Comparative Analysis of TAM and UTAUT Models for Digital Technology Adoption in Banking: A Meta-Regression Approach

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A R T I C L E I N F O

A B S T R A C T

This study aims to compare the role of perceived usefulness (PU) and perceived ease of use (PEU) between the TAM and UTAUT model in shaping behavioral intentions (BI) and predicting actual use (AU) of banking technology. A meta-regression analysis was conducted on 52 empirical studies that met the inclusion criteria, with the results showing that the UTAUT model is significantly superior to TAM. PU and PEU in UTAUT had a stronger influence on BI than in TAM. In addition, the relationship between BI and AU was stronger in UTAUT. This study provides theoretical contributions by strengthening the evidence of UTAUT's superiority, as and practical implications for the banking industry in designing more applicable technology adoption strategies

INTRODUCTION

Technology is an important element in supporting the operational activities and customer service of the banking sector. The adoption of financial technology (fintech), such as internet banking, mobile banking (Abrar & Ihza, 2025), cashless payment (Djaelani & Darmawan, 2021), and other similar services is increasing as an effort by banking institutions to provide faster, more practical and efficient services. In addition, the Covid-19 pandemic has also become a trigger for the banking sector to adapt to restrictions on people's mobility while still providing financial products for customers in the 'new normal' era (Kurniawan et al., 2023). Through the digitization of products and services, banks can still serve customers without the need for direct contact so that banks can continue their operational activities without reducing service efficiency (Windasari et al., 2022). Another effect of the pandemic is that digital services, which were initially taken as common, are now a crucial need for customers (Tafti et al., 2022). The adoption of digital financial technology is a concern both for customers to continue to utilize banking services, and for banks to remain relevant in the times. However, the success of digital technology adoption in the banking sector is highly dependent on users' behavioral intentions (Almashhadani et al., 2023) to adopt and use these technologies in their banking activities.

Behavioral intention (BI) serves an important role in the digital technology adoption process. BI determines whether individuals will actually use available digital services. Behavioural intention and actual use (AU) are the main factors that are often examined in studies related to technology adoption models, including the Technology Acceptance Model (TAM) (Igamo et al., 2024; Krah et al., 2024; Singh & Hess, 2020) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Islam et al., 2024; Pobee et al., 2023; Rahman et al., 2020). TAM developed by Davis (1989) emphasizes that user intentions are influenced by Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Meanwhile, UTAUT developed by Venkatesh et al. (2003) expanded this model by including additional factors such as Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC). Both of these models include convenience and usability factors in supporting behavioral intentions to adopt technology.

Several studies have shown that perceived usefulness (PE or PU) and perceived ease (EE or PEU) are key determinants of BI (Alblooshi et al., 2019; Chao, 2019; Sair et al., 2018), which in turn influence the actual use of banking technology (Setiawan et al., 2021; Tariq et al., 2024a; Venkatesh et al., 2012). Perceived Usefulness (PU) or Performance Expectation (PE) refers to the to what degree a person is confident that using the technology will improve his or her performance (Chauhan et al., 2022). In the context of banking, technology that facilitates financial transactions and provides significant benefits to users will increase users' intention to adopt it. Meanwhile, Perceived Ease of Use (PEU) or Effort Expectancy (EE) relates to the extent to which a person believes that technology is easy to use (Kavitha & Gopinath, 2020). Banking technology with an interface that is convenient to use and does not involve much work to learn is likely to increase user confidence and encourage them to adopt it. The TAM and

UTAUT models are often used in studies to measure technology adoption intentions in various sectors including the financial sector (Cassandra & Bernanda, 2024; Mensah & Khan, 2024; Rithmaya et al., 2024). However, the strengths of these models are rarely compared in the context of digital financial technology adoption, which raises the questions: (1) What is the role of perceived usefulness and perceived ease of us in shaping each model's behavioral intention (BI) in the context of banking technology adoption? (2) Which model performs better in explaining the relationship between BI and AU in digital financial technology adoption?

Answering the above questions, this meta-analysis will explain the effect of PU and PEU in the TAM and UTAUT models on the formation of banking technology adoption intention. Meta regression analysis is also conducted to test the differences between the TAM and UTAUT models in explaining behavioral intention towards the adoption of banking technology. Meta regression analysis is used because it is able to test how the characteristics of the study (model) affect the results of the effects studied (Berenstein et al., 2009). The results of this study will contribute theoretically by providing comparative evidence regarding the superiority of TAM or UTAUT in the context of banking technology adoption. This research also provides a practical contribution for banking service providers in designing strategies to increase the acceptance and adoption of digital technology by customers and employees.

LITERATURE REVIEW
Technology Acceptance Model (TAM)

TAM, conceptualized by Fred Davis (1989), is a model adapted from the Theory of Reasoned Action (TRA) that aims to analyze the factors that drive technology acceptance. TAM conceptualizes that the intention to use technology or innovation is the impact of attitudes towards technology or innovation, and these attitudes are influenced by the perceived ease of use and perceived usefulness of the technology or innovation. Several studies have discussed TAM in banking technology adoption. Perceived usefulness and perceived ease of use are shown to influence user behavioral intentions which ultimately drive the adoption of mobile banking (Nurmajid et al., 2023; Wira Hutomo, 2023), internet banking (Albort-Morant et al., 2022; Teka, 2020) and digital payments (Ly & Ly, 2022; Sharma et al., 2024).

Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT was developed to comprehend the point of view of acceptance and use of technology by its users (Venkatesh et al., 2003). UTAUT is built by four major constructs namely performance expectancy, effort expectancy, social influence, and facilitating conditions. According to UTAUT, behavioral intention and actual use are directly influenced by the four factors above (Tariq et al., 2024). Compared to other models, UTAUT is claimed to have a better ability to explain the effect of behavioral intention on actual use (Lu et al., 2009; Venkatesh et al., 2003). Several studies have examined the UTAUT model in explaining the adoption intention of banking technology. PE, EE, and FC are proven to affect students' intention to adopt fintech (Sultana et al., 2020), and Muslims' intention

to use mobile banking for zakat efficiency (Ahmad & Yahaya, 2020). Then, PE, EE, and SI are confirmed to affect fintech adoption in women-owned small businesses (Kurniasari & Lestari, 2024). Finally, PE and EE are the drivers of behavioral intention in using mobile banking in China (Mensah & Khan, 2024).

The Effect of Perceived Usefulness and Ease of Use on Behavioural Intention

Perceived usefulness is identical to the benefits that users expect from using new technology. This perception is associated with the extent to which the use of certain technologies will provide useful results for users to help ease their work (Venkatesh et al., 2003). Perceived usefulness is a vital predictor and trigger of behavioral intention to use a specified technology (Basri, 2018). In the context of banking technology adoption, perceived usefulness refers to users' understanding that banking technology will provide a more optimal banking experience and services. Then, perceived ease of us is related to user comfort in using certain technologies. Perceived ease of us is a psychological assumption that describes the user's perspective regarding the level of ease or difficulty in using a technology (Armansyah, 2021). In the context of banking technology adoption, perceived ease of us relates to the extent to which the adoption of banking technology will require effort for its users. Perceived ease of us is important to note because the amount of effort required may affect the acceptance and adoption of banking technology by users (Rithmaya et al., 2024). Users may hesitate or have difficulty using banking technology if they feel this technology is too complex and difficult. Several empirical studies have proven that perceived usefulness and convenience affect behavioral intention to adopt banking technology, such as mobile banking (Long et al., 2024; Wijaya & Noviaristanti, 2024), cashless payment (Islam et al., 2024; Rahman et al., 2020), and digital banking (Kurniawan et al., 2023b; Meiranto et al., 2024).

Behavioral Intention to Actual Use of Banking Technology

Behavioural intention is defined as an individual's desire to participate in a certain behavior (Misra et al., 2022). Actual behavior itself is defined as the continued use of technology, which shows its acceptance and integration into the user's life routine (Venkatesh et al., 2012). Behavioural intention is claimed to be an important construct especially in the context of technology adoption models to measure actual consumer behavior (Rehman et al., 2022). Analysis of behavioral intention provides precise directions regarding user behavior that contributes to changes in actual behavior. For example, behavioral intention is confirmed to affect the actual behavior of mobile banking services (Ivanova & Kim, 2022) and mobile payment (Alkhowaiter, 2022). Other research states that when users develop a desire to use technology such as digital banking, they will eventually adopt the technology (Jadil et al., 2021). Understanding the usage behavior of banking technology can help optimize customer experience, know customer trends and preferences, and develop better services and features.

METHODOLOGY

Literature Search Strategy

Articles used in this meta-analysis came from the Scopus and Science Direct databases (for English-language articles) and Sinta (for Indonesian-language articles) searched through Google Scholar. Search queries were formed using relevant keywords and logical operators (AND/OR). To ensure that the articles obtained were empirical studies with quantitative methods, keywords such as SEM and regression were added. Then, to narrow down the search in the context of banking, keywords such as fintech, mobile banking, internet banking, digital banking, cashless payment, mobile payment and e-wallet were included in the query. Lastly, to ensure that the actual adoption of the technology is included in the literature, keywords such as adoption intention, usage intention, adoption, and usage were used in the query. The initial search yielded 1617 pieces of literature. A rigorous analysis was conducted based on the following inclusion criteria: (1) the study was published through a peer-review process, (2) the scope of the study should be within the banking area, (3) the study used quantitative methods and contained the variables under study, and (4) the study provided correlation coefficients and a complete sample size. Through this screening process, 52 articles met the criteria to be used in the meta-regression analysis.

Variable Standardization

The main information to be extracted from the articles is the relationship between the dependent variable and the independent variable. However, there are some variables that have different names despite having the same meaning. In this analysis, the variables perceived usefulness and performance expectancy are standardized into perceived usefulness variables. The variables perceived ease of use and effort expectancy are standardized into perceived ease of use variables. In addition, the behavioral intention variable is the standardization of the intention to use, intention to adopt, and intention variables. Finally, the actual use variable is the standardization of the actual adoption, actual behavior and actual use variables.

Analysis Techniques

In this study, the effect size used is the correlation coefficient between variables. When the correlation coefficient was not available, other statistical values such as t-statistic and regression coefficient were converted using the method proposed by Hedges & Olkin (1985). Publication bias was first analyzed by Egger's test for all pairs of variables studied. Then, meta-analysis was conducted to measure the effect of PU and PEU on behavioral intention, as well as the effect of behavioral intention on actual use of banking technology for each model. Furthermore, meta-regression was conducted to analyze the strength between TAM and UTAUT models so that it is known whether there is a significant difference between models. Before the meta-regression was conducted, a heterogeneity test was conducted to determine the significance of variation in effect size between studies with the Q or I^2 test (Higgins, 2003). If heterogeneity is high, then a random effect model is used in the meta-regression. The regression coefficient (β) indicates how much the moderator variable (in this

study is the model) affects the effect size (Lipsey & Wilson, 2001). If the moderator is significant, it means that the model is more robust in explaining actual use in banking technology adoption.

RESEARCH RESULT

This meta-analysis reviews 52 literatures that discuss the influence of behavioral intention on actual use of banking technology based on TAM and UTAUT models. These studies analyze the relationship between perceived usefulness (PU or PE) and perceived ease of use (PEU or EE) with behavioral intention which ultimately contributes to the adoption of banking technology. Publication bias was first tested with Egger's test for each pair of variables tested, namely (1) behavioral intention with actual use, (2) perceived usefulness with behavioral intention, and (3) perceived ease of use with behavioral intention. The test results showed that these three pairs of variables showed no indication of publication bias, as evidenced by the significance of each pair being more than 0.05.

Meta-analysis was then conducted to examine these relationships within each model. The results of the analysis are summarized in the following tables.

Table 1. Meta Analysis Result for TAM Model

Variabel Dependen	Variabel Independen	coef	Sig.	CI (95%)		Q	I^2
Behavioral Intention	Perceived Usefulness	0.278	< 0.001	0.178	0.376	3396.8	98.46
	Perceived Ease of Use	0.269	< 0.001	0.167	0.372	2002.5	98.78
Actual Use	Behavioral Intention	0.443	< 0.001	0.316	0.569	1361.34	98.84

Table 2. Meta Analysis Result for UTAUT Model

Variabel Dependen	Variabel Independen	coef	Sig.	CI (95%)		Q	I^2
Behavioral Intention	Performance Expectancy	0.551	< 0.001	0.494	0.607	663.5	95.89
	Effort Expectancy	0.562	< 0.001	0.507	0.616	524.72	95.16
Actual Use	Behavioral Intention	0.625	< 0.001	0.567	0.682	533.84	95.70

Table 1 shows that in the TAM model, PU ($\beta = 0.278, p < 0.001$) has a significant effect on behavioral intention. High heterogeneity was found in these results ($I^2 = 98.78\%$), which indicates that there is considerable variation between studies. Furthermore, the results of the UTAUT model analysis in table 2 show that the relationship of PU to behavioral intention in the UTAUT model is also significant and has an effect size of $\beta = 0.551$, with $p < 0.001$ and

heterogeneity of $I^2 = 95.89\%$, which is lower than that of the TAM model, indicating that the UTAUT model research results have lower variability. Similar findings were seen in the relationship of PEU to behavioral intention, where the UTAUT model had a larger effect estimate ($\beta = 0.562$) than the TAM model ($\beta = 0.269$) and with a lower level of heterogeneity (TAM=98.78%, UTAUT=95.16%). This shows that perceived usefulness and Perceived ease of us in the UTAUT model have a greater impact on behavioral intention of banking technology adoption than the TAM model. This result is in line with the research of Rekha et al. (2020) which proves that perceived usefulness and Perceived ease of us in the UTAUT model are significant predictors that can explain 53.1% of the variance in behavioral intention, compared to the TAM model which only explains 39% of the variance in the same construct.

Behavioral intention was also shown to influence the actual use of banking technology, both in the TAM model ($\beta = 0.443, p < 0.001$), and in the UTAUT model ($\beta = 0.625, p < 0.001$). The heterogeneity of both models is also at a high level, indicating that the between-study variability in both models is significant. The difference in effect size between the two models reinforces the claim that the UTAUT model is more effective in explaining banking technology adoption than TAM, especially in predicting whether users will actually use the pre-planned technology (Alalwan et al., 2016). This finding supports the research results of Cassandra & Bernanda (2024) which prove that the UTAUT model can predict behavioral intention by 70.1%, higher than the TAM model which is at 50.8% in explaining the same construct.

The findings in this study consistently show that the UTAUT model has different strengths from the TAM model in predicting the actual adoption of banking technology by behavioral intention which is constructed by PU and PEU. However, the difference in effect size itself is not enough to provide information on whether the UTAUT model is indeed more robust than the TAM model in predicting the adoption of banking technology. Therefore, further analysis using meta-regression with the model as a moderator variable was conducted to test whether this difference was significant and meaningful. A summary of the meta-regression results with moderators is shown in Table 3 below.

Table 3. Meta-Reggression Result with Moderator

Dependen Variable	Independen Variable	Intercept (TAM)	Moderator (UTAUT)	p-value	R^2
Behavioral Intention	Perceived Usefulness	0.279	0.275	< 0.001	30.73%
	Perceived Ease of Use	0.271	0.289	< 0.001	32.75%
Actual Use	Behavioral Intention	0.446	0.178	0.006	14.66%

Table 3 shows that PU and PEU are shown to have a stronger and significant effect in the UTAUT model than the TAM model. PU in the UTAUT model has a 0.275 stronger effect with significance <0.001 on behavioral intention, PEU in the

same model also has a 0.289 stronger effect with significance <0.001 on behavioral intention. In addition, behavioral intention in the UTAUT model is confirmed to be able to predict actual use 0.177 stronger with a significance of 0.006 than the TAM model. This finding is consistent with the research results of Rondan-Cataluña et al. (2015) which proves that the UTAUT model produces better predictive power than other models including TAM in the context of mobile internet service users.

DISCUSSION

The results of the above analysis indicate that there is a considerable difference in the magnitude of the effect between the TAM and UTAUT models in estimating the effect of PU and PEU on behavioral intention in the adoption of banking technology. The UTAUT model has significant superiority over TAM in explaining the adoption of digital banking technology. This advantage is reflected in the stronger effect on the relationship between PU and PEU on behavioral intention, as well as the relationship between behavioral intention and actual use. In addition, the lower heterogeneity in the UTAUT model suggests that it provides more consistent results across studies than TAM. This result supports the theoretical proposition that the UTAUT model is more comprehensive than TAM because it considers additional factors such as Social Influence and Facilitating Conditions (Venkatesh et al., 2003). Although PU and PEU have a significant influence on BI in TAM, the magnitude of the influence may vary based on contextual factors such as technology type and user characteristics (King & He, 2006). In addition, TAM also has limitations in explaining social factors (Legris et al., 2003), which may explain the high heterogeneity in this model.

The most notable effect difference occurs in the relationship between perceived ease of use and behavioral intention, indicating that the ease of use aspect in UTAUT (Effort Expectancy) more strongly predicts behavioral intention than the similar construct in TAM (Perceived Ease of Use). This may be due to the inclusion of contextual factors in UTAUT that are more relevant to the user experience of banking technology (Kurniawan et al., 2023). For example, Facilitating Conditions in UTAUT is able to capture aspects of technical support and infrastructure that are crucial in the adoption of digital banking services. Then, the high value of residual heterogeneity for all models indicates that there is substantial variation in effect size between studies that is not fully explained by model differences. Although the model variables were able to explain about 30% of the heterogeneity for the relationship of PU and perceived ease of use to behavioral intention, this proportion dropped to only 14.66% for the relationship of behavioral intention and actual use. This finding is in line with the research of Almashhadani et al. (2023) who found that external factors such as organizational policies and government regulations often play an important role in the actual use stage of banking technology that is not covered by both models.

The findings of this study make an important contribution to the development of technology adoption theory, especially in the context of banking. The consistent results regarding the superiority of UTAUT over TAM reinforce

the theoretical proposition that social and contextual factors play a crucial role in determining technology adoption intention and behavior (Venkatesh et al., 2003). However, the high unexplained heterogeneity suggests the need to extend these models to include banking sector-specific variables, such as trust and risk perception, which have been identified as important determinants in the fintech literature (Almashhadani et al., 2023). Finally, this study emphasizes the importance of an adaptive approach in banking digital transformation strategies. The technology adoption model must be continuously adapted to the dynamics of users and the evolving socio-cultural context.

CONCLUSIONS AND RECOMMENDATIONS

This study consistently proves that UTAUT is superior to TAM in predicting the adoption of digital banking technology, mainly due to its ability to accommodate social and contextual factors. The meta-regression results show that UTAUT provides stronger effects on the relationship of perceived usefulness and perceived ease of use to behavioral intention, and behavioral intention to actual use of banking technology. However, high heterogeneity indicates the need for consideration of additional moderators such as user characteristics, technology type, and cultural context.

Based on the findings, several recommendations are proposed. First, the use of the UTAUT model as an evaluation framework can help banks identify critical factors that influence customer behavior towards digital service adoption. Second, the findings on the strong influence of Effort Expectancy (EE) in UTAUT highlight the importance of investing in attractive interface design and user education programs, especially for the less tech-savvy customer segment. In addition, to increase actual use (AU), banks need to ensure alignment between digital services and organizational policies and external regulations

ADVANCED RESEARCH

Despite the contributions made, this study recognizes some limitations. First, although 52 studies were used, some studies did not provide all the required correlation coefficients so some studies were excluded in the meta-regression. Second, moderators other than the model have not been taken into account, so future research can explore other moderators such as age, education level, type of banking technology to test their influence. Finally, not all constructs in UTAUT were used so future research can compare the TAM and UTAUT models as a whole using SEM meta-analysis.

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