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Determinants of user acceptance of Internet banking: an empirical study

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Keywords Virtual banking, Individual perception, Data security, User studies

Abstract The explosion of Internet usage and the huge funding initiatives in electronic banking have drawn the attention of researchers towards Internet banking. In the past, the conventional focus of Internet banking research has been on technological development, but this is now shifting to user-focused research. Although millions of dollars have been spent on building Internet banking systems, reports have shown that potential users may not use the systems in spite of their availability. This points out the need for research to identify the factors that determine acceptance of Internet banking by the users. According to the technology acceptance model (TAM), perceived ease of use and perceived usefulness constructs are believed to be fundamental in determining the acceptance and use of various IT. These beliefs may however not fully explain the user’s behavior toward newly emerging IT, such as Internet banking. Using the technology acceptance model (TAM) as a theoretical framework, this study introduces “perceived credibility” as a new factor that reflects the user’s security and privacy concerns in the acceptance of Internet banking. It also examines the effect of computer self-efficacy on the intention to use Internet banking. Based on a sample of 123 users from a telephone interview, the results strongly support the extended TAM in predicting the intention of users to adopt Internet banking. It also demonstrates the significant effect of computer self-efficacy on behavioral intention through perceived ease of use, perceived usefulness, and perceived credibility.

Introduction
Traditional branch-based retail banking remains the most widespread method for conducting banking transactions in Taiwan as well as any other country. However, Internet technology is rapidly changing the way personal financial services are being designed and delivered. For several years, commercial banks in Taiwan have tried to introduce Internet-based e-banking systems to improve
their operations and to reduce costs. Despite all their efforts aimed at developing better and easier Internet banking systems, these systems remained largely unnoticed by the customers, and certainly were seriously underused in spite of their availability. In 2002, only about 1-3 percent of banking transactions in Taiwan were conducted via the Internet. Only a total of 1.25 million Taiwanese people reported having ever visited the Internet banking sites in May 2002 (NetValue, 2002). This figure represents only 19.6 percent of the Internet population in Taiwan. Therefore, there is a need to understand users’ acceptance of Internet banking, and a need to identify the factors that can affect their intention to use Internet banking. This issue is important because the answer holds the clue that will help the banking industry to formulate their marketing strategies to promote new forms of Internet banking systems in the future.

There is a growing body of academic research being focused on examining the determinants of computer technology acceptance and the utilization among users (e.g. Moore and Benbasat, 1991; Mathieson, 1991; Davis, 1989; Davis et al., 1989; Taylor and Todd, 1995). Among the different models that have been proposed, the technology acceptance model (TAM) (Davis, 1989; Davis et al., 1989) adapted from the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975), appears to be the most widely accepted among information systems researchers. The reason for its popularity is perhaps because of its parsimony, and the wealth of recent empirical support for it (Agarwal and Prasad, 1999). According to the TAM, adoption behavior is determined by the intention to use a particular system, which in turn is determined by the perceived usefulness and perceived ease of use of the system. Although information systems researchers have investigated and replicated the TAM, and agreed that it is valid in predicting the individual’s acceptance of various corporate IT (Adams et al., 1992; Chin and Todd, 1995; Doll et al., 1998; Segars and Grover, 1993), the TAM’s fundamental constructs do not fully reflect the specific influences of technological and usage-context factors that may alter the users’ acceptance (Moon and Kim, 2001). As Davis (1989) noted, future technology acceptance research needs to address how other variables affect usefulness, ease of use, and user acceptance. However, factors affecting the acceptance of a new IT are likely to vary with the technology, target users, and context (Moon and Kim, 2001). Recent research has indicated that “trust” has a striking influence on user willingness to engage in online exchanges of money and personal sensitive information (e.g. Hoffman et al., 1999; Friedman et al., 2000). Therefore, perceived ease of use and perceived usefulness may not fully reflect the users’ intention to adopt Internet banking, necessitating a search for additional factors that better predict the acceptance of Internet banking.

One key benefit of using TAM to understand system usage behavior is that it provides a framework to investigate the effects of external variables on
Several important external variables that have received more and more attention in the context of TAM research are individual differences, such as computer self-efficacy (see Agarwal and Prasad, 1999; Venkatesh and Morris, 2000; Hong et al., 2001). Consistent with practice in the information systems research literature (e.g. Alavi and Joachimsthaler, 1992; Harrison and Rainer, 1992), individual differences refer to user factors that include traits such as personality and demographic variables, as well as situational variables that account for differences attributable to circumstances such as experience and training. Although there are points of similarity in prior research in terms of specific individual difference variables, considered to be germane influences on the acceptance of a new information technology (IT), it is evident from the mixed empirical results obtained in prior work that the “process” through which individual differences influence IT acceptance are not well understood (see Agarwal and Prasad, 1999; Venkatesh and Morris, 2000). Furthermore, there has been no such empirical research to explicate how individual differences influence the usage intention of Internet banking through TAM variables.

Therefore, the primary objective of this research is to extend the TAM in the context of Internet banking. We propose a new construct (“perceived credibility”) to enhance the understanding of an individual’s acceptance behavior of Internet banking. This research also identifies critical individual difference variables (i.e. computer self-efficacy) that have a significant effect, through the TAM framework, on the intention of potential users to use Internet banking. By explaining usage intention from the user’s perspective, the findings of this research will not only help Internet banking authorities to develop better user-accepted Internet banking systems, but also provide insights into how to present the new IT to potential users.

**The theoretical background**

*Technology acceptance model*

Based on theories in social psychology, such as the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980) and the theory of planned behavior (TPB) (Ajzen, 1985), the TAM has been validated as a powerful and parsimonious framework for explaining the adoption of IT by the users (Davis, 1989; Davis et al., 1989). TAM posits that user adoption of a new information system is determined by the users’ intention to use the system, which in turn is determined by the users’ beliefs about the system. TAM further suggests two beliefs – perceived usefulness and perceived ease of use – are instrumental in explaining the variance in the intention of the users. Perceived usefulness is defined as the extent to which a person believes that using a particular system will enhance his or her job performance, while perceived ease of use is defined as the extent to which a person believes that using a particular system will be free of effort. Among the beliefs, perceived ease of use is hypothesized to be a
predictor of perceived usefulness. Furthermore, both types of beliefs are influenced by external variables.

Previous research on TAM has found that individual differences are important external variables. Individual difference variables play a crucial role in the implementation of any technological innovation in a wide variety of disciplines, including information systems, production, and marketing (e.g., Harrison and Rainer, 1992; Majchrzak and Cotton, 1988). Zumd’s (1979) review and synthesis of prior work related to individual differences and management information systems success reveals a rich literature that has paid close attention to individual differences. Numerous individual difference variables have been studied, including demographic and situational variables, cognitive variables, and personality-related variables (Zumd, 1979). Empirical research has also found significant relationships between individual differences and IT acceptance via TAM (Hong et al., 2001; Agarwal and Prasad, 1999; Igbaria et al., 1995; Jackson et al., 1997; Venkatesh, 2000; Venkatesh and Morris, 2000). However, the mixed empirical results obtained in prior work suggest that the process through which individual differences influence IT acceptance are not well understood (see Gefen and Straub, 1997; Kwon and Chidambaram, 2000; Palvia and Palvia, 1999). As Chen et al. (2000) noted, the effects of individual differences on the use of the new IT are yet to be found out. Davis et al. (1989) suggested that the internal psychological variables (i.e. the beliefs) that are central to TAM, fully mediate the effects that all other variables in the external environment may have on an individual’s use of an innovation. Motivated by the insights from prior work about the potential existence of mediating variables, it is now possible to propose a more complete explanation of how individual differences influence users’ acceptance of Internet banking via intervening TAM variables. While several individual difference variables, such as gender, age, level of education, and computer self-efficacy, may have a significant influence on users’ acceptance of Internet banking via TAM variables, only computer self-efficacy can be manipulated by practitioners through promotion and training approaches. Furthermore, the ultimate objective of Internet banking is to reach different demographic groups. The effects of gender, age, and level of education on TAM variables, as a result, have few implications for practitioners that wish to promote the adoption of Internet banking by users in the long term. Hence, computer self-efficacy is chosen as the only individual difference variable to influence the constructs of TAM.

In sum, although TAM has been applied to a wide range of IT (e.g. Jackson et al., 1997; Venkatesh and Davis, 2000), none investigated the acceptance of Internet banking using the TAM framework. Most of the prior studies have aimed at relatively simple IT, such as personal computers, the e-mail system, word processing and spreadsheet software, and the WWW. However, caution needs to be taken when applying the findings developed for the earlier generations of IT to the new virtual environment (Chen et al., 2000). Furthermore,
the target user groups of Internet banking usually have a more diversified education and socio-economic background than those of other information systems. Thus, it is imperative to examine the acceptance of new technologies with different user populations in different contexts (Hartwick and Barki, 1994).

**Perceived risk, trust, and perceived credibility**

Perceived risk is the consumer’s subjective expectation of suffering a loss in pursuit of a desired outcome. It is a multi-dimensional construct with overall risk being subdivided into performance, physical, financial, psychological, social loss, and time (Greatorex and Mitchell, 1994). However, risk is difficult to capture objectively (Pavlou, 2001). Mitchell (2001) also argued that prior studies only focus on overall perceived risks, or on a few sub-dimensions of perceived risks, and that these studies do not accurately and completely assess all the relevant dimensions of risks. Therefore, it is relatively difficult, in the Internet banking context, to conceptually define and discriminate every risk dimension, and to identify the potential risk dimensions that may influence users’ acceptance of Internet banking. Furthermore, reliable measures on perceived risk could not be obtained in the virtual banking context (Liao et al., 1999). Consequently, perceived risk does not readily apply to the context of this study because of its multi-dimensionality and measurement problem.

Trust is an important catalyst in many transactional relationships, and it determines the nature of many businesses and the social order (Gefen et al., 2003). Drawing on literature in social psychology (Larzelere and Huston, 1980) and marketing, Doney and Cannon (1997) define trust as the perceived credibility and benevolence of a target of trust. The first dimension of trust, perceived credibility, is the extent to which one partner believes that the other partner has the required expertise to perform the job effectively and reliably (Ganesan, 1994). This is to say that trust based on a partner’s expertise and reliability focuses on the objective credibility of an exchange partner: an expectancy that the word or written statement of the partner can be relied on (Lindskold, 1978). The second dimension of trust, benevolence, is the extent to which one partner is genuinely interested in the other partner’s welfare, and has intentions and motives beneficial to the other party when new conditions arise, conditions for which a commitment was not made. Benevolence is rooted in repeated buyer-seller relationships (Ring and Van de Ven, 1992; Zaheer et al., 1998). However, this study focuses on the intention of consumers who may now be the non-users of Internet banking. Hence, benevolence does not readily apply to the context of this study, since it requires familiarity and prior interaction. Perceived credibility is usually impersonal and relies on reputation, information and economic reasoning (Ba and Pavlou, 2002). It is more related to one’s judgment on the privacy and security issues of the Internet banking systems. Consequently, perceived credibility is used as a new construct to reflect the security and privacy concerns in the acceptance of Internet banking.
Research model and hypotheses

Considering both the simplicity of TAM, and the uniqueness of an Internet banking system and its user groups, we feel confident here to use extended TAM as a theoretical framework to examine the effects of computer self-efficacy on users’ acceptance of Internet banking through three beliefs:

1. perceived usefulness;
2. perceived ease of use; and
3. perceived credibility.

The research model tested in this study is shown in Figure 1. In the extended model, like in many other studies of TAM (e.g., Adams et al., 1992; Lu and Gustafson, 1994; Chau, 1996; Hong et al., 2001) the “attitudes” construct has been taken out to simplify the model. The proposed research model includes one individual differences variable (computer self-efficacy) and three beliefs variables (perceived ease of use, perceived usefulness, and perceived credibility), the selections of which are supported by prior studies in the information systems literature.

Computer self-efficacy

In general, prior research has suggested a positive relationship between experience with computing technology and a variety of outcomes such as an affect towards computers and computer usage (Levin and Gordon, 1989; Harrison and Rainer, 1992; Agarwal and Prasad, 1999). A related construct, called computer self-efficacy, has been examined in the IS literature (e.g. Compeau and Higgins, 1995; Compeau et al., 1999; Hong et al., 2001). Computer self-efficacy is defined as the judgment of one’s ability to use a computer (Compeau and Higgins, 1995). Continuing research efforts on computer self-efficacy can be observed in recent IS studies (Agarwal et al., 2000; Johnson and Marakas, 2000; Hong et al., 2001; Chau, 2001), which confirm the critical role that computer self-efficacy plays in understanding individual responses to information technology. The proposed relationship between computer self-efficacy and perceived ease of use is based on the theoretical argument by Davis (1989) and Mathieson (1991). There also exists...
empirical evidence of a causal link between computer self-efficacy and perceived ease of use (e.g. Venkatesh and Davis, 1996; Igbaria and Iivari, 1995; Venkatesh, 2000; Agarwal et al., 2000). Based on the social cognitive theory developed by Bandura (1986), Igbaria and Iivari (1995) postulated that computer self-efficacy affects an individual’s computer anxiety, which in turn, influences the perceived ease of use, perceived usefulness, and system usage. However, computer experience might be positively related to the existence of concerns regarding the privacy and security of online exchanges, implying that computer self-efficacy will have a negative effect on perceived credibility of the Internet banking. Therefore, based on the theoretical and empirical support from the IS literature, we test the following hypotheses:

**H1a.** Computer self-efficacy will have a positive effect on perceived usefulness of the Internet banking systems.

**H1b.** Computer self-efficacy will have a positive effect on perceived ease of use of the Internet banking systems.

**H1c.** Computer self-efficacy will have a negative effect on perceived credibility of the Internet banking systems.

**Perceived ease of use**  
Extensive research over the past decade provides evidence of the significant effect of perceived ease of use on usage intention, either directly or indirectly through its effect on perceived usefulness (Agarwal and Prasad, 1999; Davis et al., 1989; Hu et al., 1999; Jackson et al., 1997; Venkatesh, 1999, 2000; Venkatesh and Davis, 1996, 2000; Venkatesh and Morris, 2000). In order to prevent the “under-used” useful system problem, Internet banking systems need to be both easy to learn and easy to use. ITs that are easy to use will be less threatening to the individual (Moon and Kim, 2001). This implies that perceived ease of use is expected to have a positive influence on users’ perception of credibility in their interaction with the Internet banking systems. Thus, we hypothesize that perceived ease of use will have a positive effect on perceived usefulness, perceived credibility, and behavioral intention for using the Internet banking systems.

**H2.** Perceived ease of use will have a positive effect on perceived usefulness of the Internet banking systems.

**H3.** Perceived ease of use will have a positive effect on perceived credibility of the Internet banking systems.

**H4.** Perceived ease of use will have a positive effect on behavioral intention to use the Internet banking systems.
Perceived usefulness

There is also extensive research in the IS community that provides evidence of the significant effect of perceived usefulness on usage intention (Agarwal and Prasad, 1999; Davis et al., 1989; Hu et al., 1999; Jackson et al., 1997; Venkatesh, 1999, 2000; Venkatesh and Davis, 1996, 2000; Venkatesh and Morris, 2000). The ultimate reason people exploit Internet banking systems is that they find the systems useful to their banking transactions. Therefore, we test the following hypothesis:

\[ H5. \] Perceived usefulness will have a positive effect on behavioral intention to use the Internet banking systems.

Perceived credibility

Besides the ease of use and usefulness beliefs, the usage intention of Internet banking could be affected by users’ perceptions of credibility regarding security and privacy issues. The majority of computer system users are relatively ignorant about the security, or non-security, of the system they use. In fact, if asked, they tend to claim that they do not care (Karvonen, 1999). However, if the same people are asked to explain how they adapt their behavior according to the situation at hand, it rapidly becomes apparent that much of their behavior is based on a perceived sense of security or insecurity (Adams and Sasse, 1999). Besides, the Internet threatens user information privacy in new and extreme ways. This threat has pushed many users to opt out of various forms of participation in the Internet (Hoffman et al., 1999), including providing personal, sensitive information to Web sites for banking transaction purposes. The lack of perceived credibility is manifested in people’s concerns that the Internet banking system (and/or the hackers intruding the system) will transfer their personal information or money to third parties without their knowledge or permission. Although this concern also exists in the physical world, this issue takes on a greater sense of urgency online, owing to the special characteristics of the Internet (Hoffman et al., 1999). Therefore, perceived fears of divulging personal information and the feelings of insecurity of the users provide unique challenges to Internet banking planners to find ways in which to develop and improve the perceived credibility by the user of Internet banking. Users are concerned about the level of security present when providing sensitive information online (Warrington et al., 2000), and will perform transactions only when they develop a certain level of trust. Therefore, perceived credibility refers to the two important dimensions – security and privacy – that are identified across many studies as affecting intention by users to adopt the Internet-based transaction systems.

Security refers to the protection of information or systems from unsanctioned intrusions or outflows. Fear of the lack of security is one of the factors that has been identified in most studies as affecting the growth and development of e-commerce. Thus, the perception of users as to the extent to
which Internet banking systems ensure that their transactions are conducted without any breach of security, is a very important consideration that will affect Internet banking use.

Privacy, on the other hand, refers to the protection of various types of data that are collected (with or without the knowledge of the users) during users’ interactions with the Internet banking system. Also, the perception by the users of the privacy policy and rules followed by Internet banking systems may affect the usage of the systems.

In general, the perceived credibility that people have in the system to conclude their transactions securely and to maintain the privacy of their personal information affects their voluntary acceptance of Internet banking systems. These results suggest the following hypothesis:

H6. Perceived credibility will have a positive effect on behavioral intention to use the Internet banking systems.

Research design and method
Measures of the constructs
To ensure the content validity of the scales, the items selected must represent the concept about which generalizations are to be made (Bohmstedt, 1970). Therefore, items selected for the constructs were mainly adapted from prior studies to ensure content validity. One advantage of using the TAM to examine Internet banking acceptance is that it has a well-validated measurement inventory (Davis, 1989; Doll et al., 1998). Items for the perceived ease of use and perceived usefulness were taken from the previous validated inventory and modified to fit the specific technology studied. The items to measure behavioral intention were taken from previous applications of TAM (Agarwal and Prasad, 1999; Venkatesh and Davis, 1996). Three items for the computer self-efficacy construct were adapted from the original instrument of computer self-efficacy developed by Compeau and Higgins (1995). Finally, perceived credibility was measured by two statements specifically developed for this study. Likert scales (1-7), with anchors ranging from “strongly disagree” to “strongly agree” were used for all questions except for the items measuring computer self-efficacy. The anchors of the items measuring computer self-efficacy ranged from “Not at all confident” to “Totally confident.” The Appendix lists the items used in this study.

Data collection procedure
A telephone interview method was employed for the survey. A representative cross-section of the Taiwanese adult population was included in the interview sample. Respondents were screened for whether they had ever conducted banking transactions. Only those who had previously conducted banking transactions continued with the interview. The interviews were conducted over a period of three weeks by a team of three interviewers. All interviewers had prior experience in conducting telephone interviews. A standard interview
protocol was utilized by all interviewers. Out of 154 interviews conducted, 123 interviews of those with experience of conducting banking transactions were obtained for data analysis. Of the 123 respondents, 55 percent were male and the majority (87 percent) were between 20 and 40 years of age. Most (88 percent) had completed high school, while the rest (12 percent) had obtained college degrees.

Data analysis and results

Measurement model

A confirmatory factor analysis using LISREL 8.3 was conducted to test the measurement model. Seven common model-fit measures were used to assess the model’s overall goodness of fit: the ratio of $\chi^2$ to degrees-of-freedom (df), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normalized fit index (NFI), non-normalized fit index (NNFI), comparative fit index (CFI), and root mean square residual (RMSR). As shown in Table I, all the model-fit indices exceeded their respective common acceptance levels suggested by previous research, thus demonstrating that the measurement model exhibited a fairly good fit with the data collected. Therefore, we could proceed to evaluate the psychometric properties of the measurement model in terms of reliability, convergent validity, and discriminant validity.

Reliability and convergent validity of the factors were estimated by composite reliability and average variance extracted (see Table II). The composite reliabilities can be calculated as follows: (square of the summation of

<table>
<thead>
<tr>
<th>Fit indices</th>
<th>Recommended value</th>
<th>Measurement model</th>
<th>Structural model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$/df</td>
<td>3.00</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Goodness-of-fit (GFI)</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>Adjusted goodness-of-fit (AGFI)</td>
<td>0.80</td>
<td>0.85</td>
<td>0.84</td>
</tr>
<tr>
<td>Normed fit index (NFI)</td>
<td>0.90</td>
<td>0.96</td>
<td>0.95</td>
</tr>
<tr>
<td>Non-normed fit index (NNFI)</td>
<td>0.90</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Comparative fit index (CFI)</td>
<td>0.90</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>Root mean square residual (RMSR)</td>
<td>0.10</td>
<td>0.027</td>
<td>0.034</td>
</tr>
</tbody>
</table>

Table I. Fit indices for measurement and structural models

<table>
<thead>
<tr>
<th>Factor</th>
<th>CR</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer self-efficacy</td>
<td>0.96</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>0.97</td>
<td>0.40</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>0.94</td>
<td>0.36</td>
<td>0.66</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived credibility</td>
<td>0.95</td>
<td>0.04</td>
<td>0.25</td>
<td>0.20</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Behavioral intention</td>
<td>0.81</td>
<td>0.28</td>
<td>0.56</td>
<td>0.46</td>
<td>0.31</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Table II. Reliability, average variance extracted, and discriminant validity

Notes: CR = composite reliability; Diagonal elements are the average variance extracted; off-diagonal elements are the shared variance
the factor loadings)/{(square of the summation of the factor loadings)+(summation of error variables)}. The interpretation of the resultant coefficient is similar to that of Cronbach’s alpha, except that it also takes into account the actual factor loadings rather than assuming that each item is equally weighted in the composite load determination. Composite reliability for all the factors in our measurement model was above 0.80. The average extracted variances were all above the recommended 0.50 level (Hair et al., 1992), which meant that more than half of the variances observed in the items were accounted for by their hypothesized factors. Convergent validity can also be evaluated by examining the factor loadings and squared multiple correlations from the confirmatory factor analysis (see Table III). Following Hair et al.’s (1992) recommendation, factor loadings greater than 0.50 were considered to be very significant. All of the factor loadings of the items in the research model were greater than 0.50, with most of them above 0.90. Also, squared multiple correlations between the individual items and their a priori factors were high (above 0.50 in all cases). Thus, all factors in the measurement model had adequate reliability and convergent validity.

To examine discriminant validity, we compared the shared variances between factors with the average variance extracted of the individual factors (Fornell and Larcker, 1981). This analysis shows that the shared variance

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Factor loadings</th>
<th>Squared multiple correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer self-efficacy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSE1</td>
<td>5.01</td>
<td>1.55</td>
<td>0.93</td>
<td>0.86</td>
</tr>
<tr>
<td>CSE2</td>
<td>5.16</td>
<td>1.50</td>
<td>0.95</td>
<td>0.91</td>
</tr>
<tr>
<td>CSE3</td>
<td>5.24</td>
<td>1.48</td>
<td>0.94</td>
<td>0.89</td>
</tr>
<tr>
<td><strong>Perceived ease of use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEU1</td>
<td>4.55</td>
<td>1.70</td>
<td>0.93</td>
<td>0.87</td>
</tr>
<tr>
<td>PEU2</td>
<td>4.63</td>
<td>1.64</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>PEU3</td>
<td>4.57</td>
<td>1.69</td>
<td>0.97</td>
<td>0.93</td>
</tr>
<tr>
<td>PEU4</td>
<td>4.65</td>
<td>1.67</td>
<td>0.93</td>
<td>0.86</td>
</tr>
<tr>
<td><strong>Perceived usefulness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU1</td>
<td>4.54</td>
<td>1.49</td>
<td>0.91</td>
<td>0.82</td>
</tr>
<tr>
<td>PU2</td>
<td>4.61</td>
<td>1.51</td>
<td>0.95</td>
<td>0.91</td>
</tr>
<tr>
<td>PU3</td>
<td>4.68</td>
<td>1.52</td>
<td>0.91</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>Perceived credibility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC1</td>
<td>3.08</td>
<td>1.88</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>PC2</td>
<td>3.01</td>
<td>1.83</td>
<td>0.90</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Behavioral intention</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BI1</td>
<td>4.01</td>
<td>1.84</td>
<td>0.90</td>
<td>0.81</td>
</tr>
<tr>
<td>BI2</td>
<td>4.16</td>
<td>1.97</td>
<td>0.74</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Table III. Descriptive statistics of items
between factors were lower than the average variance extracted of the individual factors, confirming discriminant validity (see Table II). In summary, the measurement model demonstrated adequate reliability, convergent validity, and discriminant validity.

**Structural model**

A similar set of fit indices was used to examine the structural model (see Table I). Comparison of all fit indices with their corresponding recommended values provided evidence of a good model fit ($\chi^2/df = 3.0$, GFI = 0.90, AGFI = 0.84, NFI = 0.95, NNFI = 0.96, CFI = 0.97, RMSR = 0.034). Thus, we could proceed to examine the path coefficients of the structural model.

Properties of the causal paths, including standardized path coefficients, $t$-values, and variance explained for each equation in the hypothesized model are presented in Figure 2. As expected, hypotheses $H4$, $H5$, and $H6$ were supported, in that perceived ease of use, perceived usefulness, and perceived credibility all had a significant positive effect on behavioral intention. Altogether, they accounted for 62 percent of the variance in behavioral intention with perceived ease of use ($\beta = 0.48$) contributing more to intention than both perceived usefulness ($\beta = 0.18$) and perceived credibility ($\beta = 0.24$). In addition, hypotheses $H2$ and $H3$ were also supported. Perceived ease of use had a positive effect on both perceived usefulness ($\beta = 0.71$) and perceived credibility ($\beta = 0.64$). The total effect of perceived ease of use on behavioral intention was $0.76 (= 0.48 + 0.71 \times 0.18 + 0.64 \times 0.24)$.

As for the paths from the individual difference variable to the three TAM factors, the results were significant. All three hypotheses concerning the effects of computer self-efficacy on perceived usefulness, perceived ease of use, and perceived credibility were supported ($H1a$, $H1b$, $H1c$). Computer self-efficacy had a positive effect on both perceived usefulness and perceived ease of use, and had a negative effect on perceived credibility. The total effect of computer self-efficacy on behavioral intention was $0.56 (= 0.16 \times 0.18 + 0.63 \times 0.71 \times 0.18 + 0.63 \times 0.48 + 0.63 \times 0.64 \times 0.24 + (-0.21) \times 0.24)$.

![Figure 2. Hypotheses testing results](Image)

*Note: t-values for standardized path coefficients are described in parentheses*
Discussion
This study focused on the extended technology acceptance model to illustrate the process by which individual differences (i.e. computer self-efficacy) influence technology acceptance. Most empirical studies of TAM have examined relatively simple end-user technologies. It is not clear whether the constructs and relationships embodied in TAM would be equally applicable to more complex technologies. This study is a pioneering effort in applying TAM to the newly emerging context of Internet-based banking systems, which have become available and popular only recently. Using the technology acceptance model as a theoretical framework, this study introduced “perceived credibility” as a new TAM factor to reflect the user’s security and privacy concerns in the acceptance of Internet banking, and examined the effect of computer self-efficacy on the intention to use Internet banking.

The findings of this study strongly support the appropriateness of using extended TAM to understand the intention of people to adopt Internet banking services. Significant effects of perceived usefulness, perceived ease of use, and perceived credibility on behavioral intention were observed, with perceived ease of use exerting a stronger influence than both perceived usefulness and perceived credibility. We also found the new TAM variable (“perceived credibility”) to have a stronger influence on behavioral intention than the traditional TAM variable (“perceived usefulness”) in the context of Internet banking. Given that the usage of Internet banking is completely voluntary, and that the target user group consists of a large number of people with diversified backgrounds, the findings of this study suggest that in order to attract more users to Internet banking, it is not going to be enough to make the system easy to interact with. It is of paramount importance to develop Internet banking systems with valuable functions and with a trustworthy protection of security and privacy for the users. In addition, the Internet banking authorities need to concern themselves less with directly influencing behavioral intentions. As suggested by our extended TAM, these internal psychological processes will result if the belief formation is appropriately managed. Thus, management attention might be more fruitfully focused on the “development” of belief. Especially, the Internet banking authorities should employ training and promotion approaches to develop the customers’ beliefs of usefulness, ease of use, and credibility in the system, which in turn will influence the behavioral intention to adopt Internet banking services.

Our results provide evidence of the significant effects of the individual difference variable (i.e. computer self-efficacy) on behavioral intention through perceived ease of use, perceived usefulness, and perceived credibility. Consistent with our hypothesis, users who have a higher computer self-efficacy are likely to have more positive usefulness and ease of use beliefs, but have more negative credibility belief about the Internet banking. These findings also support prior research that has found a significant direct
relationship between computer self-efficacy and perceived ease of use (Igbaria and Iivari, 1995; Venkatesh and Davis, 1996; Agarwal et al., 2000; Venkatesh, 2000; Hong et al., 2001) and extend its generalizability to Internet banking. While computer self-efficacy had a negative effect on perceived credibility, its total effect on behavioral intention is positive. Hence, management in the banking industry can increase the usage intentions of their customers through computer self-efficacy and the three mediating TAM variables. In order to increase the computer self-efficacy of customers, the Internet banking authorities can organize training courses on various Internet applications to increase the familiarity of customers with computing technologies. Even if these courses are not directly related to the Internet banking itself, they will still help the customers to develop positive usefulness, ease of use, and credibility beliefs about the system in general.

Compared to other e-banking or e-tailing acceptance research that is based on trust or perceived risk, the findings of this study strongly suggest that “perceived credibility” has the higher ability to predict and explain the intention of users to adopt Internet banking. For example, Kim et al. (2001) found that the benevolence type of trust did not have a significant influence on the adoption of Internet banking. Liao et al. (1999) argued that reliable measures on perceived risk could not be obtained in the virtual banking environment. Pavlou (2001) also found that the multi-dimensional trust, including benevolence and credibility, was only marginally related to the intention to transact online ($p < 0.1$).

Conclusions
This research was in response to the call for user-oriented research in Internet banking services. Utilizing the extended technology acceptance model as a theoretical framework, a critical individual difference variable, computer self-efficacy, was proposed to have significant influence on the intention to use Internet banking through perceived usefulness, perceived ease of use, and perceived credibility. The contributions of this study to technology acceptance research are twofold. First, it successfully applied the extended TAM in a new information context (i.e. Internet-based banking systems) that is quite different from the systems examined in prior studies. Perceived ease of use, perceived usefulness, and perceived credibility were found to be significant antecedents of the intention to use an Internet banking system. Second, the individual difference variable (i.e. computer self-efficacy) was found to be an important determinant of perceived ease of use, perceived usefulness, and perceived credibility of the Internet banking.

The findings of this study have implications for developing usable Internet banking systems. Considering the millions of dollars that have been invested in Internet banking systems worldwide, it is of paramount importance to ensure that people will actually use them. In order to achieve this goal, attention must
be given to designing easy-to-use, useful, and trustworthy systems. The Internet banking authorities need to develop the beliefs of usefulness, ease of use, and credibility of the customers regarding Internet banking. They can do so by organizing computer training courses to increase the general computer self-efficacy of the consumers. People with higher computer self-efficacy are more readily prepared to use the Internet banking services.

This empirical study has several limitations. First, investigation of Internet banking acceptance is relatively new to IS researchers. The discussed findings and their implications are obtained from one single study that examined a particular technology and targeted a specific user group in Taiwan. Thus, we need to exercise caution when generalizing our findings and discussion to other technologies or groups. Second, we did not incorporate actual usage behavior in the proposed model. However, this is not a serious limitation as there is substantial empirical support for the causal link between intention and behavior (Taylor and Todd, 1995; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000). Third, the relatively low R-square reported by the current research represents another limitation. Hence, there may be a need to search for additional variables that will improve our ability to predict usage intentions more accurately. For example, variables related to social factors similar to subjective norm, and facilitating conditions similar to perceived behavioral control, such as are being used in other behavioral models (e.g. Ajzen and Madden, 1986) of technology acceptance might be added to our extended TAM. Some other individual differences, such as age, level of education, Internet experience, and computer anxiety, need to be investigated in the future. Prior research has found computer anxiety to be a construct quite distinct from computer self-efficacy. Future research can also examine whether system characteristics, such as screen design and feedback, have any influence on the acceptance of Internet banking. Fourth, the use of self-report scales to measure study variables suggests the possibility of a common method bias for some of the results. Future research should employ both objective and subjective measures, and examine the correspondence (or lack thereof) between them. Finally, this study was conducted with a snapshot research approach. Additional research efforts are needed to evaluate the validity of the investigated models and our findings. Longitudinal evidence might enhance our understanding of the causality and the interrelationships between variables that are important to the acceptance of Internet banking by individuals.

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**Appendix**

*Perceived ease of use*

PEU1 My interaction with the Internet banking systems is clear and understandable.

PEU2 Learning to use the Internet banking systems is easy for me.

PEU3 It would be easy for me to become skillful at using the Internet banking systems.

PEU4 I would find the Internet banking systems easy to use.

*Perceived usefulness*

PU1 Using the Internet banking systems would improve my performance in conducting banking transactions.

PU2 Using the Internet banking systems make it easier for me to conduct banking transactions.

PU3 I would find the Internet banking systems useful in conducting my banking transactions.

*Perceived credibility*

PC1 Using the Internet banking systems would not divulge my personal information.

PC2 I would find the Internet banking systems secure in conducting my banking transactions.

*Behavioral intention*

BI1 Assuming that I have access to the Internet banking systems, I intend to use it.

BI2 I intend to increase my use of the Internet banking systems in the future.

*Computer self-efficacy*

I could conduct my banking transactions using the Internet banking systems...

CSE1 ...if I had only the system manuals for reference.

CSE2 ...if I had seen someone else using it before trying it myself.

CSE3 ...if I could call someone for help if I got stuck.
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