rice, 1993). Contrary to the category of informativeness where the customers only receive information, in this environment they are able to interact with each other, exchange information, give and receive a feedback about the products they consume, thereby helping other customers to make wiser purchase decisions. In addition, there are virtual advisors and technical support engineers who can help customers resolve their problems when using traceable products. If customers feel like they are involved in a traditional (face-to-face) transaction where they can explore, experience and enjoy products, receive helpful consultants, they obviously will believe that the sellers behave in a right manner without opportunism. In addition, the sellers can hardly act opportunistically given that the buyers easily give a feedback to remind others if unsuccessful transactions occur, and thus mitigating the fears of seller's opportunism (Pavlou et al., 2007). Apparently, social presence brings the buyers sufficient related information, thereby reducing information asymmetry. In this sense, two hypotheses proposed are:

**H4a: Social presence mitigates a buyer's perceived information asymmetry**

**H4b: Social presence mitigates a buyer's fears of seller opportunism**

**3.2.5 Information asymmetry:**

Information asymmetry is defined as the difference of quantity and quality of the information distributed to buyers and sellers (Mishra, Heide, & Cort, 1998). Information asymmetry has been viewed as a common problem in buyer-seller relationship which gives advantage to the sellers. Facing information asymmetry, the buyers have difficulty in distinguishing high-quality and low-quality sellers since low-quality sellers try to hide true characteristics of their product to reap unfair profits, while high-quality sellers are not able to completely convey the signals of their true quality to the buyers. The higher the degree of information asymmetry is, the higher perceived uncertainty of the transaction is. Therefore, the hypothesis proposed is:

**H5: Information asymmetry increases a buyer's perceived uncertainty**

**3.2.6 Fears of seller opportunism:**

Fears of seller opportunism is defined as the concerns of the buyers that the seller may act opportunistically (Eisenhardt, 1989). Based on principal-agent perspective, both principals and agents are motivated by their self-interest. Nevertheless, the principals are not able to monitor all actions of the agents at any time, and thus causing the agents to act opportunistically to extract their own profits due to goal incongruence. Fears of such opportunisms could lead the buyers not to believe in seller's products. When the buyers cannot accurately predict whether the sellers will act opportunistically, the perceived uncertainty occurs. In this sense, the hypothesis proposed is:

**H6: Fear of seller opportunism increases a buyer's perceived uncertainty**

**3.2.7 Perceived uncertainty and purchase intention:**

Perceived uncertainty is defined as the degree to which the buyers cannot accurately predict the states of their transaction (Bauer, 1960). Successful transaction means that a seller delivers a product as promised in a timely manner and supports after-sales services, whereas circumstances, such as fraud, lower quality, contract default, and failure to acknowledge the terms of transaction, are viewed as unsuccessful transactions. Since the buyers encounter various unsuccessful transactions, they are more likely to overestimate the probability of potential losses, and thus eroding exchange relationships and negatively influencing consumer purchase intention (Pavlou et al., 2007). If the buyers are afraid that their transaction will not be successfully fulfilled, they tend to be hesitant to make shopping decisions. The following hypotheses are proposed:

**H7a: Perceived uncertainty negatively affects purchase intention**

**3.2.8 Perceived uncertainty and price premium:**

Price premium is defined as the amount of money consumers are willing to pay for a product, compared to other relevant products (Choe et al., 2009). The buyers tend to pay a price premium for reputable sellers to assure successful transactions. Price premium can also be viewed as an evidence of reputable sellers, since the high price convey signals that the products are of high quality (Pavlou et al., 2007). In summary, it is hypothesized that perceived uncertainty reduces the buyer's willingness to pay more for a product. In other words, the consumers are supposed to buy more products if mitigated uncertainty truly arises by adopting the FTS.

**H7b: Perceived uncertainty negatively affects price premium**

**3.2.9 Perceived uncertainty and loyalty:**

Loyalty is defined as the extent to which consumers continue to believe that a specific organization's product is their best option (Anuwichanont & Jirawat, 2010). So far customer loyalty has constantly been viewed as an elementary objective to plan marketing strategies since it brings various benefits to companies. First of all, the costs of maintaining the current customers are much cheaper than that of seeking for new ones. Second, loyal customers tend to comment positively about the products they are using and recommend to other customers, thus becoming a word-of-mouth advertising with no extra costs for the suppliers. Finally, it assures repetitive buyer-seller relationships when the customers are being attracted by other competitive suppliers (Anuwichanont & Jirawat, 2010). Consumers tend to believe in a familiar supplier and repeat their transaction with them to avoid the uncertainty. In other words, it is hypothesized that perceived uncertainty can damage customer loyalty.

**H7c: Perceived uncertainty negatively affects loyalty**

**3.2.10 Data collection:**

The questionnaire was created by using Google Docs to test the modified model and 13 above hypotheses. A 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), including 21 items divided into 4 Web pages, was employed as the measure to collect responses. The questionnaire items related to perceived uncertainty, fears of seller opportunism and perceived information asymmetry were reverse-worded to help the respondents easier to understand the author’s ideas. In addition to that, the last question “How much more are you willing to pay for agro-products through the traceability system” requires respondents to choose the additional percentage of prices they are supposed to pay for agro-products (Choe et al., 2009). It is noted that all question items were marked as required, and the system did not allow respondents to complete the questionnaire with unanswered questions, and thus missing data can be avoided. Questionnaire was designed in two versions: the one in Vietnamese language was made for data collection, and the other in English mainly for analysis purpose. Then the questionnaire was sent out to Vietnamese customers via Facebook website for data collection.

Vietnamese respondents know about products managed by the FTS. Before filling out the questionnaire items, all respondents was asked to read a brief description and watched a short video clip to learn about the main goal of the current study and basic information related to the FTS. After that, each of them spent a few minutes on filling their personal information and answering questionnaire items. 144 Vietnamese respondents were asked to fill out the questionnaire in 2 months (from January 31 2015 to March 31 2015).

Table 1 depicts the questionnaire items that we used to collect the data for research objectives. All of the questionnaire items were translated into Vietnamese language when conducting the survey in Vietnam.

**Table 1: Survey questionnaire items**

Variables		Questionnaire items		Reference
Product diagnosticity	1	The traceability system provides me with a real feel for products.	DIA1	Kempf and Smith (1998) Pavlou et al (2007)
	2	The traceability system enables adequate evaluation of product characteristics.	DIA2	
	3	Using the traceability system alleviates the selection of low-quality or incorrect products and facilitates the actual purchasing processing.	DIA3	
Informativeness	4	The traceability system is more informative than other sources I have ever known.	INFO1	Luo (2002)
	5	The traceability system offers me data that I need to make my purchase decisions.	INFO2	
Trust	6	The information provided by the traceability system is credible.	TRUST1	Pavlou and Gefen (2004)
	7	The traceability system enhance my confidence to make purchasing decisions.	TRUST2	
Social presence	8	The traceability system makes me perceive that online exchange is similar to traditional (face-to-face) interpersonal transactions.	PRE1	Rice (1993)
	9	I can easily extract relevant information using the traceability system by myself.	PRE2	
Perceived information asymmetry	10	The information irregularity related to the quality of agro-products between the buyers and the sellers can be mitigated by using the traceability system.	ASYM1	Mishra, Heide and Cort (1998)
	11	Since consumer can fully evaluate the quality of a product by using traceability system, the sellers hardly take advantage of the situation	ASYM2	
Fears of seller opportunism	12	The sellers of agro-products who do business through the traceability system will not cheat on buyers.	FEAR1	Eisenhardt (1989)
	13	The buyers can predict whether the particular seller	FEAR2	



		will act opportunistically through the traceability system		Pavlou et al. (2007)
	14	The traceability system will mitigate the probability of low-quality products.	FEAR3	
Perceived uncertainty	15	Purchasing agro-products through the traceability system will increase the probability of the successful transactions.	UNC1	Pavlou and Fygenson (2006)
	16	Purchasing agro-products through the traceability system will mitigate the after-sales adverse possibilities.	UNC2	
Purchase intention	17	I expect to use the traceability system for shopping	INT1	Pavlou and Fygenson (2006)
	18	I plan to increase the quantity of agro-products after using the traceability system	INT2	
Loyalty	19	I plan to continue purchasing agro-products using the traceability system next time	LOY1	Anuwichanont & Jirawat (2010)
	20	I plan to recommend my friend to buy agro-products using the traceability system	LOY2	
Price premium	21	How much more are you willing to pay for agro-products through the traceability system?	PRI	Choe, Park, Chung & Moon (2008)

Before officially implementing this survey in practice for data collection, we conducted a pilot study with 40 respondents to find out whether questionnaire items are appropriate for receiving desired results. All Cronbach's Alpha coefficients ranged from 0.702 to 0.802, which suggested that the reliability of all the questionnaire items were confirmed. As a result, this survey questionnaire was reliable enough to officially implement in practice for collecting data.

#### 4. EMPIRICAL RESULTS

##### 4.1 Descriptive statistics:

**Table 2: Respondent personal profile distribution**

Personal profile		Percent	Personal profile		Percent
Age	Under 20	6.9	Marital status	Single	66.0
	20-30	54.9		Married	34.0
	31-40	24.3	Occupation	Student	41.0
	41-50	10.4		White collar job	45.8
	Over 50	3.5		Blue collar job	9.7
Sex	Male	45.8	Others	3.5	
	Female	54.2	Household income per month	Under US\$ 300	14.6
Highest level of education	Under high school education	7.6		US\$ 300-US\$500	34.0
	High school	21.5		US\$500-US\$700	25.0
	Undergraduate	52.8		US\$700-US\$900	17.4
	Graduate	18.1		Over US\$900	9.0

Table 2 shows the background characteristics of 144 survey respondents. As can be seen, 90% of the respondents range in age between 20 and 50, implying that these groups could become target customers of the FTS. The number of female respondents is slightly more than male.

The percentage of respondents who are undergraduate or postgraduate students is over two times higher than that of people without college education it is implied that highly educated people seem to easier approach the benefits of the FTS. In addition, only 34% of respondents are married in contrast to 66% of single people. Nearly 90% of the respondents are students and white collar workers, while blue collar workers and people with other jobs only account for 13.2%.

More than a half of Vietnamese families range in the household income between US\$ 300 and US\$ 700 per month, while families with monthly income higher than US\$ 900 only represent 9%. Therefore, to adopt the FTS in Vietnam, we should consider offering customer reasonable prices so that they are affordable to buy the products.

4.2 Correlation analysis:

Table 3: Mean, standard deviation and correlation matrix

Variable	Item	Mean	Standard deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Diagnosticity (1)	DIA1	2.875	1.14583	1									
	DIA2	3.0556	0.92198										
	DIA3	3.4236	0.97937										
Informativeness (2)	INFO1	3.7917	0.97432	.588**	1								
	INFO2	3.6042	0.91007										
Trust (3)	TRUST1	3.6111	0.86187	.537**	.411**	1							
	TRUST2	3.4792	0.95323										
Social presence (4)	PRE1	3.5417	0.86804	.476**	.445**	.421**	1						
	PRE2	3.4792	0.86071										
Perceived information asymmetry (5)	ASYM1	3.625	0.8352	.405**	.451**	.369**	.476**	1					
	ASYM2	3.5139	0.90828										
Fears of seller opportunism (6)	FEAR1	3.5208	0.73825	.497**	.442**	.354**	.411**	.528**	1				
	FEAR2	3.5556	0.75519										
	FEAR3	3.5764	0.73456										
Perceived uncertainty (7)	UNC1	3.6042	0.83807	.511**	.419**	.396**	.473**	.459**	.417**	1			
	UNC2	3.4861	0.84445										
Purchase intention (8)	INT1	3.5486	1.00926	.499**	.470**	.493**	.451**	.449**	.381**	.599**	1		
	INT2	3.4722	0.86051										
Loyalty (9)	LOY1	3.5278	0.8686	.473**	.423**	.418**	.394**	.339**	.314**	.482**	.622**	1	
	LOY2	3.5417	0.82678										
Price premium (10)	PRI	2.5903	0.79696	0.084	.187*	0.126	0.053	0.02	0.067	-0.03	0.074	-0.023	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

The mean, standard deviation and correlation matrix of variables are provided in Table 5. Most mean values are higher than 3, which means that the majority of Vietnamese respondents generally agree to the content of items. In addition, except for the category of price premium, coefficients of all the others are significant at  $p < 0.01$  and greater than 3, indicating that most variables are highly correlated with other variables. Among these variables, informativeness has the strongest positive correlation of 0.588, reflecting that this variable can strongly explain dependent variable, whereas purchase intention has the weakest positive correlation of 0.314. Nevertheless, there is high correlations among independent variables, it means that the multicollinearity might happen. If so, we should check the VIF (Variance Inflation Factor), no multicollinearity occurs when VIF is smaller than 2. Pearson’s correlations of price premium on other variables, except on informativeness (0.187 at 0.05 level), are all insignificant, this indicates that price premium has low correlations with other variables.

4.3 Results and discussion:

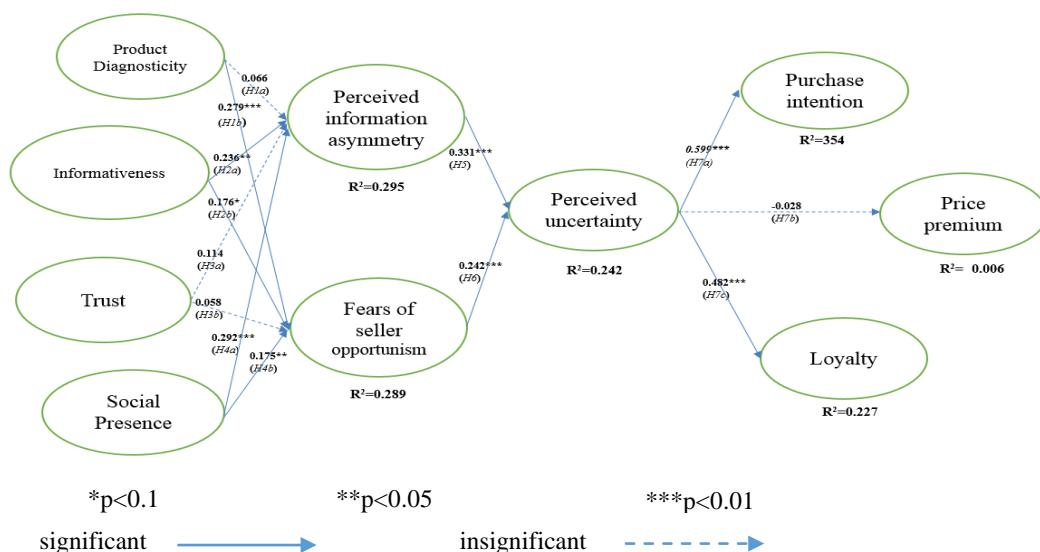


Figure 5: Data analysis results of the modified model of Pavlou et al. (2007)

Figure 5 depicts test results of the modified model. As can be seen, all hypotheses are significant except for H1a, H3a, H3b and H7b. 29.5% of the variance in perceived information asymmetry is explained by product diagnosticity ( $\beta=0.066$ ), informativeness ( $\beta= 0.236$ ), trust ( $\beta=0.114$ ) and social presence ( $\beta=0.292$ ), so this will not yield a very accurate prediction. Among of these variables, the path coefficients of social presence is significant at 0.01 level and informativeness is significant at  $p < 0.05$ , while product diagnosticity and trust are not significant. Therefore H1a and H3a are not supported, whereas H2a and H4a are supported. Of all mitigators, social presence has the strongest impact on perceived information asymmetry ( $\beta=0.292$ ,  $p < 0.01$ ). Similarly, 28.9% of the variance in the fears of seller opportunism can be explained by product diagnosticity ( $\beta=0.279$ ), informativeness ( $\beta=0.176$ ), trust ( $\beta=0.058$ ) and social presence ( $\beta=0.175$ ). Among of these variables, the path coefficients of product diagnosticity is significant at 0.01 level, social presence is significant at 0.05 level, informativeness is significant at  $p < 0.1$ , while trust is insignificant. Therefore, these results provide support for all variables except for trust, among which product diagnosticity has the strongest influence on reducing the fears of seller opportunism in terms of  $\beta$ .

These results came to several conclusions as follows. To begin with, when customers can receive more related information about the quality and safety of food, such valuable and helpful information increases their product diagnosticity and informativeness, helping to mitigate their perceived information asymmetry and/or fears of seller opportunism (Chen & Huang, 2013). In addition, creating an online exchange similar to traditional (face-to-face) interpersonal relationships can effectively convey the presence of the seller and reduce their anxiety about online purchase (Pavlou et al., 2007).

Nevertheless, the study also found that trust has no impact on reducing the information asymmetry and fears of seller opportunism, reflecting that the FTS has difficulty in building customer trust. According to Vietnam E-commerce Association (VECA), although e-commerce is growing significantly, only a few Vietnamese customers are truly convinced by the benefits of e-commerce sites (Phuong, 2014). The reason may be the fact that many of whom are dubious that online sellers will deceive them to extract unjustified profits. Barbour-Lacey and Zaca (2014) pointed out that many Vietnamese people do not believe in the product quality until they are able to physically touch them, and they prefer to buy the item at a physical store after viewing it on a website.

The adjusted R2 of perceived uncertainty is at 0.242, and this indicates that 24.2% of the variance in perceived uncertainty can be explained by information asymmetry and the fears of seller opportunism. Due to the respective path coefficients of 0.331 and 0.242 each, both variables are significant, and thus hypotheses H5 and H6 are supported. We also found that information asymmetry has a larger impact than fears of seller opportunism does on the perceived uncertainty.

H7a and H7c are supported since the path coefficients from perceived uncertainty to purchase intention and loyalty are significant ( $\beta=5.99$  and  $0.482$ , respectively) at  $p < 0.01$ . Nevertheless, the path coefficient from reduced uncertainty to price premium is insignificant with  $\beta=-0.028$ , and thus H7b is not supported. Reduced uncertainty has a stronger impact on purchase intention than customer loyalty.

In addition to that, all VIF (Variance Inflation Factor) coefficients are greater than 2, so there is no multicollinearity.

**Table 4: Price premium, purchase intention and loyalty distribution**

Price premium	Frequency	Percent	Purchase intention (INT2)	Frequency	Percent	Loyalty (LOY1)	Frequency	Percent
0	6	4.2	Strongly disagree	3	2.1	Strongly disagree	3	2.1
1-5%	66	45.8	Disagree	14	9.7	Disagree	11	7.6
6-10%	56	38.9	Neutral	51	35.4	Neutral	53	36.8
11-15%	13	9	Agree	64	44.4	Agree	61	42.4
Over 16%	3	2.1	Strongly agree	12	8.3	Strongly agree	16	11.1
Total	144	100	Total	144	100.0	Total	144	100.0

Table 4 shows the comparison of customer behavior through price premium, purchase intention and loyalty. As can be demonstrated, although most customers are willing to pay more for products managed by the FTS, they only intend to spend a low price premium. To specific, 84.7% can accept 1-10% of price increase, 4.2% of them refuse to pay more. Only 2.1% of consumers are inclined to pay more than 16% for traceable products. These results imply that Vietnamese customers would rather purchase products with reasonable prices than pay higher prices on products.

According to the results of question INT2 “I plan to increase the quantity of agro-products after using the traceability system”, 52.7% of customers agree to buy more food through the FTS, and less than 12% of whom show reluctance to buy more. 53.5% opt to repeat their purchase decisions when being asked as to whether they plan to continue purchasing agro-products using the traceability system next time (LOY1), and only 9.7% decline it. It is thus implied that adopting the traceability system can help suppliers to increasing their quantity of sold goods and attract more loyal customers. Once Vietnamese customers believe the quality and safety of traceable products, they are willing to buy more food and loyal to their familiar suppliers.

## 5. IMPLICATION

### 5.1 Research implication:

Our findings provide several implications for researchers to widen the scope of their studies. On one hand, it is worth mentioning that social presence ( $\beta=0.236$ ,  $p<0.05$ ) and informativeness ( $\beta=0.292$ ,  $p<0.01$ ) have the strong impact on reducing information asymmetry, thus it is important for research to emphasize social presence and informativeness in adopting the FTS in Vietnam. Moreover, according to our findings, product diagnosticity ( $\beta=0.279$ ), informativeness ( $\beta=0.176$ ), trust ( $\beta=0.058$ ) and social presence ( $\beta=0.175$ ) influence fears of seller opportunism, among which product diagnosticity has the highest impact on mitigating fears of seller opportunism, thus this mitigator should be considered as the priority in creating an effective FTS.

On the other hand, the study only found that reduced uncertainty plays important roles in increasing purchase intention and loyalty, but has no impact on price premium. This interesting finding is consistent with prior study conducted by Pavlout et al. (2007) in terms of purchase intention, but not consistent with the result from Choe (2009) which shows that mitigated uncertainty positively affects price premium. Thus, further research might focus on approaches to positively change the influence of the FTS on price premium in Vietnam.

### 5.2 Managerial implication:

The empirical results of this study provide several implications to adopt the FTS in Vietnamese agriculture. Two main aspects, based on the mitigators and customer behavior, will be addressed as follows:

Suppliers and the government should invest in trustful methods and incentives to enhance product diagnosticity, trust, informativeness and social presence. First, diagnosticity could be increased by displaying multiple extensive descriptive images to clearly describe products attributes, bring a sense of professionalism to buyers and help them have a better evaluation on agro-products (Pavlou et al., 2007). Second, to increase informativeness, the FTS should provide customers with sufficient detailed and creditable information, and allow them to extract related information in every step of supply chain at anytime. The websites are required to properly designed to meet some requirements such as high security, ease of use, information privacy, concurrently facilitate purchase process (Comcowich, 2014). Third, building trust can only be carried out by making products that meet international standard like ASC, GLOBAL, GAP and pass strict quality tests (Pavlou et al., 2007). In the same time, approaches to verify related information should be provided by the government or traceability suppliers (Choe et al., 2009). Finally, to increase social presence, what we need to do is to create an online environment which resembles the real life context. In this environment, people can interact with each other, they can not only receive information but also exchange information and give feedback about the products they consume, and thus helping other customers to make wiser purchase decisions. In addition, we should employ virtual advisors and technical support engineers who can help customers solve their problems when using traceable products.

Since the findings showed that informativeness and social presence proved to be the most important mitigators to reduce perceived uncertainty, we should emphasize enhancing these two factors in adopting FTS. It is implied that FTS should provide credible information about products and create an online environment that effectively convey the presence of sellers.

Next step, after determining the effects of the FTS on customer behavior, suppliers should come up with appropriate strategies to successfully adopt this system with the condition of affordable prices. Since most of the customers are willing to buy more and repeat their purchase rather than pay more for the food, suppliers should offer products with reasonable prices, and gain profits from the increased sales and customer loyalty. Although the implement cost is still high (an estimated of US\$ 84,100) (ATCWG, 2009), it is impossible to increase prices too much, we could compensate for costs by increasing the quantity of goods sold and attracting more patrons. Once customers are aware of the

effectiveness FTS could bring to them, they are inclined to purchase more and loyal to their familiar supplier. Higher prices could be considered in a small amount (below 10%), but should be reasonable to maintain the competitive advantage.

## 6. CONCLUSION

The Food Traceability System is an emerging technology developed in many countries to diminish perceived uncertainty by providing relevant information about food processing. However, the wide adoption of this system in Vietnamese agriculture is still a long journey.

The current study aims to investigate the influence of perceived uncertainty on customer behavior in terms of purchase intention, price premium and loyalty. The study fulfills these objectives by applying the modified model of Pavlou et al. (2007) on data obtained through a survey questionnaire of Vietnamese consumers.

The results suggest that customers are inclined to buy more traceable products and repeat their purchase, but reluctant to pay more. In other words, customers are willing to pay for them when they raise the awareness of the FTS. On the other hand, they may still be concerned about the soaring price because of the adoption of the system. In addition to that, informativeness and social presence play important roles in mitigating perceived information asymmetry, and fears of seller opportunism can be reduced by product diagnosticity, informativeness and social presence.

Several implications are provided for the adoption of FTS in Vietnamese agriculture. For instance, we should provide traceable products with reasonable prices, and earn profits by increased sales and customer loyalty. Moreover, it is required to create a system that can provide customers with trustful information about the quality and safety of the products and an online environment that brings effectiveness and convenience to customers.

However, there are several limitations of the current study that need to be considered. For instance, given that the data is only collected from respondents completing the online questionnaire, it may not represent the whole Vietnamese customers using FTS. However, it is relatively difficult to meet this requirement since not many Vietnamese consumers have a chance to use high-tech devices and only a small percentage of whom are currently using the FTS for their purchases. In addition, the model of Pavlou et al. (2007) is employed to lower the level of perceived uncertainty based on principal-agent perspective, so it does not well account for other aspects of the system, such as the usability, system quality and service quality of web-based system. Therefore, we suggest that further studies with new approaches should be necessary to give more insights into this field.

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