Predicting and explaining the adoption of online trading: An empirical study in Taiwan

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ABSTRACT

This study investigates how stock investors perceive and adopt online trading in Taiwan. We developed a research model which integrates perceived risk, perceived benefit and trust, together with technology acceptance model (TAM) and theory of planned behavior (TPB) perspectives to predict and explain investors' intention to use online trading. The model is examined through an empirical study involving 338 subjects using structural equation modeling techniques. The results provide support for the proposed research model and confirm its robustness in predicting investors' intentions to adopt online trading. In addition, this study provides some useful suggestions and/or implications for the academician and practitioners in the area of online trading.

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1. Introduction

The last decade of the 20th century witnessed profound technological changes among which is the advent of electronic commerce, or the exchange of products and payments via the Internet [32]. The monetary value of products and services exchanged using electronic commerce reached US $7 trillion by 2004 [63]. Among all electronic commerce applications, online trading is a highly profitable financial services industry [59] and truly one of the best areas to fully understand and implement ecommerce [28]. While online securities trading in Taiwan began in 1997, its adoption rate of online trading has been lower than expected during the past decade. In December 2005, according to statistics from the Taiwan Stock Exchange Corporation (TSEC) [53], only 13.2% of the total market turnover value was conducted online and 19% of total investor accounts were online accounts. In contrast, in Korea, 54% of the total market turnover value was conducted online and 65% of total investor accounts were online accounts by the end of 2005 [34]. Obviously, online trading has experienced limited spread/use and suffered from relatively high levels of customer resistance in Taiwan. In light of this, a comprehensive model describing the factors that drive customers to accept online trading would be useful for both academics and practitioners, in that it would help them to better understand customer online behavior in the emerging online transaction environment.

In order to provide a solid theoretical basis for selecting influential driving factors, this paper integrate two important streams of literature under the nomological structure of the theory of reasoned action (TRA) [2,17,51]; (a) the technology acceptance model (TAM) [13,14] as well as the theory of planned behavior (TPB) [1], and (b) the literature on benefit, risk and trust [6,15,20,33,41]. Since TAM and TPB have been utilized individually in many online contexts to predict and understand user perceptions of system use and the probability of adopting an online system [20,27,60], they could be the most appropriate tools for understanding online trading adoption. Therefore, the marriage of TAM and TPB should provide a more comprehensive model to explain online trading adoption. In addition, past research has also suggested the need for incorporating additional factors in order to improve their predictive ability and explanatory power [16,20,60]. Drawing upon these studies, this paper employs trust, benefit and risk perception as external variables and theoretically develops and empirically validates a research model that predicts customer acceptance of online trading.

Online trading has lot of advantages, such as faster trading speed, better information transparency, and lower operating cost [29], and naturally it is expected that a stock investor will choose to adopt online trading if they perceive that doing so will provide greater benefits than existing methods. Because perceived benefit has been empirically shown to significantly impact Internet adoption [43], affect e-business adoption [64] and influence the corporate website adoption [7], employing it in the technology-driven context of online trading is a rational undertaking.

However, according to the risk theory of consumer behavior [6], Bauer indicated that benefits are often accompanied with risks. The spatial and temporal separation between customers and stock brokerage firms and the unpredictability of the Internet infrastructure

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generate an implicit uncertainty around online transactions. First, there is the risk of monetary loss due to transaction error or stock account misuse. Second, there is the risk of loss of privacy due to Internet fraud or hacker intrusion. The open nature of the Internet as a transaction infrastructure and its global nature create uncertainty around online transactions, and this makes trust and risk crucial elements of e-commerce [25]. Yousafzai and Pallister argue that the notion of trust is perhaps the most important component of electronic banking transactions [63]. Therefore, perceptions of trust and risk are likely to be important factors in predicting online trading acceptance.

Trust has long been regarded as a catalyst for buyer–seller transactions that can provide consumers with high expectations of satisfying exchange relationships. Many researchers maintain that trust is essential for understanding interpersonal behavior and economic exchanges [15,42]. The importance of trust is elevated in e-commerce because of the high degree of uncertainty and risk present in most online transactions [8]. Jarvenpaa et al. empirically showed the favorable effect of trust on consumer purchase intentions [30,31]. Thus, the role of trust is of fundamental importance for adequately capturing consumer behavior in online trading. Perceived risk is also an important element of B2C e-commerce that is likely to affect consumer behavior [31]. Since trust and perceived risk are essential constructs when uncertainty is present [46], these beliefs are integrated in the proposed online trading acceptance model.

This study enlarges the scope of the adoption decision to explicitly include both a negative factor (perceived risk) and positive factors (trust and perceived benefits) simultaneously. The research may benefit practitioners by offering an increased understanding of customers' risk and trust perceptions which can be used in turn to devise risk-reducing strategies and trust-building mechanisms to encourage online trading adoption, especially in the emerging area of e-payments. The purpose of this study is as follows:

1. To investigate whether trust, perceived risk, and perceived benefit significantly impact investors' behavioral intention to adopt online trading adoption.
2. To clarify which factors are more influential and relevant with regard to affecting investors' decision whether or not to trade online.
3. To evaluate whether the integration of TAM with TPB provide a solid theoretical basis for examining the adoption of online trading.

2. Basic concepts and research background

2.1. Trust

Trust is an expectation that others one chooses to trust will not behave opportunistically [20]. It is one's belief that the other party will behave in a dependable, ethical, and socially appropriate manner [26]. Trust deals with the belief that the trusted party will fulfill commitments despite the trusting party's dependency and vulnerability [20]. Accordingly, trust is vital in many business relationships and actually determines the nature of many businesses as well as the social order. Trust is also a central aspect in many economic transactions because of a deep-seated human need to understand one's social surroundings, that is, to identify what, when, why and how others behave. When a social environment cannot be regulated through rules and customs, people adopt trust as a central social complexity reduction strategy [39]. In particular, in the case of online businesses, which are lacking in effective regulations, consumers have to trust the e-vendors from whom they purchase, assuming, in reality, that the e-vendors will be ethical and behave in a socially suitable manner, or else the overwhelming social complexity will cause them to avoid purchasing all together [20]. Gefen [21] also indicated that without a reduction in the social complexity and risks resulting from the undesirable opportunistic behavior of e-vendors, only short-term transactions would be possible. As online trading lacks the physical presence of brokerage branch and a physical interaction between the broker personnel and the customer, it renders a unique virtual environment, in which trust is of paramount importance.

2.2. Perceived benefit

Online trading has recently come to be considered as one of the most effective stock transaction method [29]. Based on a certain extent on reasons offered by Ho [24], two types of perceived benefits stood out, which can be categorized as direct advantages and indirect advantages. Direct advantages refer to immediate and tangible benefits that customers would enjoy by using online trading. For example, customers can benefit from lower order handling fees, faster transaction speed, and better information transparency. Indirect advantages are those benefits that are less tangible and difficult to measure. For example, online trading allows the customer to perform stock transactions anywhere in the world and offers customers a wider range of investment opportunities, as well as other free services such as stock quotation and news.

Compared with traditional off-line (phone-based) trading methods, the direct advantages of online trading are illustrated as follows. First, in order to attract more customers to online trading, online stock brokerage companies often offer lower brokerage fees. For example, the order handling fee of online trading is cheaper than phone-based method by 50% in Taiwan. For stock investors, the lower the order handling fees is, the more willing they are to switch from phone-based trading to online trading.

Second, online trading can save transaction time and facilitate the stock trading process. Online trading avoids the need to process paper documents, a process that generally involves errors, delay and costly clerical personnel. Online trading automates this process by mediating transactions through websites and electronic data interchange. In addition, online trading can reduce the necessity of traders' communication with brokers regarding transaction details because all the transaction details can be obtained via a website.

Third, during the transaction, online trading allows traders to monitor contractual performance at any time or to confirm delivery automatically. In other words, all the information from transactions can be viewed through web sites and is transparent to stock traders. It is easier to place or cancel orders via online trading than through a phone-based trading method. The above evidence provides strong support for including the perceived benefits as a factor in the preliminary model of online trading adoption.

2.3. Perceived risk

Since the 1960s, the theory of perceived risk has been used to explain consumers' behavior. Considerable research has examined the impact of risk on traditional consumer decision making [37]. Peter and Ryan [48] defined perceived risk as a kind of subjective expected loss, and Featherman and Pavlou [16] also defined perceived risk as the possible loss when pursuing a longed for result. Cunningham [12] noted that perceived risk consisted of the amount that would be lost (i.e. that which is at stake) if the consequences of the act were not favorable and the individual's subjective feeling of certainty that the consequences will be adverse. Most of scholars claimed that consumers' perceived risk consists of different types, which vary according to the product (or service) class [33]. The distant and impersonal nature of the online environment and the implicit uncertainty of using a global open infrastructure for transactions can bring about two specific types of risk, namely, security/privacy risk and financial risk. Security/privacy risk refers to a potential loss due to Internet fraud or hacker intrusion. Phishing is a new crime skill by which phishers attempt to fraudulently acquire sensitive information, such as usernames, passwords and credit card details, by masquerading as a trustworthy entity in an electronic communication [41]. A phishing attack takes places when a user receives a fraudulent email (often referred to as a spoof email) representing a

trusted source that leads them to an equally fraudulent website that is used to collect personal information [16]. Both fraud and hacker intrusion not only lead to users' monetary loss, but also violate user privacy, a major concern of many Internet users. Financial risk refers to the potential for monetary loss due to transaction error or stock account misuse. According to Kuisma [35], many customers are afraid of losing money while performing transactions or transferring money over the Internet. Accordingly, this study adopts perceived risk as a negative factor to explain the intention toward online trading.

2.4. Technology acceptance model

The technology acceptance model (TAM) is an adaptation of the theory of reasoned action (TRA) by Fishbein and Ajzen [2]. Davis [13] designed it to specifically explain computer-usage behavior. In this model, perceived usefulness and perceived ease of use were considered as two predecessors affecting attitude towards a technology, which affects behavioral intention to use that technology (which, in turn, leads to its actual use). *Perceived usefulness* (PU) refers to the degree to which a person believes that using a particular system will enhance his or her job performance, and *perceived ease of use* (PEOU) is defined as the degree to which a person believes that using a particular system will be free of effort [13].

2.5. Theory of planned behavior

The development of the theory of planned behavior (TPB) was originally based on the theory of reasoned action (TRA) [17], which is designed to explain almost any human behavior and has been proven successful in predicting and explaining human behavior across various application contexts [14]. It postulates that individuals' behavioral intentions are determinants of their actual behavior. Behavioral intention in TPB is a function of three determinants: attitude, subjective norm, and perceived behavioral control. *Attitude* refers to an individual's positive or negative feelings about performing the target behavior. *Subjective norm* reflects a person's perception that most people who are important to him think he or she should not perform the

behavior in question. *Perceived behavioral control* reflects perceptions of internal and external constraints on behavior [55].

3. Research model and hypotheses development

For the past decade, researchers have applied TAM to examine IT usage and have verified that user perceptions of both usefulness and ease-of-use are key determinants of individual technology adoption. While TAM has many strengths, including its basis in social psychology, the validity and reliability of its instruments and its parsimony, it is often criticized for ignoring the influence of social and control factors on technology acceptance. Such factors have been found to have a significant influence on IT usage behavior [54]. These variables are also key determinants of behavior in the theory of planned behavior (TPB), where social influences (subjective norms) are modeled as determinants of behavioral intention, and perceived behavioral control is modeled as a determinant of both intention and behavior. As the focus of this study is the adoption of online trading, which is considered as an instance of the acceptance of innovative technology intertwined with social systems and personal characteristics, the integration of TAM and TPB for our research framework should provide a more comprehensive model to examine the acceptance of online trading. Fig. 1 illustrates the research model. It asserts that the intention to use online trading is a function of: perceived benefit, PU, attitude, perceived behavior control and subjective norm. The model further indicates that attitude mediates the impact of trust, perceived benefit, PU, and PEOU on intention to conduct online trading. The proposed constructs and hypotheses are supported by prior studies in information systems literature.

3.1. TAM and TPB

Hypotheses 1–5 are proposed based on TAM as discussed in Section 2.1, while Hypotheses 6 and 7 are initiated with the underlying TPB as described in Section 2.2.

H1. Perceived usefulness has a positive effect on intention to trade online.
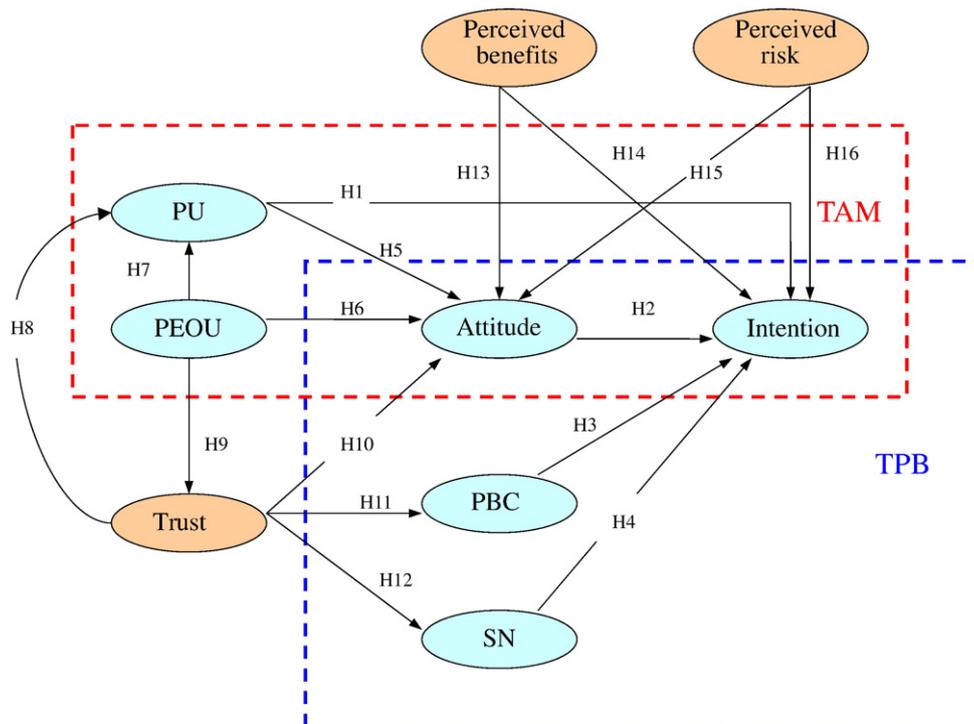

Fig. 1. The proposed research model and research hypotheses.

H2. Perceived usefulness has a positive effect on attitude to trade online.

H3. Perceived ease of use has a positive effect on perceived usefulness to trade online.

H4. Perceived ease of use has a positive effect on attitude to use online trading.

H5. Attitude has a positive effect on intention to trade online.

H6. Perceived behavioral control has a positive effect on intention to trade online.

H7. Subjective norm has a positive effect on intention to trade online.

3.2. Trust and TAM

The connections between trust and TAM have been widely discussed in literature where the relationships among PU, PEOU, and trust are hypothesized in many online-based business settings [20,46]. In particular, a model of Trust and the TAM model were well defined in online tax settings [60]. This model explicitly indicates that trust is an antecedent of perceived usefulness, PEOU is an antecedent of trust, and trust has a direct influence on behavioral intention to adopt online tax services. Trust is one of the determinants of PU, especially in an online environment, because part of the guarantee is that consumers will sense that the expected usefulness from the web site is based on the sellers behind the web site. Hence, we hypothesize that:

H8. Trust has a positive effect on perceived usefulness regarding online trading.

Gefen et al. [20] studied the effect of PEOU on trust in a field study of online shopping. They found that the PEOU has a positive influence on trust because the PEOU can help promote customers' favorable impressions of e-vendors in the initial adoption of on-line services and further, causes customers to be willing to make investments and commit to the buyer–seller relationship. Hence, we hypothesize that:

H9. Perceived ease of use has a positive effect on trust in online trading.

For stock investors, trust is viewed as a relevant belief that directly affects investors' attitudes toward online trading behavior. Just as cost–benefit paradigm greatly influences people's attitudinal beliefs and outcome judgments, trust can be a direct influencer that determines people's attitudes toward behavior [5]. Additionally, research has shown that trust definitely increases the confidentiality of business relationships and determines the quality of transaction between buyers and sellers, as well as people's outcome expectations for many commerce activities [26,36,39]. Hence, we hypothesized that:

H10. Trust has a positive effect on attitudes leading to online trading.

3.3. Trust and TPB

The relationship between trust and TPB can be examined from two aspects in which trust is hypothesized as the common antecedent of perceived behavioral control and subjective norm. With regard to the perceived behavioral control construct, trust can increase perceived behavioral control over online transactions since the virtual interactions between customers and e-vendors become more expectable [47]. According to Shih [52], perceived behavioral control encompasses two components. The first component is "facilitating conditions" [56], which reflect the availability of resources needed to perform a particular behavior. The second component is self-efficacy [1], that is, being confident of the ability to behave successfully in the situation. Explicitly, trust influences perceived behavioral control through the controlling

factors of self-efficacy and the facilitation of favorable conditions [60]. According to psychological reports, self-efficacy in personal relationships is constructed from self-confidence and mutual trust in friendships [40]. Hence, mutual trust in the relationship between customers and e-vendors should increase customer self-efficacy and in turn, increase perceived behavioral control. On the other hand, trust can be a perceptual resource that facilitates customers' ability to gain control over online transactions [60]. While customers trust an e-vendor that behaves in accordance with their expectations, the trust beliefs are likely to increase customer's perceived behavioral control over online transactions [47]. Accordingly, the following hypothesis is proposed.

H11. Trust has a positive effect on perceived behavioral control of online trading activities.

With regard to the subjective norm construct, researchers have found that mutual trust and mutual influence between users and information system (IS) units are highly correlated to each other based on a study concerning the performance of information system groups [44]. Furthermore, Taylor and Todd [55] in his proposed decomposed TPB model revealed that there are both peer and superior influences on users when determining subjective norms toward IS usage. Evidence provided by an online tax adoption study shows that trust positively influences subjective norm to adopt online tax [60]. It is reasonable to infer that trust in peers and superiors about their beliefs in the context of online trading should play a role in determining subjective norms. Therefore, we hypothesized that:

H12. Trust has a positive effect on subjective norms affecting use of online trading.

3.4. 3–4 Perceived benefit

Recent developments in Internet-based transaction technologies have brought lots of potential benefits for online trading such as lower transaction costs, increased transaction speed and better information transparency as mentioned above. Therefore, a stock investor will choose to adopt online trading if he/she perceives that doing so will provide greater benefits than existing methods. The perceived benefit construct has been empirically shown to significantly impact Internet adoption [43], affect e-business adoption [64], and influence the corporate web site adoption [7]. Therefore, it is reasonable to infer that perceived benefit positively influence customers attitude and intention to adopt online trading. Therefore, we hypothesized that:

H13. Perceived benefit has a positive effect on attitude regarding use of online trading.

H14. Perceived benefit has a positive effect on intention to trade online.

3.5. 3–5 Perceived risk

Among the reasons commonly cited for consumers' resistance to online purchasing are the concerns of fraud and identity theft [19]. Consumers' perceptions of risk are considered to be central to different steps in the buying process including their evaluations, choices, and behaviors since consumers are often more motivated to avoid mistakes than to maximize utility in purchasing [11]. Thus, in online contexts, an increase in the risk perceived by consumers could reduce their intention to buy through a particular web site. The perceived risk associated with online transactions may reduce perceptions of behavioral and environmental control, affecting transaction intentions negatively [19]. Perceived risk has been found to have a negative influence on consumers' attitudes or intentions to purchase online. Similar logic

should hold true for perceived risk toward online trading. These statements lead us to formulate the following hypotheses:

H15. Perceived risk has a negative effect on attitudes regarding online trading.

H16. Perceived risk has a negative effect on intention to trade online.

4. Research methods

4.1. Questionnaire development

The instrument was designed to include a two-part questionnaire as presented in Appendix A. The first part includes nominal scales, and the remainder includes a seven-point Likert scale, ranging from "disagree strongly" (1) to "agree strongly" (7). Accordingly, the first part is basic information. This part of questionnaire was used to collect information about respondents' characteristics including gender, age, education, occupation, and experience using online trading. The second part was developed based on the constructs of perceived risk, perceived benefit, trust, and TAM and TPB. The items regarding TAM and TPB were adapted from Taylor and Todd [54] and Davis [13]. Trust was measured using 3 item measures adapted from Gefen [20]. Perceived risk and perceived benefit were assessed using 3 item measures each adapted from Litter and Melanthiou [38] and Yao [62].

Before conducting the main survey, we performed a pre-test to validate the instrument. The pre-test involved 10 respondents who have used online trading for more than 3 years. Respondents were asked to comment on the length of the instrument, the format, and the wording of the scales. Therefore, the content validity of the instrument has been confirmed. This study was conducted using SPSS10.0 and AMOS 5.0 as analysis tools. The data analysis method involved descriptive statistics, correlation analysis, confirmatory factor analysis and the structural equation model (SEM). The proposed model was tested using the structural equation modeling (SEM). The test of the proposed model includes an estimation of two components of a casual model: the measurement and the structural models.

4.2. Sample and data collection

This study conducted a web-based survey to allow respondents to feel anonymous and to overcome time and place constraints, thus helping our study to reach respondents more easily than using other survey methods such as interviews (personal and telephone) and other self-administered survey technologies [58]. Empirical data were collected by conducting a field survey of stock trading investors. Subjects were self-selected by messages placed on the popular stock-related website, Yahoo Stock [61] in Taiwan. The message stated the purpose of this study and provided a hyperlink to the survey form. Additionally, we used an E-mail to invite users in which we ask them to fill out the questionnaire by mailing an E-mail. This online survey, which yielded 356 responses, was conducted for one month, with incomplete responses and missing values deleted, resulting in a sample size of 338 users for an overall response rate of 95.2%.

4.3. Common method bias

In this study, because we collected the data for the independent and dependent variables from the same respondents, concerns about common method bias could arise [50]. Common method variance is defined as the overlap in variance between two variables due to a relationship between the underlying constructs. We conducted Harmon's one-factor test to assess the potential common method variance bias in this study. We entered all the variables into a factor analysis. These factors emerged with the first factor, accounting for 23.2% of the variance in the variables. Because more than a single factor emerged from the factor analysis and

no general factor accounted for the majority of the variance in those variables, we saw no evidence to suggest the presence of common method variance bias. In addition to Harmon's one-factor test, we performed the partial correlation procedure to further test the existence of common method bias. Specifically, we computed the partial correlations between all variables with the first principal component partialed out. We found significant partial correlations between some of the predictor variables and criterion variables, suggesting no evidence of common method variance bias [50]. Thus, we concluded that there is no evidence to suggest the concern of common method bias in our data.

5. Results

Consistent with the two-step approach advocated by Anderson and Gerbing [3], this study first developed the measurement model by conducting confirmatory factor analysis (CFA) to measure convergent and discriminant validity. Then, the structural equation model was then estimated for hypotheses testing. Both the measurement model and the structural model were assessed by the maximum likelihood method using AMOS 5.0. To evaluate the fit of models, Chi-square with degrees of freedom, the comparative fit index (CFI), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), the normed fit index (NFI), and the root mean square error of approximation (RMSEA) were assessed in addition to the chi-square test. In general, model fit is considered to be adequate if GFI, NFI and CFI are larger than 0.9, AGFI is larger than 0.8, and RMSEA is smaller than 0.08.

5.1. Analysis of the measurement model

The measurement model yielded a Chi-square value of 984.5 with 418 degrees of freedom ($p < 0.001$), indicating a general lack of fit. However, the chi-square test is sensitive to sample sizes, especially for cases in which the size exceed 200 respondents [22]. As an alternative, we used the ratio of the chi-square to degrees-of-freedom. This approach obtained a value of 2.35, which falls within the suggested value of

Table 1
Construct reliabilities.

Construct	Item	Factor loading	t-value	Composite reliability (CR)	Average variance extracted	Cronbach's alpha
Perceived usefulness	PU1	0.907	11.757	0.938	0.792	0.92
	PU2	0.888	10.086			
	PU3	0.900	9.529			
	PU4	0.865	11.319			
Perceived ease of use	EOU1	0.869	10.433	0.936	0.786	0.91
	EOU2	0.903	11.589			
	EOU3	0.868	9.418			
	EOU4	0.906	8.704			
Attitude	ATT1	0.915	11.038	0.937	0.788	0.92
	ATT2	0.911	12.906			
	ATT3	0.843	9.590			
	ATT4	0.883	10.927			
Subjective Norm	SN1	0.928	11.409	0.942	0.843	0.91
	SN2	0.934	10.643			
	SN3	0.892	12.125			
Perceived Behavioral control	PBC1	0.910	11.695	0.937	0.832	0.91
	PBC2	0.907	9.604			
	PBC3	0.918	12.987			
Intention	INT1	0.919	10.122	0.939	0.836	0.92
	INT2	0.906	11.662			
	INT3	0.918	12.078			
Trust	TST1	0.848	11.530	0.909	0.769	0.88
	TST2	0.867	12136			
	TST3	0.914	10.691			
Perceived benefits	PB1	0.940	13.815	0.939	0.836	0.91
	PB2	0.919	19.078			
	PB3	0.883	17.814			
Perceived risk	PR1	0.925	13.103	0.926	0.813	0.90
	PR2	0.911	18.906			
	PR3	0.883	17.927			

Table 2
Discriminant validity.

Construct	PU	PEOU	Attitude	SN	PBC	Intention	Trust	Perceived benefits	Perceived risk
PU	0.836								
PEOU	0.67	0.768							
Attitude	0.62	0.60	0.843						
SN	0.30	0.28	0.33	0.831					
PBC	0.29	0.30	0.32	0.36	0.792				
Intention	0.29	0.54	0.63	0.32	0.33	0.786			
Trust	0.56	0.56	0.52	0.23	0.21	0.53	0.789		
Perceived benefits	0.43	0.37	0.42	0.22	0.20	0.46	0.37	0.836	
Perceived risk	−0.46	−0.38	−0.54	−0.28	−0.26	−0.58	−0.38	−0.30	0.845

Note: Diagonal elements are square roots of average variance extracted.
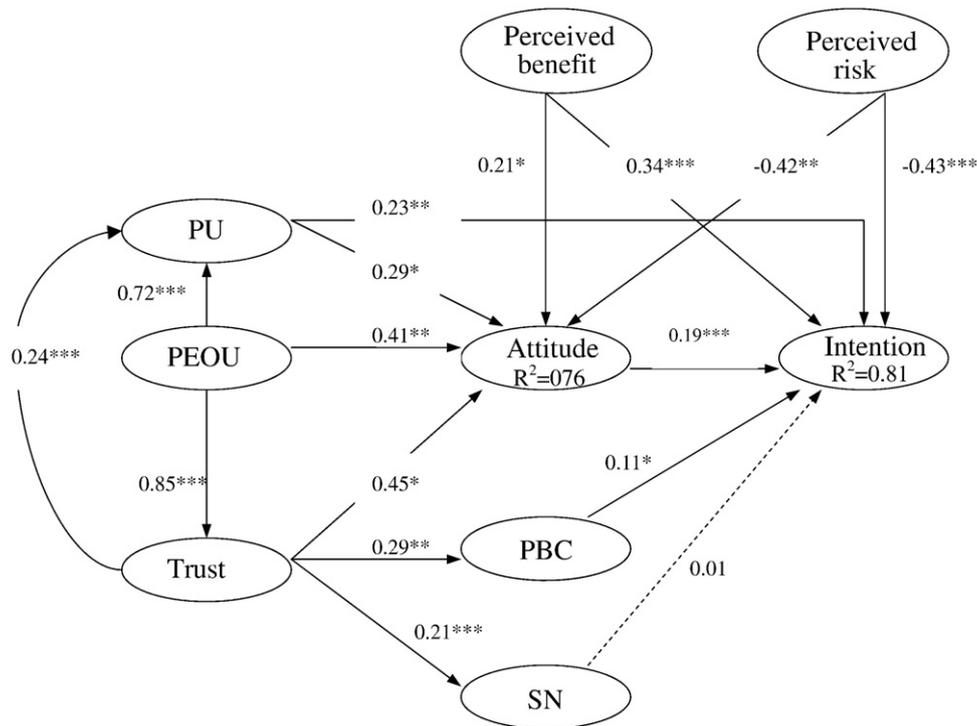
5 or below [4]. In addition, the other indices satisfied the recommended value (GFI − 0.91, AGFI − 0.89, NFI − 0.92, CFI − 0.93, and RMSEA − 0.053). Therefore, there is a reasonable overall fit between the model and the observed data. Cronbach's alpha scores shown in Table 1 indicated that each construct exhibited strong internal reliability. Convergent validity was assessed based on the criteria that the indicator's estimated coefficient was significant on its posited underlying construct factor. We evaluated for the measurement scales using the three criteria suggested by Fornell and Lacker [18].

(1) All indicator factor loading (λ) should be significant and exceed 0.5
(2) Construct reliabilities should exceed 0.8

(3) Average variance extracted (AVE) for each construct should exceed the variance due to measurement error for the construct (e.g., AVE should exceed 0.5)

All λ values in confirmatory factor analysis of the measurement model exceed 0.5 and were significant at $p<0.001$. Composite reliabilities of constructs ranged from 0.81 to 0.93, exceeding the acceptable level of 0.8 (see Table 2). The AVE, ranging from 0.57 to 0.83, was greater than the variance due to measurement error. Therefore, all three conditions for convergent validity were met.

Discriminant validity assesses the extent to which a concept and its indicators differ from another concept and its indicators [4]. According

χ^2 / df = 2.19, GFI of 0.91, AGFI =0.89, CFI = 0.94, NFI = 0.93, RFI=0.94, and RMSEA= 0.06

*　　p < 0.05
**　　p<0.01
***　　p < 0.001

Note: Dotted line represents no significance.

Fig. 2. Results of structural model analysis.

to Fornell and Larcker [18], discriminant validity is established if the AVE is larger than the squared correlation coefficients (r^2) between variables. Table 2 lists the correlations among constructs, with the square root of the AVE on the diagonal. All diagonal values exceed the inter-construct correlations. The overall results indicated that the discriminant validity of constructs was acceptable.

The potential problem of multicollinearity can be examined formally in the context of regression analysis. The variance inflation factor (VIF), which indicates the degree to which each predictor variable is explained by other predictor variables, is a common measure of multicollinearity in regression analysis. High multicollinearity masks the effect of an individual predictor, and results in incorrect estimations of regression weights. A threshold VIF that is less than or equal 10 (i.e., Tolerance > 0.1) is commonly suggested. The VIFs for PEOU, PU, Attitude, Trust, perceived risk, perceived benefit, PBC, SN were 1.22, 2.12, 1.25, 2.13, 2.08, 1.23, 1.23 and 1.12, respectively. The independent variables with the VIF values are all less than 2.50, providing evidence against multicollinearity.

5.2. Analysis of the structural model

We assessed overall goodness of fit using the chi-square test. The chi-square test assesses the adequacy of a hypothesized model in terms of its ability to reflect variance and covariance for the data. For the statistical significance of parameter estimates, t values were used. The results of structural equation modeling obtained for the proposed conceptual model revealed a good model fit ($\chi^2/df = 2.19$, GFI of 0.91, AGFI = 0.89, CFI = 0.94, NFI = 0.93, RFI = 0.94, and RMSEA = 0.06). Fig. 2 shows the structural model estimates, where the estimate parameters are standardized path coefficients. All the standardized path coefficients are significant except for the path from subjective norm to intention to use online trading. As reported in Table 3, analytical results indicate that all the hypotheses in TAM and TPB except H4 are significant, providing support for H1–H3, H5–H7. The hypothesized positive relationships between trust and the TAM two beliefs (PU and PEOU) have significant effects. Thus, H8 and H9 are supported. Moreover, trust significantly influenced all the three antecedents − of behavioral intention in TPB, providing support for H10–H12. Perceived benefit significantly influenced attitude and behavioral intention. Therefore, H13 and H14 were supported. Finally, perceived risk has a significantly negative influence on attitude and behavioral intention, thus providing support for H14 and H15.

6. Discussion

This study aims to shed light on the critical antecedents of customers' intention to adopt online trading. The overall explanatory

Table 3
Summary of hypotheses tests.

	Hypothesized relationship	Sign	Estimate	t-value	Supported
H1	PU → Intention	+	0.23	2.73	Yes
H2	Attitude → Intention	+	0.34	3.73	Yes
H3	PBC → Intention	+	0.11	2.25	Yes
H4	SN → Intention	+	0.02	0.49	No
H5	PU → Attitude	+	0.29	2.01	Yes
H6	PEOU → Attitude	+	0.40	2.86	Yes
H7	PEOU → PU	+	0.72	8.15	Yes
H8	Trust → PU	+	0.24	3.31	Yes
H9	PEOU → Trust	+	0.85	8.95	Yes
H10	Trust → Attitude	+	0.12	2.03	Yes
H11	Trust → PBC	+	0.49	6.77	Yes
H12	Trust → SN	+	0.51	6.75	Yes
H13	PB → Attitude	+	0.21	2.58	Yes
H14	PB → Intention	+	0.19	4.71	Yes
H15	PR → Attitude	−	−0.42	−10.92	Yes
H16	PR → Intention	−	−0.43	−7.61	Yes

Notes: Significant levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
PB denotes "Perceived Benefits"; PR denotes "Perceived Risk".

Table 4
Direct indirect and total effects.

Dependent variable	Intention to use online trading		
Predictor	Direct effects	Indirect effects	Total effects
Perceived easy of use	–	0.50	0.50
Perceived risk	−0.43	−0.14	−0.57
Perceived benefit	0.19	0.03	0.22
Trust	–	0.18	0.18
Perceived usefulness	0.23	0.09	0.32
Subject norm	–	–	–
Perceived behavioral control	0.11	–	0.11.
Attitude	0.34	–	0.34

Note: 1. All non-zero effects are significant at $p < 0.05$.
2. n.s. means non-significant effects.

power of our research model had an R-square of 81% for the intention to use online trading, suggesting that the proposed research model is capable of explaining a relatively high proportion of variation of intention to adopt online trading. Several insightful results could be summarized from our research framework as follows.

First, perceived risk, perceived benefit, attitude, PBC, SN and PU are six important factors which impact customers' intention to trade online. The result shows that the intention to use online trading is adversely affected primarily by perceived risk ($\beta = -0.43$, $p < 0.05$). Notably, perceived risk also has an indirect influence on behavioral intention to use online trading via attitude, which mediated the impact of perceived risk on the intention to use online trading (see Table 4). This finding demonstrates that perceived risk exerts a stronger effect on customers' decision making than the other factors. The emergence of perceived risk as a key inhibitor underscores the fact that risk is at the top of the minds of online stock investors. Many stock investors in Taiwan believe that they are vulnerable to identity theft and fraud while using online trading services [29]. The risk concern may explain why the adoption rate of online trading in Taiwan is still very low. Therefore, online trading companies should put an emphasis on reducing online stock investors' risk concerns.

Compared with the negative factor perceived risk, the intention to use online trading is most dominantly and positively affected by perceived benefit ($\beta = 0.34$) and less so by attitude ($\beta = 0.19$) and perceived behavioral control ($\beta = 0.11$). This implies that the perceived benefit is the most important positive predictor of the intention to trade online. Perceived benefit was introduced as a factor to reflect people's concerns about their transaction fees and the time needed to trade online. This result is consistent with Huang [29], who indicated that perceived benefit is important for the website adoption. Our results also reinforce the premise that the inclusion of perceived benefit significantly improves the prediction of intention to use online trading.

Attitude also has a significant impact ($\beta = 0.19$) on the intention to use. Moreover, attitude is predicted jointly by PU ($\beta = 0.29$), PEOU ($\beta = 0.41$), perceived benefit ($\beta = 0.21$), perceived risk ($\beta = -0.42$) and trust ($\beta = 0.12$). Previous researchers have suggested that the inclusion of attitude is not meaningful [23]; our research suggests otherwise. We argue that attitude should continue to be used in subsequent research.

Perceived usefulness has significant effects on the intention to use online trading ($\beta = 0.27$) and the attitude ($\beta = 0.29$), which mediated the impact of perceived usefulness on the intention to use online trading. Perceived ease of use has significant effects on perceived usefulness ($\beta = 0.72$) and attitude ($\beta = 0.41$). Although all our TAM-related hypotheses are supported here, the results challenge some of the basic tenets of TAM. TAM emphasizes the importance of perceived usefulness as the key determinant of user acceptance of IT. In this study, the effect of perceived ease of use on attitude is greater than that of perceived usefulness (0.41 > 0.29). This finding demonstrates that perceived ease of use exerts a stronger effect on customers' decision making than perceived usefulness. This is different from many prior studies that examined TAM. For example, Pikkarainen [49] and Chan and Lu [9], who investigated acceptance of Internet banking in Finland and Hong Kong, respectively, concluded that perceived usefulness is more

important than perceived ease of use. One possible explanation for this inconsistency is that the earnings generation of online stock trading comes from the investment strategies rather than from trading methods. Either online trading or phone-based methods can achieve the goal of transacting stocks. Most stock investors might use online trading just because of ease of use. The difficulty of using online systems is becoming more of a concern nowadays [60]. Featherman [16] similarly suggests that Internet users are very concerned about learning how to use and troubleshoot a new e-service. Thus, we suggest that the online trading system designer should pay more attention to whether the online trading system is user-friendly (easy to use).

Empirical data show that trust is considered to be an important antecedent of the three determinants of intention to use, attitude ($\beta = 0.45$), perceived behavioral control ($\beta = 0.29$), and subjective norm ($\beta = 0.21$), and in turn, jointly contributes a high explanatory power with $R^2 = 0.81$ to behavioral intention to use online trading. Although perceived usefulness ($\beta = 0.41$) and perceived ease of use ($\beta = 0.29$) in TAM representing technology-based antecedents both significantly influence attitude toward behavior; however, trust ($\beta = 0.45$) demonstrates more positive impact on attitude. The results indicate the fact that initial users tend to rely more on trust than technology-based features to form their attitude toward the behavior.

Finally, subjective norm appeared to have no significant effect on the intention to use. Although investors may turn to their social groups for opinions relating to the mode of online trading, their decision to trade online seemed to be insignificantly affected by social pressure as indicated by an insignificant path linking social norms to behavioral intention ($\beta = 0.03$, P>0.05). A plausible explanation is that the investment activities are very personal and individual and the decision to conduct online trading is voluntary rather than mandatory. This is consistent with the that finding of Venkatesh and Davis [57] wherein subjective norm could significantly determine intention to use in a mandatory-usage context, but its impact would become less significant while users are in a voluntary-usage context.

7. Implications

7.1. Practical implications

The results of this study shed light on some important issues related to customers' intention toward online trading that have not been addressed by previous studies. First, although perceived benefit and perceived risk have a significant influence on intention, this study reveals that perceived risk is a more important influential factor than perceived benefit in online trading decision making, implying that controlling the risk of online trading is more important than providing benefits to customers who trade online. This finding is particularly important for managers of online trading companies as they decide how to allocate resources. However, building a risk-free online stock trading environment is much more difficult than providing benefits to customers [45]. Online trading companies need to search for risk-reducing strategies that might assist in inspiring high confidence in customers. This study suggests that online trading companies should consider focusing more on the prevention of intrusion, fraud and identity theft. For example, online trading companies could build secure firewalls to avoid intrusion and develop methods for strengthening encryption and authenticating their websites in order to prevent fraud and identity theft.

Furthermore, this study also finds that trust is a critical cue that affects customers' intention to trade online. This finding is particularly important for novice users, especially for those who do not have confidence with online trading. This study suggests that online trading companies could develop trust-building mechanisms to entice investors into embracing online trading. For examples these trust-building mechanisms include statements of guarantees, increased familiarity through advertising, and long-term customer service. It is worthy to note that because online trading is a less verifiable and controllable environment, in which online

service or transaction is offered without physical contact and official receipts, online trading customers usually have difficulty in asking for compensation when transaction errors occur. Thus we suggest that online brokers should provide customers with digital receipts or a guarantee for every transaction in order to increase customers' confidence with regard to online trading. Customers may be willing to trust in online trading if they're confident that the service providers stand behind their service.

7.2. Theoretical implications

This study provides two implications for researchers. First, this study enlarges the scope of the adoption decision to explicitly include both a negative factor (perceived risk) and positive factors (trust and perceived benefits) simultaneously. The research may benefit researchers by providing an increased understanding of customers' risk and trust perceptions which can be used to devise risk-reducing strategies and trust-building mechanisms to encourage online trading adoption. Second, although TAM and TPB have been widely applied to IT systems adoption for the past decade, neither TAM nor TPB have been found or proven to provide consistently superior explanations or predictions of behavior [54,57] since factors influencing consumers' adoption of technology can vary, depending on the technology, target consumers, and context. In essence, TAM and TPB are considered as two complementary models drawn from TRA. By integrating TAM and TPB, this study demonstrates relatively satisfactory results for the proposed research model in the context of online trading. This result implies that the integration of TAM with TPB can serve as a unified theoretical model to understand the adoption of online trading. Notably, this unified model may be also appropriate for the analysis of other e-commerce applications.

8. Conclusions and future research

The objective of this study is to develop a theoretical model to explain and predict the stock traders' behavioral intentions to use online trading by using the concepts of perceived benefit, perceived risk and trust and integrating the TAM and TPB models. A large sample survey of online trading investors was employed to empirically examine this research model. The measurement model indicates the theoretical constructs have adequate reliability and validity, while the structured equation model is shown to have a high model fit for the empirical data. The study's findings show that the proposed model has good explanatory power and confirms its robustness in predicting customers' intention to use online trading.

As with any research, care should be taken when generalizing the results of this study. First, the survey was conducted using web based forms and employed a non-random convenience sample. Gathering a larger sample using an alternate survey modality and random sampling methods would be costly. The online survey method was appropriate for collecting data from participants with experience of the Internet and was free of geographical constraints. However, generalizability could be enhanced if future research is systematically sampled from a more dispersed sample.

Second, although this study has identified three external factors (trust, perceived risk and perceived benefits) influencing consumers' adoption of online trading, it is important to recognize the cultural and national limitations of these findings. For example, in contrast to Korea's high adoption rate of about 54% for online trading, Taiwan has a much lower adoption rate only about 20%. This phenomenon may be influenced by the cultural differences between the two nations because Chen [10] indicated that consumers in Taiwan have a lower degree of trust propensity with regard to e-business environments. Hence, it would be useful to test whether the research model proposed in this study can be generalized to situations in other countries. The replication of this study on a wider scale with different national cultures is essential for the further generalization of the findings.

Third, the conclusions drawn from our study are based on cross-sectional data, and thus we only took a snapshot of this model. A stricter test of our argument, however, could be employed by using a longitudinal study to evaluate this aspect. By using a longitudinal study in the future, we could investigate our research model across different time periods and make comparisons, thus providing more insight into the phenomenon of online trading adoption. Finally, this study suggests that future research should investigate the differences between the extended TAM model, the extended TPB model, and the model proposed in this study regarding the acceptance of online trading, and should explore which theory is best suited to explain the customers' behavior regarding the use of online trading.

Appendix A. Questionnaire items

Constructs

Perceived usefulness (Gefen [20])
• Online trading is useful for searching stock investment information.
• Online trading can yield more profits than phone-based stock trading methods.
• Using the online trading will enhance my effectiveness in stock trading.
• An online trading website provides me useful information regarding stock investment opportunities.

Perceived ease of use (Gefen [20])
• The online trading website is easy to use.
• Interaction with the online trading site does not require a lot of mental effort.
• Learning to operate the online trading website is easy.
• The online trading website is flexible to interact with.

Attitude (Davis [13])
• Using online trading for stock trading would be a good idea.
• Using online trading for stock trading would be a wise idea.
• I like the idea of using online trading for stock trading.
• Using online trading for stock trading would be a pleasant experience.

Subjective norm (Taylor and Todd [54])
• People who are important to me would think that I should use online trading.
• People who influence me would think that I should use online trading.
• People whose opinions are valuable to me would prefer that I use online trading.

Perceived behavioral control (Taylor and Todd [54])
• I will be able to use the online trading well when trading.
• Using online trading is entirely within my control.
• I have the resources, knowledge, and ability to use online trading.

Intention to use online trading (Pavlou [46])
• I intend to buy and sell my stocks through a website.
• I expect to trade stocks online in the future.
• If I have access to online trading, I want to use it as much as possible.

Trust (Gefen [20])
• Based on my perception of online trading, I know it is trustworthy.
• Based on my perception of online trading, I know it is not opportunistic.
• Based on my perception of online trading, I believe it is predictable.

Perceived benefit (Mehrens [43])
• Online trading transaction costs are very low.
• Online trading transaction speed is very fast.
• All the information from transactions can be viewed through website and is transparent.

Perceived risk (Litter and Melanthiou [38])
• I would not feel secure sending private personal information on the Internet.
• If online trading errors were to occur, I worry that I would be unable to get compensation.
• I worry about the occurrence of fraud and hacker intrusion while trading online.

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