A Comparative Analysis of Factors Influencing the Adoption of Internet-Based Financial Transactions

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Abstract

This study examined the impact of the security, trust, and reliability of internet-based financial transactions, including internet banking, online securities brokerage, foreign exchange (FX), cryptocurrency, and smartphone-specific securities, on customer satisfaction. SHAP (SHapley Additive exPlanations) of machine learning was adopted to avoid assuming a particular stochastic distribution. The main results were: (1) Security, trust, and reliability were essential to customer satisfaction in using internet-based financial transactions overall. (2) The importance of security/trust was confirmed, especially in internet banking and cryptocurrency. Three key items of security and trust, which encompass a full range of security measures, effective management, and company credibility, significantly impact customer satisfaction, particularly in internet banking. On the other hand, the effect of company credibility was most pronounced in the cryptocurrency. (3) The effect of usefulness was larger than that of security, trust, and reliability. Cryptocurrency is a new technology that is expected to support the e-society of the future, but it also entails risks. Therefore, customers are concerned about the company's credibility and require the disclosed information to be clear. The contribution of this study is to compare the particularities among internet-based financial transactions in Japan from the viewpoint of customer satisfaction by machine learning.

Keywords: *internet-based financial transactions, internet banking, cryptocurrency, security measures, company credibility, SHAP (SHapley Additive exPlanations)*

1. INTRODUCTION

The security, trust, and reliability of internet-based financial transactions form a critical part of the infrastructure of today's e-society. While information and communication technologies (ICT) have been transforming society for decades, leveraging their potential is not always straightforward, as rapid progress also introduces new threats. Internet-based financial services, such as online banking, have enabled customers to reduce transaction costs and save time by eliminating the need for in-person visits. They can also access information and make inquiries conveniently through social media platforms like LINE. However, this convenience comes with inherent risks, making security measures essential. Internet banking, as one of the most widely used online financial services, is now

Table 1: Eleven e-SQ dimensions by [Zeithaml, 00]

(1)	Reliability	Correct technical functioning of the site and the accuracy of service promises (having items in stock, delivering what is ordered, delivering when promised), billing, and product information.
(2)	Responsiveness	Quick response and the ability to get help if there is a problem or question.
(3)	Access	Ability to get on the site quickly and to reach the company when needed.
(4)	Flexibility	Choice of ways to pay, ship, buy, search for, and return items.
(5)	Ease of navigation	Site contains functions that help customers find what they need without difficulty, has good search functionality, and allows the customer to maneuver easily and quickly back and forth through the pages.
(6)	Efficiency	Site is simple to use, structured properly, and requires a minimum of information to be input by the customer.
(7)	Assurance/trust	The confidence the customer feels in dealing with the site is due to the reputation of the site and the products or services it sells, as well as the clear and truthful information presented.
(8)	Security/privacy	The degree to which the customer believes the site is safe from intrusion and personal information is protected.
(9)	Price knowledge	The extent to which the customer can determine the shipping price, total price, and comparative prices during the shopping process.
(10)	Site aesthetics	Appearance of the site.
(11)	Customization/ personalization	How easily and how much the site can be tailored to individual customers' preferences, histories, and shopping habits.

accessible through multiple channels—including PCs, tablets, and smartphones—and offers a broad range of features, such as loyalty points, promotional campaigns, brokerage account integration, personal finance apps, electronic money, and split-account services.

Particular attention should be given to cryptocurrency, which leverages the decentralized nature of blockchain to operate as a peer-to-peer monetary system independent of governmental or institutional control. Unlike traditional financial assets, cryptocurrencies are not backed by any central authority. Regulatory bodies such as the SEC have cautioned investors about their risks (Clayton et al., 2017). Although blockchain technology now extends beyond digital currency to smart contracts, it fundamentally relies on cryptography for security (Ghosh et al., 2020). Due to the absence of underlying assets, cryptocurrency prices can fluctuate sharply based on user demand and other market dynamics, simultaneously mitigating and introducing risks.

As internet-based transactions—including online shopping and smartphone payments—have become deeply embedded in everyday life, trust remains central to their adoption. Yet, the online financial ecosystem is highly vulnerable to cyberattacks, requiring continuous development of robust security measures. Against this background, this study examines how security, trust, and reliability influence customer satisfaction in internet-based financial services, including internet banking, online securities trading, foreign exchange (FX), cryptocurrency, and smartphone-based investment platforms. Additionally, other factors such as responsiveness, price, and usefulness are considered within the framework of e-Service Quality (e-SQ).

We hypothesize that the results differ for various types of transactions. In Section 2, we provide an overview of previous studies, and in Section 3, we present the details of the theoretical framework. After that, we conduct the data analysis in Section 4. Section 5 summarizes the issue, and Section 6 provides the conclusion.

2. LITERATURE REVIEW

First, we will provide an overview of the basic framework for applying to e-transactions before addressing the main issue. The current measurement of perceived service quality can be traced to the research of Parasuraman, Zeithaml, and Berry (Cronin, J. & Taylor, 1992). Zeithaml et al. (2000) define e-SQ (Electronic Service Quality) broadly to encompass all phases of a customer's interactions

with a website, specifically the extent to which a website facilitates efficient and effective shopping, purchasing, and delivery.

The e-SQ dimensions are: (1) reliability, (2) responsiveness, (3) access, (4) flexibility, (5) ease of navigation, (6) efficiency, (7) assurance/trust, (8) security/privacy, (9) price knowledge, (10) site aesthetics, (11) customization/personalization. While it is not always possible to fully apply e-SQ dimensions to the analysis of financial transactions by using the internet, evaluating the quality of service can be helpful. Many previous studies have relied on this framework.

We introduce another well-known framework for deciding whether to adopt new technologies. The Technology Acceptance Model (TAM) posits that two variables, perceived ease of use and perceived usefulness, mediate the complex relationship between system characteristics (external variables) and potential system usage (Marangunić & Granić, 2015).

The e-SQ and TAM are essential frameworks for previous studies focusing on e-financial transactions. We summarize the following previous studies. Liao and Cheung (2002), which was prior literature from the early 2000s, relatively early and comprehensive in its analysis, showed that expectations of accuracy, security, network speed, user-friendliness, user involvement, and convenience were the most important quality attributes underlying perceived usefulness in Internet-based e-banking. User-friendliness has clear and easy-to-follow instructions, simple operating procedures, light hard- and software requirements, ready availability of help facilities, and efficiently designed websites. User involvement, which describes a situation where the individual could exercise a high degree of perceived control when banking on the Internet, is measured by the questionnaire: being able to terminate transactions any time before confirmation and performing operations at preferred speeds. Convenience is measured by the items of access at any time, access from anywhere, and a wide variety of services readily accessible. Twum and Ahenkora (2012) examined how trust in the Internet banking system (security, transaction reliability, privacy), trust in the Internet banking provider, awareness of Internet security threats, and knowledge of protective measures influenced customer perception of Internet banking security. According to Vimi (2016), customer satisfaction with Internet banking was depicted with six factors: (1) reliability, which refers to the ability of one to perform the promised service accurately; (2) efficiency, for example, secure, instant feedback; bank information; (3) comfort which is defined as whatever makes life easy; (4) security; (5) dependability which assesses the quality of the integrated processes applied to technology; (6) confidence which is closer to the notion of legitimacy and is something that institutions have to earn and sustain.

Similar analyses have been conducted in Internet securities brokerage services. Balasubramanian et al. (2003) considered trust as an endogenously formed entity that ultimately impacts customer satisfaction, and it elucidated the linkages between trust and other factors related to the performance of the online service provider and the service environment. Balasubramanian et al. (2003) suggested that the perceived trustworthiness of an online broker was a significant antecedent to investors' satisfaction and that perceived environmental security and operational competence impact the formation of trust. Yang and Fang (2004) found that (1) responsiveness, (2) competence, which was the ability to solve problems, knowledge to answer questions, research capacity, and quickly solve problems, (3) service reliability, and (4) ease of use are key determinants of both satisfaction and dissatisfaction. Roca (2009) suggested that perceived trust, usefulness, and ease of use are important issues in online trading systems.

Compared with other currencies, cryptocurrency has a particular aspect: decentralized transactions (Jiang, Li & Wang, 2021). Bitcoin and Ethereum are two such cryptocurrencies that have leveraged the decentralized nature of blockchain (Ghosh et al., 2020). Nevertheless, the spread of cryptocurrency is a new phenomenon, and much research has already been conducted. It is essential to note that cryptocurrency is closely tied to social media. Crypto trading has also emerged during the era of social media, leading to a strong social media culture of crypto advisors, influencers, and more experienced advisors on platforms such as

YouTube (Delfabbro et al., 2021). Cryptocurrency enthusiasts have created social media groups (Yeong et al., 2022). Therefore, social influence is added to the factors affecting cryptocurrency use and customer satisfaction. Shahzad et al. (2018) indicated that awareness and perceived trustworthiness were significant factors in determining the intention to use Bitcoin, while perceived usefulness partially mediated the relationship between perceived ease of use and intention to use. Chen et al. (2022) revealed that social influence, price value, traceability, and attitude were all impactful in the adoption of cryptocurrency, with customer satisfaction mediating these effects. Yeong et al. (2022) concluded that performance expectancy, social influence, facilitating conditions, and price value affect an individual's adoption behavior. Performance expectancy is derived from the degree to which people believe that using cryptocurrency will enhance their job performance.

The common factors cannot be examined for every e-financial transaction. Our study compares each e-financial transaction, focusing on the security, trust, and reliability mentioned above in the next section.

Recent global research further enriches the understanding of digital finance adoption beyond the Japanese context. For example, Raimo et al. (2023) conducted a comprehensive systematic literature review of digital finance adoption worldwide, highlighting that perceived ease of use, security, social influence, and regulatory support are consistently significant determinants of adoption. Importantly, they emphasize that the relative importance of these factors varies across institutional and cultural environments, suggesting that trust formation and risk perception are shaped by broader structural contexts.

In a regional empirical setting, Rashid et al. (2024) examined digital payment adoption among Generation Z in Malaysia and found that convenience, perceived cost, security, innovativeness, and social influence significantly influence adoption intentions. Their results underscore the persistent importance of trust-related constructs—particularly perceived security—even among younger cohorts who are often early adopters of emerging financial technologies.

Together, these studies provide complementary perspectives that situate our findings within a broader academic conversation. They demonstrate that the determinants of digital finance adoption are consistent across diverse contexts, yet their manifestations differ depending on technological maturity, regulatory structures, and cultural environments. Integrating these global insights strengthens our argument that credibility—as a distinct construct—becomes increasingly salient as financial services transition from centralized to decentralized systems such as cryptocurrency.

3. THEORETICAL FRAMEWORK

The rapid evolution of internet-based financial services has transformed how individuals interact with financial institutions and platforms. As these services have expanded from traditional internet banking to decentralized systems such as cryptocurrency, the theoretical constructs underpinning customer satisfaction require deeper examination. In particular, the triad of trust, reliability, and credibility has emerged as foundational to understanding user behavior and perceptions in digital finance. While previous studies have often treated these concepts interchangeably, their conceptual boundaries—and their relevance across different financial services—demand a more precise delineation. This section reexamines existing theoretical frameworks, introduces credibility as an independent construct, and situates it within the broader landscape of electronic service quality and technology acceptance.

3.1. Reconsidering trust, reliability, and credibility

Trust has long been regarded as a critical determinant of technology adoption and customer satisfaction in online services. Rooted in social psychology and organizational theory, trust is defined as a user's willingness to be vulnerable to the actions of a service provider, based on the expectation that the provider will act competently and benevolently (Balasubramanian et al., 2003; Vimi, 2016). In the context of internet-based financial transactions, trust refers to the psychological belief that a platform or institution will safeguard users' assets and

act in their best interest.

Reliability, by contrast, denotes the technical consistency and predictability of a system's performance. As captured in the e-SQ framework (Zeithaml et al., 2000), reliability encompasses the correct functioning of online platforms, accurate execution of transactions, and adherence to promised services. Reliability builds the infrastructural basis upon which trust can form but does not guarantee it; a system can be technically reliable without engendering user trust if users perceive other forms of risk.

Emerging from the distinct characteristics of decentralized finance is the construct of credibility, which we define as the perceived legitimacy, transparency, and accountability of the information sources and entities associated with a financial service. Unlike trust, which involves a relational expectation toward a provider, credibility concerns the epistemic foundation of decision-making: users' confidence in the truthfulness and integrity of the information on which they base their actions. This distinction is particularly salient in cryptocurrency environments, where no central authority guarantees transactions, regulatory oversight is limited, and price dynamics are highly volatile (Ghosh et al., 2020; Harrast et al., 2022). In such contexts, credibility arises not from institutional guarantees but from transparent disclosure, verifiable protocols, and the perceived integrity of service providers or exchanges.

This tripartite conceptualization suggests that trust, reliability, and credibility operate at different analytical levels: Reliability is primarily technical (system functionality and accuracy). Trust is primarily relational (confidence in provider intentions and behavior). Credibility is primarily epistemic (belief in the truthfulness and legitimacy of information).

These distinctions are not merely semantic; they reflect different antecedents, mechanisms, and outcomes in the customer satisfaction process. For instance, a bank's secure system (reliability) may not foster trust if the institution has a history of misconduct, and a cryptocurrency platform may fail to achieve credibility even with strong encryption if information disclosure is opaque.

3.2. Extending e-SQ and TAM with credibility

The e-Service Quality (e-SQ) framework (Zeithaml et al., 2000) provides a foundational model for evaluating online services, encompassing dimensions such as reliability, responsiveness, assurance/trust, and security/privacy. However, its original formulation presupposes the presence of centralized actors—banks, brokers, or regulated entities—whose legitimacy is taken for granted. In decentralized contexts, where such actors may be absent or opaque, credibility emerges as an independent and indispensable dimension. It is no longer sufficient to assume that "assurance" or "trust" will be derived from institutional reputation; credibility must instead be actively constructed through transparent governance, open-source verification, and traceable transaction histories.

Similarly, the Technology Acceptance Model (TAM), originally proposed by Davis (1989) and further elaborated by Marangunić and Granić (2015), emphasizes perceived ease of use and perceived usefulness as key mediators of system adoption. Yet TAM does not explicitly address the role of information legitimacy, particularly in contexts where users must evaluate not just system functionality but also the veracity and transparency of the information underpinning the service. Building on the original formulation by Davis (1989), integrating credibility into TAM refines the model by highlighting an additional antecedent to perceived usefulness and behavioral intention in decentralized finance. For example, in cryptocurrency platforms, users' perception of a system's usefulness is closely tied to whether they deem the disclosed information—about security measures, token issuance, or transaction fees—to be credible.

3.3. Hypotheses

Building upon the refined conceptualization above, this study tests the following hypotheses across five types of internet-based financial transactions:

H1: Security, trust, reliability, and credibility significantly affect customer satisfaction across all internet-based financial transactions, with their relative importance varying by service type.

H2: Usefulness significantly affects customer satisfaction across all internet-based financial transactions.
H3 (New): Credibility emerges as a distinct and dominant determinant of customer satisfaction in decentralized financial services, particularly cryptocurrency, where institutional guarantees are absent.

This expanded framework provides a more nuanced theoretical foundation for understanding how users evaluate and adopt internet-based financial services. By distinguishing between trust, reliability, and credibility—and by situating credibility as a new, independent construct—this study extends existing theoretical models and lays the groundwork for analyzing how customer satisfaction dynamics evolve in both centralized and decentralized financial ecosystems.

4. DATA ANALYSIS OF CUSTOMER SATISFACTION WITH EACH INTERNET-BASED FINANCIAL TRANSACTION

4.1. Data set and methodology

This study utilizes the data from the "Oricon dataset," which includes internet-based financial transactions in Japan (Oricon ME Inc., 2023). This dataset examines customer satisfaction with internet-based financial transactions, specifically, the question "Overall, how satisfied are you with your experience?" and variables that may affect customer satisfaction, drawing on previous studies. All variables are measured on a 10-point Likert scale (10 points: Very satisfied ← → 1 point: Very dissatisfied). All data were collected in 2021.

Internet-based financial transactions in this study encompass internet banking, online securities brokerage, foreign exchange (FX), cryptocurrency, and smartphone-specific securities. No previous study has examined customer satisfaction with foreign exchange (FX); however, factors derived from e-SQ dimensions, which have been used in other internet-based financial transactions, are applied.

Many previous studies have conducted PLS-SEM (Partial Least Squares Structural Equation Modeling). PLS-SEM could be sensitive to sample size. PLS-SEM tends to be more lenient in its assumptions about measurement models. While this flexibility can be advantageous in some cases, it can also lead to oversimplification or misspecification of measurement models.

On the contrary, we adopted SHAP (SHapley Additive exPlanations) because we do not assume a particular stochastic distribution and causality among variables. SHAP (SHapley Additive exPlanations) is a cooperative game theoretic approach that explains the output of any machine learning model. It connects optimal credit allocation with local explanations using the classic Shapley values from game theory and their related extensions. SHAP (SHapley Additive exPlanations) is the unified approach for model interpretation proposed by (Lundberg & Lee, 2017). Machine learning and deep learning have been adopted rapidly because of their accuracy in predicting. However, those methods are criticized due to their black-box nature. Explainable Artificial Intelligence (XAI), including SHAP, is expected to enhance the transparency of models based on Machine learning and deep learning.

Empirical studies that deployed SHAP have recently increased. Homafar et al. (2022) aimed to model the coking coal index. Jabeur et al. (2021) forecasted the gold price using SHAP. Bussmann et al. (2021) applied correlation networks to Shapley values, grouping Artificial Intelligence predictions according to the similarity in the underlying explanations in credit risk management. Alenezi and Ludwig (2021) used Tree, Deep, and Kernel of SHAP (SHapley Additive exPlanations) to detect cybersecurity threats.

The Shapley value is expressed in the linear explanatory model (Homafar et al, 2022).

$$f(x) = \varphi_0 + \sum_{i=1}^{N} \varphi_i x_i' \quad (1)$$

f denotes the mapping function by machine learning. Inputs x' and are related through the mapping function. N represents the number of input features. φ_0 is the average of all predictors and φ_i is the SHAP value for the *i th* feature.

$$\varphi_i = \sum_{S \subseteq N \setminus \{x_i\}} \frac{|S|!(|N|-|S|-1)!}{|N|!} [V(S \cup \{x_i\}) - V(S)] \quad (2)$$

S is the subset of N, which does not contain features, and N denotes all of them. $[V(S \cup \{x_i\}) - V(S)]$

Table 2: Comparing common variables among Internet-based financial transactions

		Internet-based banking	online securities brokerage	FX	cryptocurrency	smartphone-specific securities
customer satisfaction	N	10410	5476	2463	1967	1338
	average	7.58	7.37	7.22	7.42	7.42
	median	8	8	7	8	8
	S.D.	1.54	1.46	1.58	1.61	1.61
security measures	N	10410	5476	2463	1967	1338
	average	6.92	6.78	6.97	6.83	6.83
	median	7	7	7	7	7
	S.D.	1.71	1.58	1.64	1.66	1.66
company credibility	N	10410	5476	2463	1967	1338
	average	7.28	7.27	7.27	7.14	7.14
	median	7	7	7	7	7
	S.D.	1.70	1.60	1.67	1.75	1.75

Table 3: Category and item: Internet banking

Security/Trust	Ease of understanding of security measures (including handling of personal information and my number) Full range of security measures (login and biometric authentication, transaction notification emails, tokens (one-time passwords), etc.) Company Credibility Soundness of management
Responsiveness	System improvement of the online banking site and quick updating of the dedicated application. Details of the response of the person in charge of the inquiry
Reliability	Frequency of maintenance of online banking site and dedicated application (fewer glitches)
Price value	Deposits (including foreign currency) interest rates (including interest and interest expense) ATM transaction fees Preferential services (stage system, interest rates, number of free ATM withdrawals, number of free transfers, etc.) Transfer fees for online banking services Full range of promotions and co-branded points (e.g., special interest rate promotions, etc.)
Usefulness/User friendliness/Ease of use	Full range of products and services (loans, insurance, FX, foreign currency deposits, mutual funds, auctions, public auctions, debit cards, etc.) Ease of understanding of products and services (loans, insurance, FX, foreign currency deposits, mutual funds, auctions, public auctions, debit cards, etc.) Uniqueness of products and services (products and services not offered by other banks) Information and notifications about products and services (e.g., push notifications via email, LINE, and apps) Good design of the online banking site (color and layout, text color and size, line spacing and text layout, etc.) Ease of understanding of My Page (top page after login) on the online banking site (menu structure including page transitions and button placement) Ease of use of My Page (top page after login) on the online banking site (deposit management such as balance and deposit/withdrawal history) Ease of finding information from My Page (top page after login) of the online banking site Ease of transacting on the online banking site (e.g., deposit money to a past payee with fewer operations) Good design of the dedicated application (color and layout, text color and size, line spacing and text layout, etc.) Ease of understanding of the top page of the dedicated application after login (menu structure including page transitions and button placement) Ease of use of the top page of the dedicated application after logging in (balance, deposit and withdrawal history, and other deposit management) Ease of finding information from the top page after logging in to the dedicated app Full functionality of dedicated apps (push notifications, fingerprint and smart authentication, asset management, etc.) Ease of operation of the dedicated application (easy to use, smooth operation, etc.) Ease of transactions with the dedicated application (e.g., deposit funds to past transfers with fewer operations) Ease of various administrative procedures (membership registration, change of address, etc.) without the need to visit a store Ease of automatic utility bill payment procedures Ease of setting limits (e.g., for transfers, payment of various fees, etc.) Ease of identification procedures (submission of identification documents, notification of one's own number, etc.) Ancillary services (including transaction notification service, affiliated points, etc.) Ease of integration with other services (e.g., linking accounts with brokerage firms, household account bookkeeping apps, electronic money, and split-account apps) Ease of integration with smartphone payment services (deposit, auto-charge, etc.) Ease of use of ATMs (including affiliated ones) Ease of understanding of preferential terms and conditions (stage system, interest rates, ATM withdrawal fees, conditions for transfer fees, etc.) Ease of using promotions and co-branded points Full range of inquiry methods (phone, chat, email, LINE, etc.) Ease of understanding the contact information

is the marginal contribution when added to the subset S. $\frac{|S|!(|N|-|S|-1)!}{|N|!}$ is the probability of adding x_i. The sum of the marginal contribution multiplied by its probability of occurrence is the SHAP value. We consider x_i as each explanatory variable in this paper. Therefore, we obtain its degree of influence on customer satisfaction.

Table 2 compares the common variables among each internet-based financial transaction. The sample size is sufficiently large, with more than 1,000 respondents in every case, and basic statistics, such as the average, median, and standard deviation (SD), do not show significant differences.

4.2. Internet banking

Both traditional banks and online-only banks operate internet banking. Table 2 shows the groups of each questionnaire. Ease of various administrative procedures, transfer fees for online banking services, a full range of security measures, sound management, and company credibility have the top five highest impacts on customer satisfaction

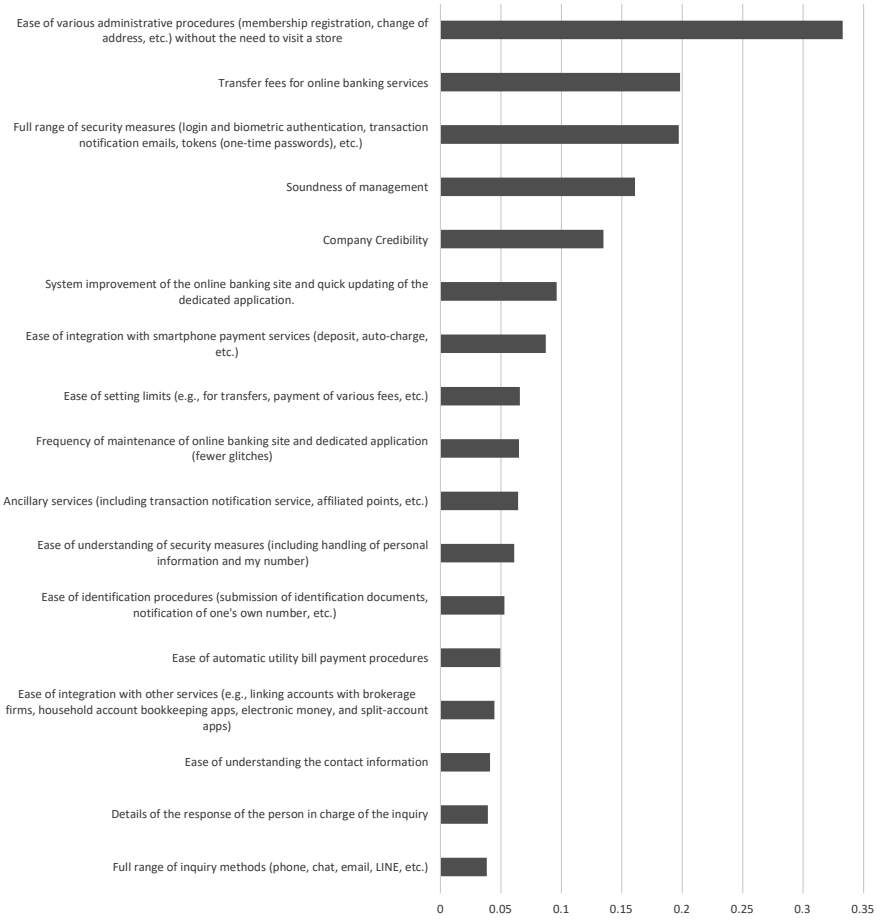


Figure 1: Absolute value of mean of SHAP value: internet banking

in internet banking (see Figure 1). A full range of security measures, sound management, and company credibility are key to security and trust. The ease of various administrative procedures is a key factor in usefulness. The transfer fees for online banking services are included in the price value. It is worth noting that the three items were included in security and trust. The effect of the ease of various administrative procedures is the largest.

4.3. Online securities brokerage

Online securities brokerage is operated by both traditional securities companies and those that exclusively trade on the internet, without physical branches. The groups of each questionnaire are described in Table 4.

Ease of account opening procedures, reasonableness of transaction fees, ease of viewing and using the website, types of products in which you can invest, and company credibility have the top five highest impacts on customer satisfaction in Online securities brokerage (see Figure 2). The effect of the ease of account opening procedures is the largest.

4.4. FX

Customers can buy and sell FX through Forex Broke, security companies, and banks. FX is one of the investment methods with a high risk of short-term trading, and Investors are sensitive to short-term price fluctuations and profit margins. The groups of each questionnaire are described in Table 5.

A full range of order methods, ease of account opening procedures, reasonableness of transaction fees, company credibility, relevance of the spread,

Table 4: Category and item: online securities brokerage

Security/Trust	Stability of system and Internet connection Security measures Company Credibility
Responsiveness	Response time for inquiries
Reliability	Reasonableness of transaction fees Reasonableness of deposit and withdrawal costs Maintenance frequency of website and trading (order) tools
Price value	Well-developed points program (e.g., points based on the amount of commodity transactions and trading commissions)
Usefulness/User friendliness/Ease of use	Ease of account opening procedures Smoothness of account opening (time required to open an account) Membership Privileges and Campaigns Ease of understanding transaction fees Types of products in which you can invest (categories such as domestic stocks, foreign stocks, FX, mutual funds, bonds, etc.) Lineup by products in which you can invest (domestic stocks: fractional units, etc.; foreign stocks: Malaysian stocks, etc.; investment trusts: investment trust savings, etc.) Volume of IPOs and POs handled and ease of acquisition Ease of searching for investment and financial products Ease of use of trading (order) tools and website trading menu, ease of placing orders Ease of viewing and using the website (including My Page and individual products (charts) within My Page) The quality of the free analysis tools (amount of information, functionality, real-time updates, etc.) Ease of viewing, manipulating, and using the charts in the analysis tool Abundance of various rankings and ease of screening stocks Ease of viewing and managing the list of products held Ease of understanding performance and information Abundance of deposit and withdrawal channels Abundance of information provided (analyst reports, market information, etc.) Quality of information provided (analyst reports, market information, etc.) The quality of workshops and seminars Full range of inquiry methods Ease of understanding the contact information

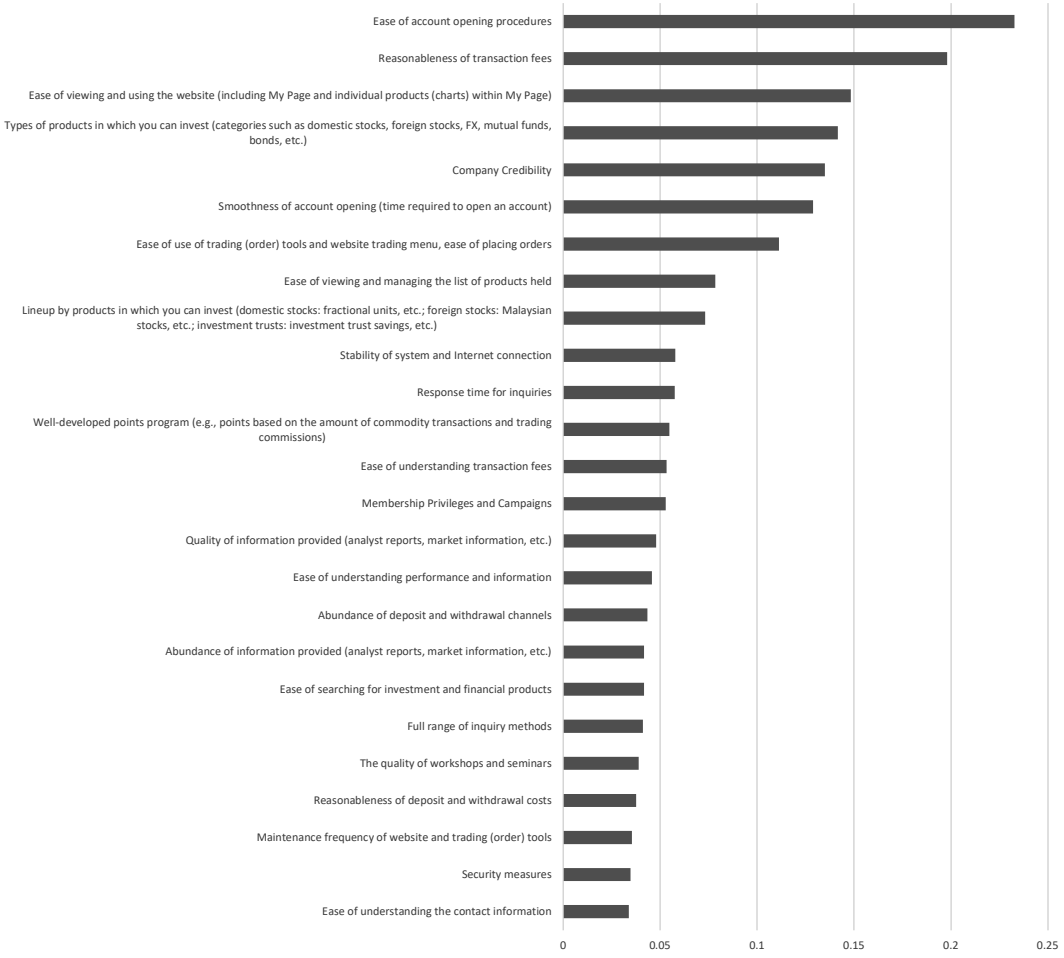


Figure 2: Absolute value of mean of SHAP value: online securities brokerage

Table 5: Category and item: FX

Security/Trust	Stability of system and Internet connection Security measures Company Credibility
Responsiveness	Response time for inquiries
Reliability	Reasonableness of transaction fees (when trading, currency units, deposits, withdrawals, account management, etc.) Relevance of the spread Maintenance frequency of website and trading (order) tools
Usefulness/User friendliness/Ease of use	Ease of account opening procedures Membership Privileges and Campaigns Smoothness of account opening (time required to open an account) Full range of order methods (stop-loss orders, OCO orders, IFD orders, etc.) Currency Pair Types Ease of search Ease of use of trading (order) tools and website trading menu, ease of placing orders Ease of viewing and using the site (including My Page and individual products (charts) within My Page) Analytical tools (volume of information, functionality, real-time updates, etc.) Ease of forecasting and chart comparison (number of types of technical indicators (moving average, MACD, etc.), historical chart comparison) Ease of viewing, manipulating, and using the charts in the analysis tool Abundance of information provided (analyst reports, market information, etc.) Quality of information provided (analyst reports, market information, etc.) The quality of workshops and seminars Full range of inquiry methods Ease of understanding the contact information

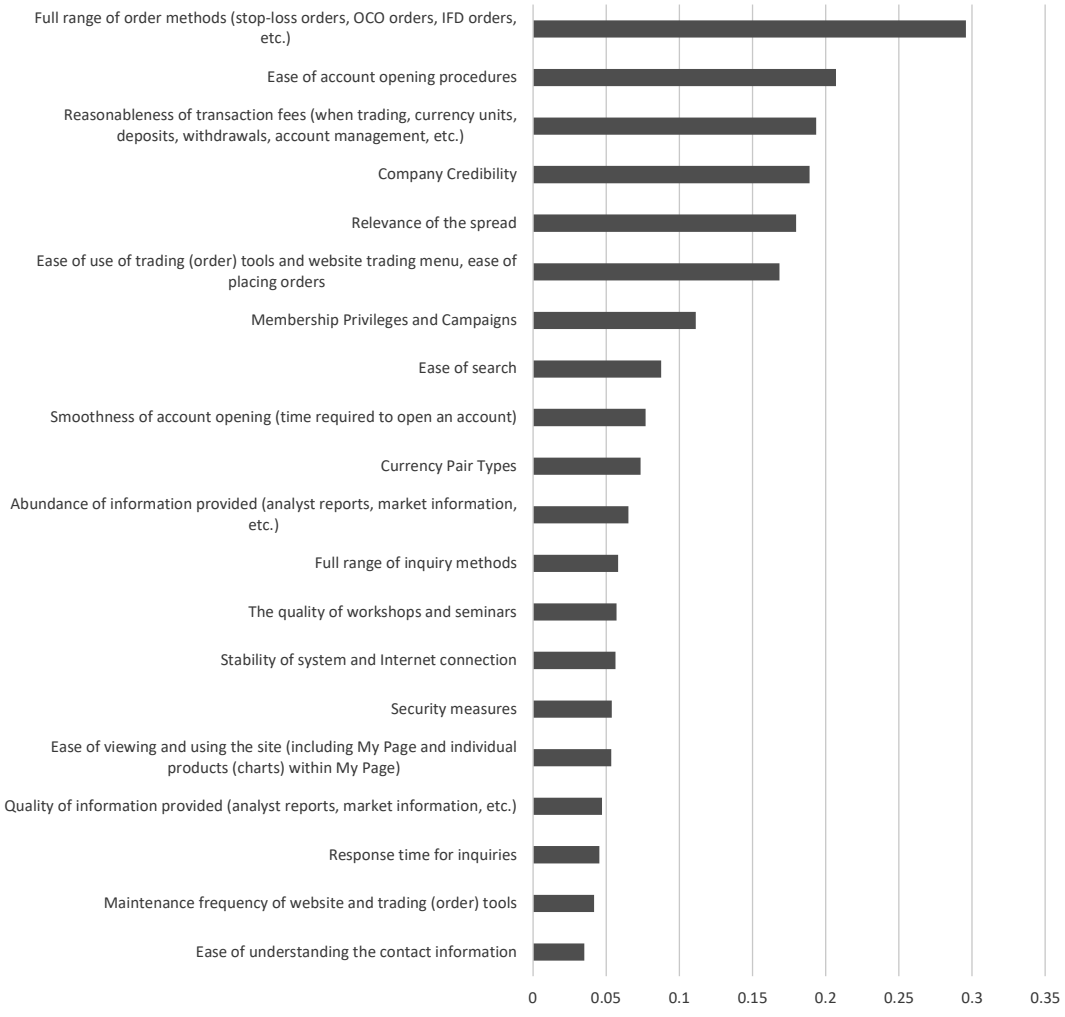


Figure 3: Absolute value of mean of SHAP value: FX

Table 6: Category and item: cryptocurrency

Security/Trust	Stability of system and Internet connection Security measures (two-step verification, cold wallets, etc.) Company Credibility
Responsiveness	Responding to inquiries
Reliability	Relevance of the spread (difference between bid and offer prices) Reasonableness of fees (transactions, deposits, withdrawals, etc.) Clarity of information disclosed (currency handled, fees, security system, etc.)
Usefulness/User friendliness/Ease of use	Ease of account opening procedures Smooth account opening process Ease of viewing the application and website (charts, trading screens, etc.) when trading Ease of use of the application and website (charts, trading screens, etc.) when trading Variety of currencies Smoothness of transactions The functionality of the application and site in transactions (alerts, point redemption function, etc.) Abundance of information provided (market information, etc.) Quality of information provided (market information, etc.) Ease of understanding of campaign details (e.g., eligibility requirements) Full campaign content Ease of understanding how to contact us

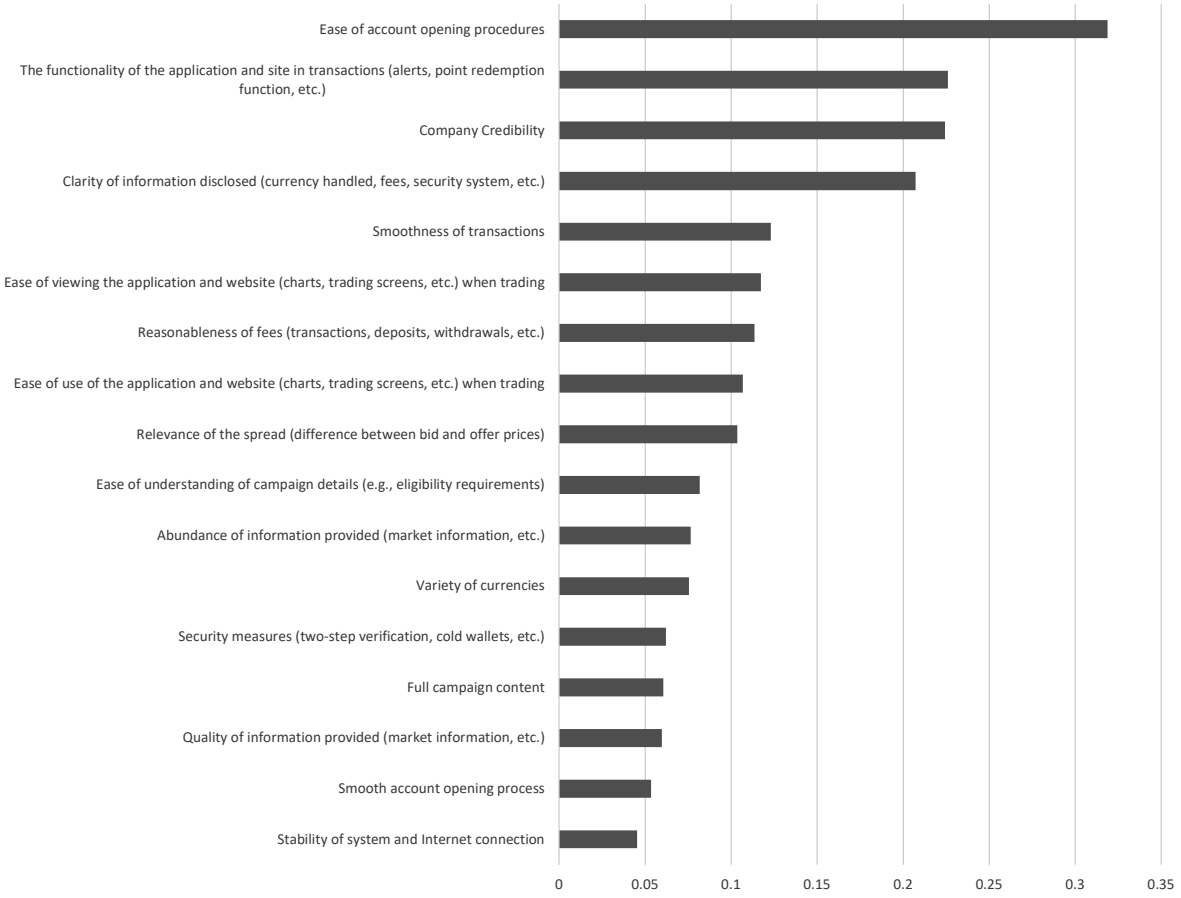


Figure 4: Absolute value of mean of SHAP value: cryptocurrency

Table 7: Category and item: smartphone-specific securities

Security/Trust	Stability of system and screen transitions (Does the screen run smoothly without freezing?) Security measures Company Credibility
Responsiveness	Transaction acceptance response time Response time for inquiries
Reliability	Reasonableness of transaction fees Reasonableness of deposit and withdrawal costs Frequency of website and trading (order) tool maintenance (fewer glitches)
Usefulness/User friendliness/Ease of use	Ease of account opening procedures Membership Privileges and Campaigns Smoothness of account opening (time required to open an account) Ease of understanding transaction fees Adequacy of service lineup (IPO, cash, margin trading, etc.) Types of products in which you can invest (e.g., number of domestic stock issues in which you can invest) Ease of searching for stocks Ease of viewing the application and website (including My Page and individual products (charts) within My Page) Good design of the app/website (colors, layout, legibility of text, size, etc.) Operability of the application and website (including My Page and individual products (charts) within My Page) Ease of viewing and managing the list of products held Ease of understanding performance and information Variety of deposit and withdrawal channels (bank accounts, credit cards, etc.) Ease of accumulating points Ease of using points (e.g., to purchase investment products) Ease of collecting information (including information on official SNS) Ease of understanding information (cartoon/video explanations, easy-to-understand expressions, etc.) Abundance of market and stock information (rankings, market information, shareholder special benefit information, etc.) Ease of understanding articles and content Ease of understanding Q&A content Full range of inquiry methods Ease of understanding the contact information

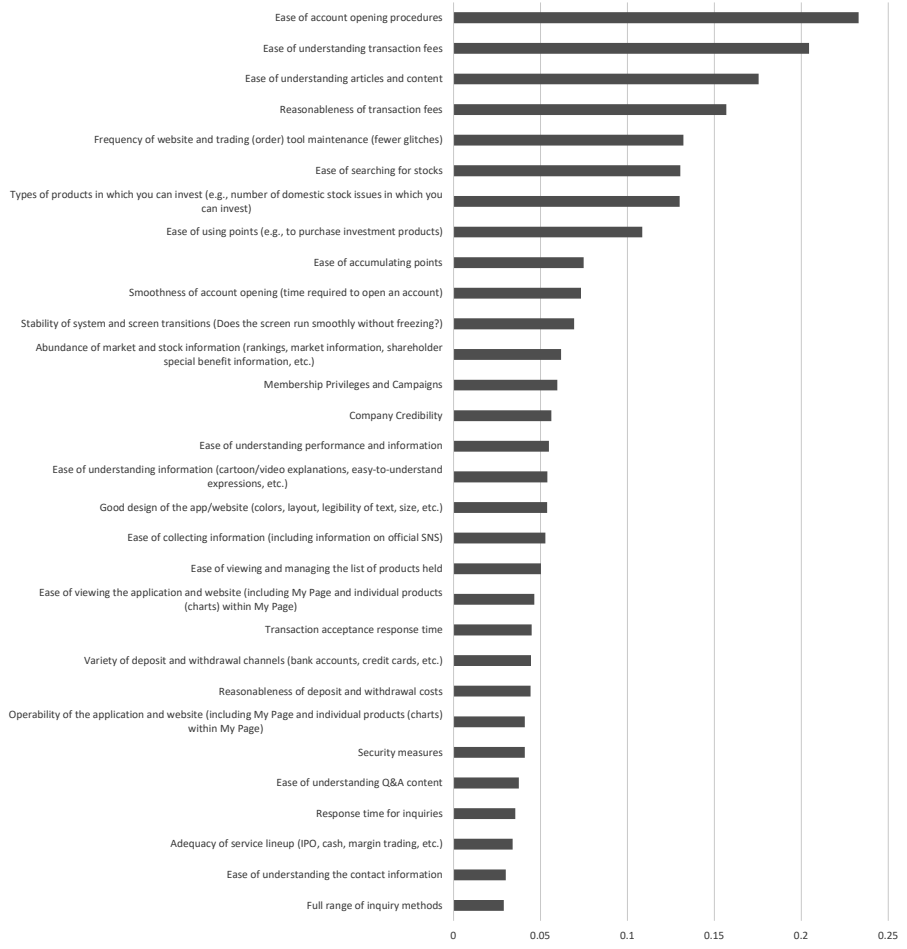


Figure 5: Absolute value of mean of SHAP value: smartphone-specific securities

and ease of use of trading tools, etc., impact customer satisfaction in FX (see Figure 3). Three items are useful, and each one is in security/trust and reliability. The effect of the full range of order methods is the largest.

4.5. Cryptocurrency

Customers can trade cryptocurrency at a cryptocurrency exchange, a platform or service that allows users to buy, sell, trade, and manage various cryptocurrencies and digital assets. The groups of each questionnaire are described in Table 6.

Ease of account opening procedures, the functionality of the application and site in transactions, company credibility, and clarity of information disclosed are crucial to customer satisfaction in cryptocurrency (see Figure 4). Company credibility encompasses security and trust, and the clarity of information disclosed is a key factor in reliability. Ease of account opening procedures, as well as the application's and site's functionality in transactions, are key factors in assessing usefulness. The effect of the ease of account opening procedures is the largest.

4.6. Smartphone-specific securities

Smartphone-specific securities services, specializing in smartphone stock trading, operate in both traditional securities companies and those that exclusively trade online, without physical branches. The groups of each questionnaire are described in Table 7.

Ease of account opening procedures, ease of understanding transaction fees, ease of understanding articles and content, and reasonableness of transaction fees all impact customer satisfaction in smartphone-specific securities (see Figure 5). The first three items are related to usefulness, and the last one is related to reliability. The effect of the ease of account opening procedures is the largest.

4.7. Summarized results by SHAP

The results showed that security/trust and reliability affected customer satisfaction in every internet-based financial transaction. It has been found that three key items of security and trust, which encompass a full range of security measures, effective management, and company credibility, significantly impact customer satisfaction, particularly in internet banking. On the other hand, the effect of company credibility was most pronounced in the cryptocurrency. From the above, hypothesis H1 was partially verified, and it was also found that some results were not initially expected. Additionally, it was found that usefulness significantly impacted customer satisfaction in every internet-based financial transaction. In all cases, the results showed that usefulness had the most significant impact on customer satisfaction. The hypothesis (H2) was completely verified. These findings provide empirical support for H3, including that credibility emerges as a distinct and particularly silent determinant of customer satisfaction in cryptocurrency services.

5. DISCUSSIONS

The findings of this study confirm that security, trust, reliability, and usefulness all play significant roles in shaping customer satisfaction across internet-based financial transactions. However, our analysis further reveals that these constructs are not uniform in meaning or impact across service types. In particular, the emergence of credibility as a distinct determinant—especially in the context of cryptocurrency—underscores the need to rethink existing theoretical frameworks in digital finance. This section discusses the broader implications of these results, synthesizes comparative insights across financial service types, and reflects on the evolving nature of trust and credibility in both centralized and decentralized environments.

5.1. Comparative insights across financial service types

Our comparative analysis demonstrates that the relative importance of trust-related constructs differs substantially depending on the structural and institutional characteristics of each financial service. Internet banking remains anchored in institutional trust, where users rely on established banks and regulatory safeguards. Here, customer satisfaction is strongly influenced by comprehensive security measures, sound management, and the overall credibility of the institution. The emphasis is on maintaining trust in a mature, regulated

environment.

In online securities brokerage, trust is shaped by both institutional reliability and functional performance. Factors such as transaction fees, the range of investment products, and the usability of trading tools dominate customer satisfaction. While security and company credibility remain relevant, they are perceived as baseline requirements rather than differentiating factors. This indicates that once a minimum level of trust is achieved, functional quality and efficiency become more salient in customer evaluations.

The FX market, characterized by high volatility and short-term trading, exhibits a hybrid trust dynamic. Here, reliability—such as system stability and execution speed—is paramount, but credibility remains critical in shaping user confidence in spreads, order methods, and market information. Customers are particularly sensitive to transparent pricing and the integrity of transactional data, reflecting a convergence of technical reliability and epistemic credibility.

The cryptocurrency domain diverges most sharply from these patterns. The absence of centralized governance shifts the locus of user confidence from institutional trust to credibility—the perceived legitimacy, transparency, and accountability of platforms and information sources. Our findings show that company credibility and clarity of disclosed information exert a stronger influence on satisfaction than traditional security measures. This reflects a fundamental transition in the nature of trust: rather than being conferred by institutional reputation, trust in cryptocurrency must be constructed through credible communication, verifiable security practices, and transparent operational disclosures.

Finally, smartphone-specific securities emphasize convenience and usability as key determinants of satisfaction. While reliability and security are necessary, they are overshadowed by ease of account opening, clarity of transaction fees, and accessibility of investment information. Trust in this context is embedded in seamless user experience rather than in institutional assurances or epistemic evaluation.

These differences highlight the need to view trust not as a monolithic construct but as a context-dependent phenomenon shaped by institutional, technical, and informational structures. They also suggest that credibility's prominence grows as the locus of control shifts away from centralized authorities, marking an evolution in how users conceptualize and experience trust.

5.2. The Evolution of Trust in Decentralized Financial Systems

The transition from traditional financial services to decentralized systems such as cryptocurrency reveals a paradigm shift in how trust is formed and maintained. In conventional contexts, trust is predominantly institutional: users rely on banks, securities firms, or regulatory agencies to ensure the safety and reliability of transactions. Reliability serves as the technical substrate of this trust, and credibility is often implicit, grounded in institutional reputation and regulatory oversight.

Decentralized finance disrupts this model by removing—or radically transforming—the role of central authorities. In the absence of institutional guarantees, credibility becomes the primary mechanism through which trust is established. Users must now evaluate the transparency of code, the legitimacy of protocols, and the clarity of disclosed information. This shift elevates credibility from a secondary attribute of trust to an independent determinant of user confidence and satisfaction.

Moreover, the social layer of credibility becomes increasingly salient. As prior studies note (Delfabbro et al., 2021; Yeong et al., 2022), social media communities, peer recommendations, and influencer endorsements significantly shape perceptions of cryptocurrency platforms. These decentralized sources of legitimacy stand in contrast to institutional trust and further highlight the epistemic dimension of credibility.

The implications of this shift are twofold. First, existing theoretical models such as e-SQ and TAM, which assume centralized service providers, require adaptation to capture the unique dynamics of decentralized trust formation. Second, practitioners must recognize that credibility in decentralized systems cannot be "inherited" from institutional authority but must be actively constructed through transparent communication, verifiable security measures, and community engagement.

5.3. Toward a refined theoretical framework

The empirical evidence from this study suggests that the triadic model of trust, reliability, and credibility provides a more comprehensive understanding of customer satisfaction in internet-based financial services than traditional binary models. In centralized contexts, reliability and institutional trust remain fundamental, but credibility increasingly mediates user perceptions as services diversify and decentralize. In decentralized contexts, credibility emerges as the foundation upon which trust and perceived usefulness are built.

Building on the original formulation of TAM (Davis, 1989), this study extends the model by identifying credibility as a critical antecedent to perceived usefulness and behavioral intention, particularly in environments where the authenticity and integrity of information cannot be taken for granted. For the e-SQ framework, credibility functions as a new quality dimension that captures users' evaluations of transparency, legitimacy, and accountability—factors not adequately addressed in the original formulation. This refined conceptualization highlights how credibility shapes user confidence in decentralized financial ecosystems and underscores the need to rethink traditional models of technology adoption in the context of emerging financial services.

6. CONCLUSIONS

This study examined the determinants of customer satisfaction across five types of internet-based financial transactions—Internet banking, online securities brokerage, foreign exchange (FX), cryptocurrency, and smartphone-specific securities—using SHAP, a machine learning interpretability method. By avoiding assumptions about stochastic distributions and causal structures, SHAP enabled a more transparent and nuanced analysis of how security, trust, reliability, usefulness, and credibility shape user evaluations of financial services.

The findings reaffirm several key insights. First, security, trust, and reliability remain foundational to customer satisfaction across all service types, particularly in Internet banking, where institutional safeguards and comprehensive security measures are central to user confidence. Second, usefulness consistently exerts the strongest influence on satisfaction, indicating that functional value and ease of use are critical determinants regardless of service type. Third, and most importantly, credibility emerges as a distinct and dominant determinant in decentralized financial contexts, such as cryptocurrency, where institutional authority is absent and users must rely on transparent information disclosure and perceived legitimacy to guide their decisions.

6.1. Theoretical contributions

This study makes several theoretical contributions to the literature on digital finance and service quality. Most notably, it introduces credibility as a new and independent construct—distinct from trust and reliability—within the frameworks of e-SQ and TAM. By conceptualizing credibility as the perceived legitimacy, transparency, and accountability of information sources, this research expands the explanatory power of existing theories, particularly in contexts where traditional institutional guarantees no longer apply.

Furthermore, the study extends e-SQ by identifying credibility as a new dimension of e-service quality, one that captures users' epistemic evaluations of information integrity alongside existing dimensions such as reliability and assurance. It also enriches the Technology Acceptance Model (TAM) by positioning credibility as a critical antecedent to perceived usefulness and behavioral intention, thereby offering a more complete account of technology adoption dynamics in decentralized financial ecosystems.

The comparative analysis across five service types deepens our theoretical understanding of how the sources and mechanisms of trust evolve as financial services move from centralized to decentralized architectures. It shows that while trust in traditional services is largely institutional and reliability-based, credibility becomes the linchpin of trust formation in decentralized systems, where governance is distributed and information asymmetry is more pronounced.

6.2. Practical implications

The findings offer several practical implications

for financial service providers and policymakers. For traditional financial institutions, the results underscore the continued importance of robust security measures, transparent communication, and reliable service delivery in sustaining customer trust. Enhancing usability and streamlining account-related procedures also remain critical for improving satisfaction and adoption.

For cryptocurrency platforms and other decentralized services, the implications are more profound. Because institutional trust cannot be assumed, credibility must be actively constructed through transparent disclosure of security protocols, clear communication of risks, and verifiable operational practices. Service providers should prioritize information clarity, ensure the visibility and traceability of transactions, and engage actively with user communities to establish legitimacy. Regulators, meanwhile, can support credibility-building efforts by developing frameworks that enhance transparency and accountability without undermining decentralization's core principles.

6.3. Future research directions

This study opens several avenues for future research. First, further work is needed to develop measurement scales for credibility and to validate them across different cultural and regulatory environments. Second, future studies could examine the dynamic interplay between credibility and social influence, particularly in the context of peer-to-peer platforms and social trading communities. Finally, longitudinal research could explore how trust, reliability, and credibility evolve over time as users gain experience with decentralized financial services.

In sum, this study contributes to both theory and practice by redefining how we understand trust-related constructs in digital finance. By distinguishing credibility as a standalone determinant and demonstrating its pivotal role in decentralized environments, it offers a refined theoretical lens for analyzing customer satisfaction and provides actionable insights for practitioners seeking to build confidence in the rapidly evolving landscape of internet-based financial services.

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