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Bank Digital Transformation and Customer Loyalty: The Mediating Role of Customer Experience – Evidence from Iraq

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Abstract

Purpose. This study examines whether customers' perceptions of their bank's digital transformation (BDT) are associated with their loyalty in Iraq, and whether customer experience (CX) accounts for part of this association. **Design/methodology/approach.** The model draws on the resource-based view and expectation-confirmation theory. A 32-item questionnaire was administered to digital banking users at 20 bank branches in central and southern Iraq between January and September 2026, and the 392 valid responses were analysed using partial least squares structural equation modelling (PLS-SEM) with 5,000 bootstrap resamples. **Findings.** BDT had a significant positive total effect on customer loyalty ($\beta = 0.54$, $p < .001$) and a significant positive effect on CX ($\beta = 0.58$, $p < .001$). CX carried an indirect effect of 0.28 (95% BCa CI [0.22, 0.34]), or about 52% of the total effect, while the direct effect remained significant ($\beta = 0.26$, $p < .001$), indicating partial (complementary) mediation. The same paths held in state-owned and private banks, and the differences between the two groups were not significant. **Research limitations/implications.** The cross-sectional, self-reported design supports associations rather than causal claims, and the sample is limited to digital users in central and southern Iraq. **Practical implications.** Banks should evaluate digital investment by its effect on how customers experience ease, speed, security and satisfaction. Regulators could complement electronic-payment targets with measures of customer experience. **Originality/value.** The study tests a customer-level pathway from bank digital transformation to loyalty in a developing banking market where evidence on this pathway is scarce.

Keywords: *bank digital transformation; customer experience; customer loyalty; expectation-confirmation; Iraqi banks; partial least squares structural equation modelling.*

1. Introduction

Banks have shifted much of their service delivery to digital channels and invest heavily in digital platforms in the expectation that these investments will strengthen customer loyalty (Setiawan et al., 2026). Digital investment, however, does not translate into loyalty automatically. Consumers evaluate digital services in terms of their ease of use, convenience, security, and satisfaction; so whether a bank's digital function engenders loyalty hinges on its customers' actual perceptions of the service (Chauhan et al., 2022; Mackay et al., 2025). Customer experience is thus an increasingly prominent focus of digital banking research.

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Most studies of bank digital transformation have only measured performance at the bank level. Zhu and Jin (2025), who use panel data on Chinese commercial banks for 2011–2021, find that BDT has a positive impact on bank financial performance (ROA) with efficiency, operational capabilities, and profitability mediating this effect. (More broadly, the evidence on performance is somewhat mixed: Do et al. (2022) find a positive effect of BDT on Vietnamese banks, Nguyen-Thi-Huong et al. (2023) find a negative effect despite efficiency improvements, and Zhang (2026) finds that digital transformation has not improved profitability in most of the 116 Chinese commercial banks for which they have data). If BDT does not affect financial performance, it may still be reflected in customer service quality and retention.

Customer side evidence has increased over recent years but is inconsistent. Setiawan et al. (2026) survey 360 mobile and internet banking customers of five Indonesian banks and find that digital transformation predicts loyalty both directly and through co-created service experience, which accounts for 42.6% of the effect. In Sierra Leone, Mackay et al. (2025) find that engagement mediates the link between content marketing and loyalty in digital banking, and that switching costs moderate this link. Gazi et al. (2025) show that customer satisfaction mediates the effects of service quality and reliability on e-banking loyalty in Bangladesh. Chauhan et al. (2022) review 88 studies published between 2001 and 2021 and propose a framework linking digital banking features to customer experience, satisfaction, loyalty and financial performance. Many of these studies place service quality or satisfaction at the centre of the model; few treat the bank's digital transformation as an investment whose effect works through customers' experience.

The question is particularly pressing in Iraq. According to the Central Bank of Iraq (CBI), the number of bank cards rose from about 16.2 million in 2022 to about 19.8 million in 2023, transactions with local cards increased by 61% to about 18.6 million, and transactions through mobile phones and e-wallets rose by 140.6% to about 13.2 million (Central Bank of Iraq, n.d.-a). Adoption is still uneven. The CBI notes that a large share of real-sector transactions are still conducted in cash (Central Bank of Iraq, 2025), and its national strategy for bank lending makes the expansion of electronic payments a priority (Central Bank of Iraq, n.d.-b). Iraqi researchers have begun to study e-banking from the customer's perspective. Abdul Kareem et al. (2023) survey 165 customers of Iraqi banks and link electronic banking services to satisfaction, reliability, responsiveness and safety, while Al-Naseri et al. (2023) examine e-banking service quality and loyalty in Iraqi state banks. Judging from their published abstracts, both studies focus on e-banking service quality and on satisfaction or loyalty; neither treats bank digital transformation as an antecedent or customer experience as a mediating mechanism.

Three gaps follow. First, the link between a bank's digital transformation and customer loyalty has been tested in only a few settings, and the customer-experience mechanism in fewer still. Secondly, existing Iraqi research and data on e-banking and loyalty is mostly descriptive and issue-based, mainly in the issue of service quality, which is not what and how transformation occurs. Thirdly, despite the fact that Iraq's banking industry consists of privately owned and state banks, there has been no investigation as to whether the same customer path occurs in both.

These are the questions this paper aims to fill. Does the way customers perceive their bank's digital transformation influence whether they stay loyal? And does customer experience mediate this relationship? Using survey data from customers of state-owned and private banks in central and southern Iraq, the study first describes the levels of digital transformation, customer experience and loyalty that customers report. It then tests whether BDT is directly related to loyalty and to customer experience, and whether customer experience mediates the relationship between BDT and loyalty. Finally, it compares these relationships across state-owned and private banks.

The closest study is that of Setiawan et al. (2026), who find that co-created service experience partly mediates the association between perceived digital transformation and loyalty among Indonesian bank customers. The present study differs in three respects. First, its mediator is the functional experience of digital banking (ease of use, speed, perceived security and satisfaction), grounded in expectation-confirmation theory, rather than customers' participation in co-creating the service. Second, it compares the pathway across state-owned and private banks and tests whether the

measures are invariant between the two groups. Third, it occurs in a market with low levels of account ownership, and where cash continues to be the primary means of exchange in the market (Klapper et al., 2025).

This study contributes in two ways. Theoretically, it constructs a customer-level model of BDT using resource-based and expectation-confirmation logic and tests whether customer experience mediates the BDT-loyalty relationship. Practically, it provides bank managers and regulators with knowledge of where digital service investments have impact at the customer level, which is relevant to Iraq's national push toward electronic payments.

2. Theoretical Background and Hypotheses

2.1 Bank digital transformation

In this paper, BDT is presented with three aspects: digital strategy, digital business and digital management (Hanelt et al., 2021; Hess et al., 2016). Digital strategy is how a bank determines and manages its digital investments (Hess et al., 2016; Bharadwaj et al., 2013). Digital business refers to how digital technologies impact a bank's process, products, services and relationships with other firms (Bharadwaj et al., 2013; Hess et al., 2016). Digital management is about the organizational design, governance and capabilities to adapt and continuously improve (Hanelt et al., 2021). All three dimensions are measured with the items of a questionnaire completed by customers who use the bank's digital services. Customer-side evidence is limited but suggestive: Boufounou et al. (2022) find that customer satisfaction in Greek banks rose after transformation, although employees took on additional workload. Customer-based measures depict the bank's digital capability from a customer point of view. As such, these measures are perceptual as opposed to purely bank measures.

2.2 Customer experience

Customer experience is defined as 'the customer's cognitive, affective, behavioral, and social response to the bank's offerings across the spectrum of brand and customer relationships' (Lemon & Verhoef, 2016). Verhoef et al. (2009) show that experience is shaped by factors the firm controls, such as the service interface and channel design, as well as by customer and situational factors. In digital banking, experience can be divided into four dimensions that matter to customers: ease of use, speed, perceived security and overall satisfaction. These dimensions have been found in previous research (e-service quality, efficiency, fulfilment, system availability and privacy, Parasuraman et al., 2005; Ease of use, Venkatesh et al., 2003). The study of technology acceptance most commonly uses these dimensions as key concepts (ease of use). The measure of CX in this study consists of these four dimensions.

2.3 Customer loyalty

Customer loyalty is defined as a customer's intention to continue to do business with a provider and preference for that provider over others (Oliver 1999). Dick and Basu (1994) state that loyalty includes attitudinal commitment and repeat patronage and that these two concepts should be treated simultaneously. Based on this distinction, in this paper, loyalty is accessed through intention to continue, recommendation and share of business with the bank.

2.4 Theoretical lens

Two bodies of theory underpin this model. Firstly, the resource-based view (Barney, 1991) models' digital transformation as an investment in a resource that can develop a capability, in this case the capability to offer a more rewarding customer experience. Secondly, expectation-confirmation theory explains the link between experience and loyalty. Customers build an expectation of a service, compare their actual experience with the expectation and form a level of satisfaction that will determine their future use (Oliver, 1980). Bhattacherjee (2001) adapted this mechanism to explain the continued use of information systems. Analogously, digital channels generate customer expectations for ease, speed, security, if those expectations are confirmed satisfaction and then loyalty is supported, otherwise the customer is less likely to continue to use digital channels, no matter the amount the bank has invested in the channel. This intuition provides some basis for a customer experience-led channel between transformation and loyalty but also may help to explain the continued existence of a direct effect of BDT.

2.5 The Iraqi context

Growth in electronic payments is recent. The CBI describes cash as still prominent in real-sector transactions (Central Bank of Iraq, 2025), and its national strategy for bank lending prioritises the expansion of electronic payments (Central Bank of Iraq, n.d.-b). Several constraints shape adoption. Account ownership remains low: according to the Global Findex 2025, 30.2% of Iraqi adults held an account in 2024 (18.6% in 2021) and 25.0% had made or received a digital payment, even though 91.5% owned a mobile phone (Klapper et al., 2025). A large proportion of both consumers and merchants remain unbanked (Shafaq News, 2026), digital skills remain low (The National, 2025) and we still face the demon of trust and network effects (Shafaq News, 2026) that inhibit greater adoption. The right experience may therefore matter more than in markets where existing customers have high levels of trust with digital channels, but we cannot test this theory with the current data. Cash transfer customers may also use digital services for different reasons than voluntary customers and the two groups may respond to different incentives. This is another reason for estimating separately on state-owned and private bank data.2.6 Hypotheses

H1 (direct effect). Bank digital transformation influences customer loyalty positively and significantly. Customers who believe their bank to be digital savvy may have a reason to prefer and remain loyal to their bank regardless of the outcome in each service encounter. Setiawan et al (2026) find that digital transformation has a direct positive influence on loyalty, which lines up with resource-based argument that capabilities have worth in addition to their performance effects**.**

H2 (BDT and Customer Experience). Bank digital transformation enhances customer experience positively and significantly. Digital capabilities such as sleek apps, integrated channels, and faster processing should facilitate customers' transactions by improving their ease, speed, and security (Kitsios et al., 2021). Similarly, this is in line with the mechanics and functional clues that constitute the digital banking experience (Chauhan et al., 2022), in addition to the positive impacts on service experience in the e-service literature (Lee & Lee, 2019).

H3 (mediation). Customer experience partly (complementarily) mediates the effect of bank digital transformation on customer loyalty. Following expectation-confirmation logic, a better experience confirms expectations and enhances

satisfaction, and that increases loyalty. Since BDT also affects loyalty through alternative routes such as perceived reputation and reliability, a direct effect is expected to exist as well. Those relationships are depicted in Figure 1.

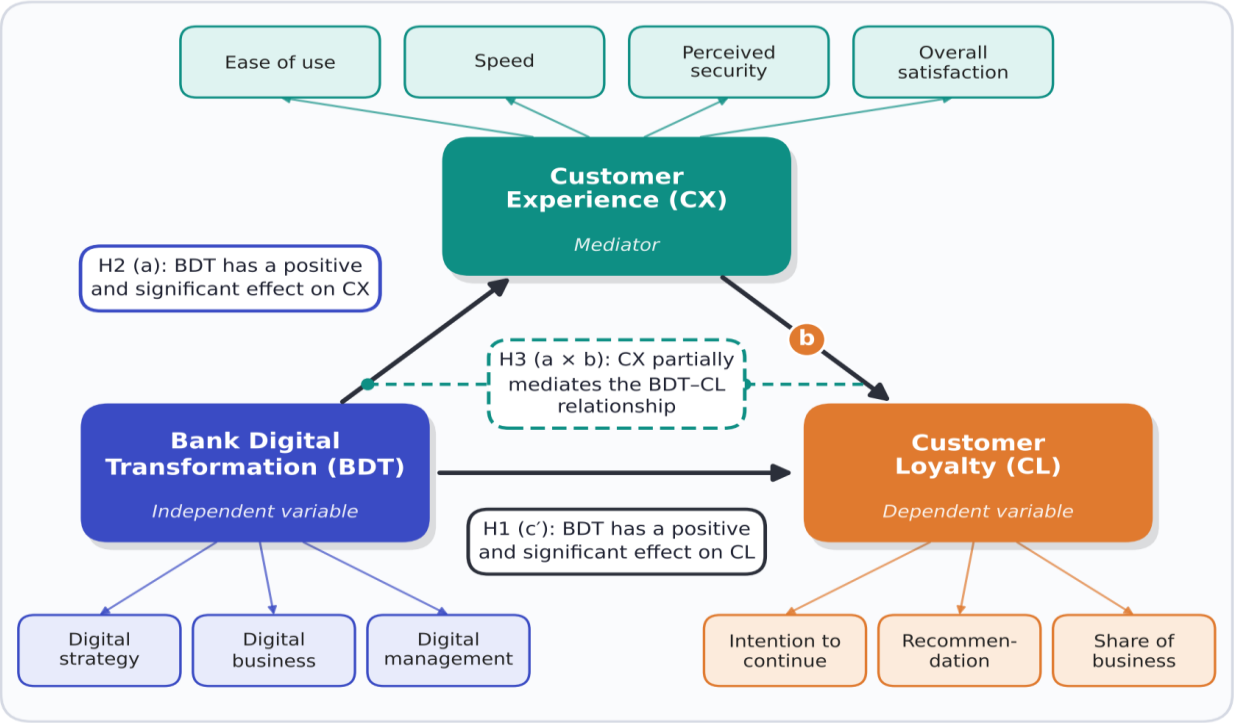


Figure 1. Conceptual model

3. Method

3.1 Design and context

Research Methods Descriptive-analytical, cross-sectional Research sample / data collection the data collected via a questionnaire, and the model tested via PLS-SEM. Through the Iraqi banking sector, and all the banking sector with state-owned and private banks working side by side according to the national policies for electronic payments.

3.2 Population, sample and data collection

The population consists of customers of banks in Iraq who use at least one digital service: a mobile banking app, internet banking, an electronic card or QR-code payment. Data were collected between 2 January and 9 September 2026 at 20 bank branches (collection sites) in five governorates of central and southern Iraq (Baghdad, Karbala, Najaf, Diyala and Babil), with four branches per governorate, two state-owned and two privates. The Kurdistan Region were not included in the study. The respondents were customers from state-owned banks as well as private banks and the type of bank that the person was in is indicated separately. The study was limited to those who have used at least one digital service and results here refer only to digital users. A convenience sample was used and was nationally stratified according to governorate and bank type. Questionnaires were distributed in two ways: through an online Google Form and on paper at bank branches. An online submission provided the code of the branch to which it was linked, and a paper submission provided the code of the branch in which it was submitted. As the dataset captures no information on the method by which a response was made it cannot report the proportion of responses by channel. To obtain at least 384 valid responses, the sample size given by Cochran's formula (Cochran, 1977) at 95% confidence and a 5%

margin of error, 450 questionnaires were distributed. This target also exceeds the minimum implied by the ten-times rule for PLS-SEM (Hair et al., 2022): the largest number of arrows pointing at a single construct is seven (CL, with two construct predictors and five controls), which requires at least 70 cases. Of the 450 questionnaires distributed, 400 were completed and returned (a response rate of 88.9%), and 392 remained valid after screening (87.1% of those distributed).

3.3 Instrument and content validity

The instrument is a 32-item questionnaire using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The items were drafted for this study. The three BDT dimensions follow the digital transformation literature reviewed in Section 2.1, and the CX and loyalty items are adapted from the service and loyalty literature (Table 1). All items refer to the respondent's own bank ('my bank'). This bank was not recorded and cannot be recovered, so the collection site is not necessarily the bank being evaluated. The English version is given in Appendix A, and the Arabic version, which respondents completed, in Appendix B. A panel of six experts in bank management and technology management reviewed the questionnaire for content and clarity. The Arabic version was translated by accredited translation offices.

3.4 Variables and controls

Table 1 lists the constructs, their dimensions and their sources. The control variables are age, gender, education, years as a customer and bank type (state-owned = 1, private = 0).

Table 1. Variables, dimensions and sources

Variable	Role	Dimensions	Items	Derived from
Bank digital transformation (BDT)	Independent	Digital strategy, digital business, digital management	12	Digital transformation literature (Section 2.1)
Customer experience (CX)	Mediator	Ease of use, speed, perceived security, overall satisfaction	12	Lemon & Verhoef (2016); Parasuraman et al. (2005)
Customer loyalty (CL)	Dependent	Intention to continue, recommendation, share of business	8	Oliver (1999); Dick & Basu (1994)

3.5 Estimation and analysis

The model was estimated with PLS-SEM, which suits prediction-oriented models with reflectively measured constructs and makes fewer distributional assumptions than covariance-based SEM (Hair et al., 2022). Outer weights were calculated using mode A, which is suitable for reflective indicators, while the inner model applied the path weighting scheme. The algorithm terminated when the change in weights fell below 10^{-7} or after completing 300 iterations. Each control variable was modeled as a single-indicator construct with its weight fixed at one. The structural model includes the paths BDT → CX, BDT → CL, and CX → CL, along with paths from each control variable to both CX and CL.

Mediation is assessed through the indirect effect a × b (BDT → CX → CL) and the total effect c = c′ + a × b, where c′ is the direct effect of BDT on loyalty. Following Zhao et al. (2010), a significant indirect effect combined with a significant direct effect of the same sign indicates complementary (partial) mediation. This approach does not depend on the causal-steps logic of Baron and Kenny (1986), which was widely used in earlier mediation research. Because the Sobel test assumes that a × b is normally distributed, indirect and total effects are tested with 5,000 bootstrap resamples and 95% bias-corrected and accelerated (BCa) confidence intervals (Preacher & Hayes, 2008). The proportion mediated (a × b / c) is reported with percentile bootstrap intervals.

3.6 Validity, reliability and bias assessment

Reliability is assessed with Cronbach's alpha, Dijkstra and Henseler's ρA and composite reliability (CR), each of which should be at least 0.70 (Dijkstra & Henseler, 2015). Convergent validity requires outer loadings of at least 0.60, and an average variance extracted (AVE) of at least 0.50. Discriminant validity is assessed with the Fornell–Larcker criterion (Fornell & Larcker, 1981) and with the heterotrait-monotrait ratio (HTMT), which should be below 0.85 (Henseler et al., 2015). Collinearity is checked with variance inflation factors (VIF) in each structural equation. To check the construct-level structure, an exploratory factor analysis of the 32 items (maximum likelihood extraction, varimax rotation) is run together with parallel analysis.

Explanatory power is assessed with R^2 for CX and CL and with f^2 for each path. Predictive relevance is assessed with the blindfolding Q^2 statistic and with PLSpredict, which compares the model's out-of-sample prediction error with that of a linear benchmark (Shmueli et al., 2019). PLSpredict, the MICOM procedure and the PLS-MGA permutation test were implemented in custom code (Section 3.8). The standardised root mean square residual (SRMR) is reported for descriptive purposes only, against the conventional cut-off of 0.08 (Hu & Bentler, 1999). Because Henseler et al. (2014) caution that SRMR is not a valid goodness-of-fit criterion for PLS-SEM, it is not used to judge model fit.

Common-method bias is assessed in three ways. Harman's single-factor test (Podsakoff et al., 2003) provides an initial screen, full collinearity VIFs offer a stronger test (Kock, 2015), and a marker variable test is also applied (Lindell & Whitney, 2001). Since the questionnaire has no dedicated marker item, gender, which is theoretically unrelated to perceptions of digital services, serves as a proxy marker.

3.7 Robustness checks

Six robustness checks were carried out: (a) a model without control variables; (b) a model with intention to continue as the only loyalty measure; (c) separate estimation for state-owned and private banks, with bootstrap-based difference tests; (d) a second-order specification, estimated with a two-stage approach, in which BDT and CX are modelled as reflective-reflective higher-order constructs (Becker et al., 2012); (e) a permutation-based multi-group analysis (PLS-MGA) and a test of measurement invariance across bank types (MICOM; Henseler et al., 2016); and (f) an analysis of clustering by collection site, including intra-class correlations, a bank-level cluster bootstrap and random-intercept models (Section 4.7). Checks (d) and (e) are reported in Table 7, and check (f) in Section 4.7 and Table 8.

3.8 Software and replicability

The PLS-SEM algorithm and the additional procedures (blindfolding, PLSpredict, the two-stage second-order model, PLS-MGA and MICOM) were implemented in custom Python code (NumPy and SciPy) written for this study, using the settings described above. Bootstrap samples were drawn with replacement at the case level, and the full algorithm was re-estimated on each sample. Because these procedures do not come from a standard package, the core estimates were checked for internal consistency: the total effect equals the sum of the direct and indirect effects, and the reported indirect and total effects follow from the path coefficients. Core estimations were rerun in R using the SEM in R package (version 2.6.0; Ray et al., 2026) with identical settings, and the comparison is shown in Section 7.

4. Results

4.1 Sample and data screening

There were 400 completed questionnaires in the data set. Four cases indicated that they did not use a digital banking service and these were excluded as at least one was required by the sampling criterion. Four more cases were lost due to a missing item (listwise deletion). The analysed sample therefore comprises N = 392 respondents, above the

threshold of 384 given by Cochran's formula. Mahalanobis distances computed on the 32 items identified no multivariate outliers at $p < .001$.

The sample is well balanced by bank type, with 194 respondents (49.5%) using state-owned banks and 198 (50.5%) using private banks. Most respondents were in Baghdad, followed by Karbala, Diyala, Babil and Najaf. Customer tenure averaged 5.24 years (SD = 3.72; range 0.2–21.2). The most widely used services were the mobile app (88.0%) and the electronic card (74.2%), followed by internet banking (37.0%) and QR payment (29.8%). Age was recorded in five bands, the largest being 21–30 years (34.4%) and 31–40 years (26.5%). Men made up 54.3% of the sample (gender code 1 = male, code 2 = female), and holders of a bachelor's degree (education code 3) made up 54.1%. Appendix C reports the coded distributions of all demographic variables.

4.2 Descriptive statistics

Table 2 reports means, standard deviations and reliability coefficients. For the dimensions, it shows only descriptive statistics and Cronbach's alpha, since reliability and validity in PLS-SEM are assessed at the construct level. Dimension means fall within a narrow range, from 3.27 to 3.35 on the five-point scale, indicating moderately positive perceptions of all three constructs. Customer loyalty averaged 3.27 (SD = 0.75). The three BDT dimensions are strongly intercorrelated (r = 0.82–0.83), as are the four CX dimensions (r = 0.75–0.80). Correlations with customer loyalty range from 0.49 to 0.54 for the BDT dimensions and from 0.55 to 0.61 for the CX dimensions.

Table 2. Descriptive statistics and reliability

Variable / dimension	Mean	SD	Cronbach's α	ρA	CR	AVE
BDT: digital strategy (4 items)	3.30	0.83	0.825	–	–	–
BDT: digital business (4 items)	3.35	0.82	0.830	–	–	–
BDT: digital management (4 items)	3.34	0.80	0.822	–	–	–
BDT overall (12 items)	3.33	0.77	0.934	0.935	0.943	0.581
CX: ease of use (3 items)	3.32	0.85	0.788	–	–	–
CX: speed (3 items)	3.30	0.85	0.785	–	–	–
CX: perceived security (3 items)	3.28	0.83	0.770	–	–	–
CX: overall satisfaction (3 items)	3.27	0.85	0.783	–	–	–
CX overall (12 items)	3.29	0.77	0.934	0.935	0.943	0.579
CL overall (8 items)	3.27	0.75	0.898	0.899	0.918	0.584

Note. **N = 392. Scale 1–5. Construct-level ρA, CR and AVE are from the PLS-SEM measurement model (Table 3).**

4.3 Measurement model

Table 3 presents the measurement model. All outer loadings lie between 0.725 and 0.792, above the 0.60 threshold, and the outer VIFs (1.81–2.32) indicate no collinearity among the indicators. Construct reliability is high: Cronbach's alpha ranges from 0.898 to 0.934, ρA from 0.899 to 0.935 and CR from 0.918 to 0.943. The AVE of each construct (0.579–0.584) exceeds 0.50, supporting convergent validity. Discriminant validity is also supported (Table 3, Panel B). The square root of each construct's AVE (0.761–0.764) is larger than its correlations with the other constructs (0.544–0.638), which satisfies the Fornell–Larcker criterion, and all HTMT ratios (BDT–CX 0.623, BDT–CL 0.591, CX–CL 0.694) are below 0.85. Common-method variance is unlikely to be a serious problem. In Harman's single-factor test, the first unrotated factor accounts for 42.4% of the variance, below the 50% benchmark. Variance inflation factors for the structural predictors range from 1.01 to 1.54, so multicollinearity is not a concern. Full collinearity VIFs and the results of the marker variable test are reported in Table 7.

Table 3. Measurement model assessment

Panel A. Outer loadings, reliability and convergent validity

Construct	Item	Outer loading	VIF	α	ρA	CR	AVE
Bank digital transformation (BDT)	strat1	0.754	2.02	0.934	0.935	0.943	0.581
	strat2	0.756	2.00				
	strat3	0.780	2.15				
	strat4	0.749	2.01				
	bus1	0.735	1.88				
	bus2	0.786	2.23				
	bus3	0.770	2.13				
	bus4	0.771	2.09				
	mgmt1	0.774	2.16				
	mgmt2	0.755	1.96				
	mgmt3	0.772	2.15				
	mgmt4	0.745	1.95				
Customer experience (CX)	ease1	0.755	2.00	0.934	0.935	0.943	0.579
	ease2	0.767	2.09				
	ease3	0.754	2.05				
	speed1	0.725	1.83				
	speed2	0.792	2.32				
	speed3	0.774	2.18				
	sec1	0.768	2.07				
	sec2	0.766	2.12				
	sec3	0.725	1.89				
	sat1	0.776	2.15				
	sat2	0.764	2.11				
	sat3	0.763	2.03				
Customer loyalty (CL)	int1	0.766	1.95	0.898	0.899	0.918	0.584
	int2	0.756	1.85				
	int3	0.772	1.92				
	rec1	0.764	1.89				
	rec2	0.767	1.94				
	conc1	0.781	2.03				
	conc2	0.757	1.85				
	conc3	0.752	1.81				

Panel B. Discriminant validity: Fornell–Larcker criterion and HTMT ratios

Construct	BDT	CX	CL
Bank digital transformation (BDT)	**0.762**	*[0.623]*	*[0.591]*
Customer experience (CX)	0.585	**0.761**	*[0.694]*
Customer loyalty (CL)	0.544	0.638	**0.764**

N = 392. Estimates from the main PLS-SEM model (mode A, path weighting scheme, with control variables), estimated in SEMinR 2.6.0. VIF = outer variance inflation factor of each item within its block. α = Cronbach's alpha; CR = composite reliability (ρC); AVE = average variance extracted. Thresholds: loadings ≥ 0.60; α, ρA and CR ≥ 0.70; AVE ≥ 0.50; outer VIF < 5. In Panel B, bold diagonal values are the square roots of the AVE; values below the diagonal are correlations between construct scores; values above the diagonal in brackets are HTMT ratios (threshold < 0.85). Item wording is given in Appendix A.

4.4 Structural model and hypothesis tests

Figure 2 presents the estimated structural model. The model explains 35% of the variance in customer experience (R^2 = 0.349; adjusted R^2 = 0.339) and 45% of the variance in customer loyalty (R^2 = 0.453; adjusted R^2 = 0.443), values that fall in the weak-to-moderate range (0.25–0.50) according to Hair et al. (2022). The effect size is large for BDT → CX (f^2 = 0.51), medium for CX → CL (f^2 = 0.28) and small for BDT → CL (f^2 = 0.08). Predictive relevance (Q^2) and PLSpredict results are reported in Table 7.

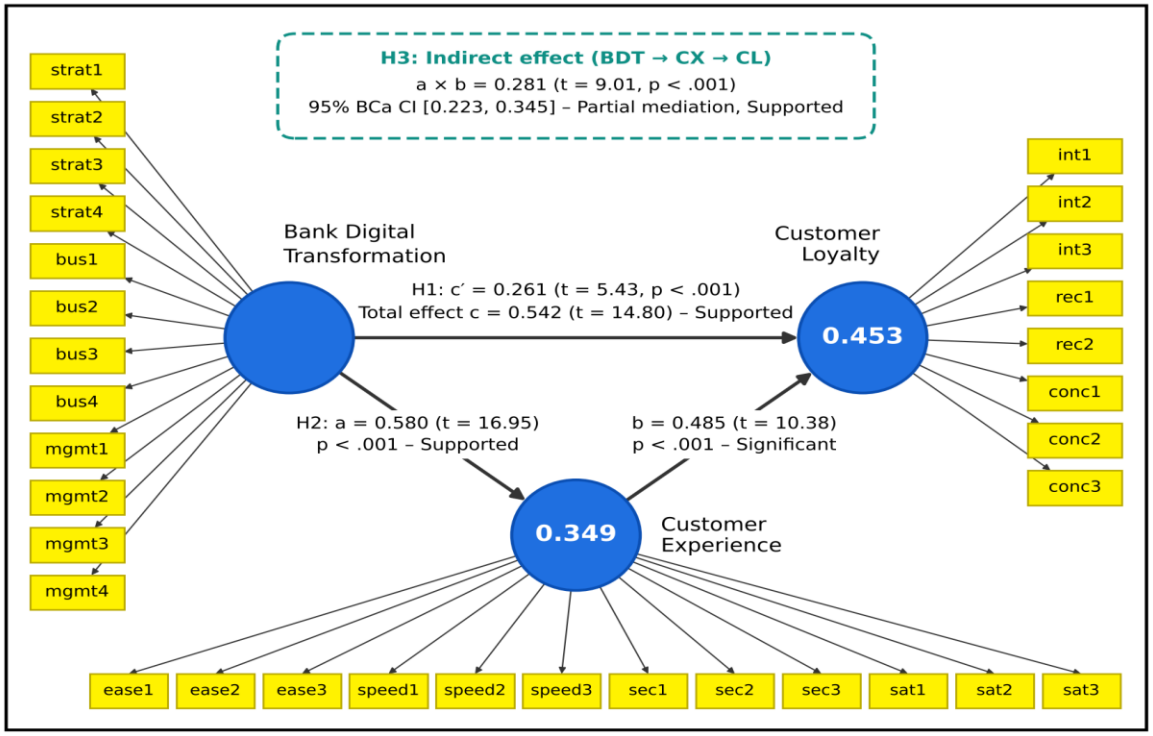


Figure 2. Structural model (PLS-SEM)

Table 4. Model fit and explanatory power

Criterion	Value	Threshold	Assessment
SRMR (descriptive only)	0.038	≤ 0.08	Below the conventional cut-off; not used as a fit test (Henseler et al., 2014)
R^2 customer experience (adjusted)	0.349 (0.339)	0.25–0.50	Weak to moderate
R^2 customer loyalty (adjusted)	0.453 (0.443)	0.25–0.50	Weak to moderate

Note. **Thresholds for R^2 follow Hair et al. (2022).**

Table 5. Structural path estimates

Hypothesis	Path	β	Bootstrap SE	t	p-value	95% BCa CI	Decision
H1	BDT → CL (total effect, c)	0.542	0.037	14.71	< .001	[0.460, 0.607]	Supported
H2	BDT → CX (a)	0.580	0.034	16.97	< .001	[0.505, 0.642]	Supported
H3	CX → CL (b)	0.485	0.046	10.60	< .001	[0.392, 0.571]	Significant
H1	BDT → CL (direct effect, c′)	0.261	0.048	5.45	< .001	[0.166, 0.352]	Significant
H3	Indirect effect a × b	0.281	0.031	9.02	< .001	[0.221, 0.342]	Supported (partial, complementary mediation)

Note. **N = 392; 5,000 bootstrap resamples. Control variables are included in all equations. The total effect is c = c′ + a × b. None of the control variables has a significant effect on customer experience or loyalty (all p > .29).**

H1 (direct and total effect): supported. BDT has a significant positive total effect on customer loyalty (β = 0.542, t = 14.71, p < .001; BCa 95% CI [0.460, 0.607]). Its direct effect on loyalty, net of customer experience, is also positive and significant (c′ = 0.261, t = 5.45, p < .001).

H2 (BDT to customer experience): supported. BDT has a strong positive effect on customer experience (a = 0.580, t = 16.97, p < .001; BCa 95% CI [0.505, 0.642]).

H3 (mediation): supported as partial, complementary mediation. Customer experience has a strong positive effect on loyalty (b = 0.485, t = 10.60, p < .001). The indirect effect (a × b = 0.281) has a BCa 95% confidence interval of [0.221, 0.342], which excludes zero. Since the direct effect c′ is still significant and in the same direction as the total effect, customer experience carries part, but not all, of the effect of BDT on loyalty. The indirect effect accounts for about 52% of the total effect (percentile 95% bootstrap CI: 39.7% to 66.5%).

4.5 Robustness checks

According to the Table 6, the results are robust using these alternative specifications. Even if taking out the control variables, the directions are very close. When using intention to continue as the only measure of loyalty, the direct

effect decreases to 0.235 (p<.001) and the indirect effect to 0.261, the conclusion is still consistent. Measuring customer experience without its satisfaction dimension (nine items) produces the same pattern (a = 0.566, b = 0.456, c′ = 0.284, a × b = 0.258, c = 0.542; all p < .001). The conclusions therefore do not depend on the overlap between the experience and satisfaction constructs.

When the model is estimated separately for state-owned and private banks, the a, b and c′ paths are significant in both groups. The direct effect is 0.205 (p = .005) in state-owned banks and 0.316 (p < .001) in private banks. Bootstrap-based difference tests show no significant between-group difference in the a path (Δ = −0.050, z = −0.74, p = .46), the b path (Δ = 0.010, z = 0.11, p = .92) or the direct path c′ (Δ = −0.112, z = −1.15, p = .25). Although the direct effect appears larger in private banks, the difference is not statistically reliable in this sample. A permutation-based PLS-MGA with 5,000 permutations gives consistent results (p = .48 for a, .92 for b and .25 for c′; Table 7). Table 7 also reports the test of measurement invariance across bank types (MICOM).

Table 6. Robustness of the path estimates

Specification	N	a	b	c′	a × b	c (total)
Main model (with controls)	392	0.580***	0.485***	0.261***	0.281	0.542
Without control variables	392	0.585***	0.486***	0.259***	0.284	0.544
Alternative DV: intention to continue only	392	0.580***	0.449***	0.235***	0.261	0.496
CX without satisfaction items (nine items)	392	0.566***	0.456***	0.284***	0.258	0.542
State-owned banks	194	0.557***	0.488***	0.205**	0.272	0.476
Private banks	198	0.606***	0.478***	0.316***	0.290	0.606

Note. **Standardised path coefficients (β). *** p < .001; ** p < .01. Significance stars apply to the path coefficients only. a × b and c are point estimates. Group-level significance levels are based on bootstrap standard errors (5,000 resamples); confidence intervals are reported for the full sample only.**

4.6 Additional measurement and predictive checks

Table 7. Additional measurement, predictive and invariance checks

Check	Criterion	Result
Exploratory factor analysis of the 32 items (KMO = 0.973; Bartlett $\chi^2(496) = 7256.8$, p < .001)	Parallel analysis; items load ≥ 0.50 on their intended factor with cross-loadings < 0.30	Parallel analysis suggests three factors, matching the three constructs. 30 of 32 items meet the criterion. The exceptions are int3 and conc2, with cross-loadings of 0.31 and 0.32 on the BDT factor
Full collinearity VIF (Kock, 2015)	VIF < 3.3	BDT 1.65; CX 1.95; CL 1.82
Marker variable test (Lindell & Whitney, 2001), proxy marker: gender, rM = 0.022	Adjusted correlations remain significant	BDT–CX 0.572, BDT–CL 0.531, CX–CL 0.628 (all p < .001; observed 0.581, 0.541 and 0.636)
Q^2 by blindfolding (omission distance 7)	$Q^2 > 0$	CX 0.195; CL 0.255
PLSpredict (10-fold, 10 repetitions) against a linear benchmark	PLS RMSE lower than the benchmark for most items	PLS RMSE lower than the benchmark for all 20 endogenous items; Q^2predict 0.13–0.24
Second-order BDT and CX (two-stage approach)	Path estimates close to the first-order model	a = 0.578, b = 0.484, c′ = 0.261, a × b = 0.280, c = 0.541; R^2 CX = 0.346, CL = 0.453; dimension loadings 0.90–0.94

Check	Criterion	Result
PLS-MGA, state-owned vs private (5,000 permutations)	No significant difference in a, b or c′	p = .48 (a), .92 (b), .25 (c′)
MICOM step 2: compositional invariance	c above the 5% permutation threshold	c > 0.999 for all three constructs in both groups
MICOM step 3: equal means and variances	Within the 2.5–97.5% permutation intervals	Standardised mean differences (state − private): BDT 0.05, CX 0.11, CL 0.01, all within ±0.20; log variance ratios within the intervals

Note. **All values computed in Python from the raw data (N = 392). Standardised mean differences are expressed in units of the pooled composite standard deviation.**

4.7 Sensitivity to clustering by collection site

Customers are nested within the 20 collection sites recorded in the data (id bank); in this section, 'bank' refers to the collection site. Because the site codes are available, the degree of clustering can be measured directly, and the analysis below does so. To gauge how far clustering could affect inference, Table 8 applies the design effect DEFF = 1 + (m − 1)ρ, where m ≈ 19.6 is the average number of customers per bank under a balanced design and ρ is the intra-class correlation. The bootstrap standard errors are multiplied by √DEFF. Paths a, b, a × b and c remain significant for every admissible value of ρ (up to 1). The direct effect c′ is the most sensitive path: it remains significant at $p < .05$ for ρ up to about 0.36, and at ρ = 0.20 its t-value is 2.51 (p = .012). This approximation assumes equal cluster sizes. The bank-level checks reported below are the direct test of clustering, while the design-effect table shows how strong clustering would need to be to change the conclusions. The intra-class correlations (ICC) of the latent scores are 0.002 for BDT, 0.005 for CX and −0.016 for CL, with 95% confidence intervals of −0.022 to 0.059, −0.020 to 0.066 and −0.032 to 0.024, respectively. A bank-level cluster bootstrap (2,000 resamples of the 20 banks) yields standard errors close to the naive ones (a = 0.035; b = 0.046; c′ = 0.045; a × b = 0.030), and all paths remain significant at $p < .001$ (95% percentile intervals: a [0.511, 0.644]; b [0.394, 0.573]; c′ [0.170, 0.348]; a × b [0.225, 0.342]). A random-intercept model by bank produces the same path coefficients as ordinary regression on the latent scores (a = 0.582 vs 0.580; b = 0.485 vs 0.485; c′ = 0.261 vs 0.261).

Table 8. Sensitivity of the structural paths to clustering by bank (design-effect approximation)

Path	Estimate	Naive t	t at ρ = 0.05	t at ρ = 0.10	t at ρ = 0.20	t at ρ = 0.30	Critical ρ (t = 1.96)
a: BDT → CX	0.580	16.97	12.22	10.04	7.81	6.62	> 1
b: CX → CL	0.485	10.60	7.63	6.27	4.88	4.13	> 1
c′: BDT → CL (direct)	0.261	5.45	3.92	3.22	2.51	2.13	0.36
a × b (indirect)	0.281	9.02	6.49	5.33	4.15	3.52	> 1
c (total)	0.542	14.71	10.59	8.70	6.77	5.73	> 1

Note. **m = 19.6 customers per collection site (392 customers in 20 sites, balanced assumption). DEFF = 1 + (m − 1) ρ, and bootstrap standard errors are multiplied by √DEFF. The critical ρ is the intra-class correlation at which t = 1.96. ρ cannot exceed 1, so entries marked "> 1" remain significant for every admissible value. The approximation ignores the variability of cluster sizes.**

5. Discussion

5.1 Summary of findings

All three hypotheses are supported. Digital transformation of the bank has a positive relationship to all types of customer loyalty (total and direct) and to an improved customer experience (CX). CX mediates a large proportion of the effect: 52% of the total effect of digital transformation on loyalty runs through CX, with the remainder of the impact running directly. This implies that these benefits of digital investments are perceivable to the customer also and not simply at the bank level that we cannot observe in this analysis.

5.2 Theoretical implications

The paper contributes to the emerging literature on bank digital transformation in three ways. First, it moves the discussion away from bank performance to bank customer loyalty because of BDT and demonstrates that the effect of customer experience accounts for a substantial portion of the total. This could help reconcile the unfavorable performance results of Nguyen-Thi-Huong et al. (2023) with the favorable relationship documented elsewhere. If BDT enhances the customer side of the bank before the bottom line, studies measuring only ROA or profitability may understate its effects (Zhang, 2026). Second, the study demonstrates that expectation-confirmation logic works for digital banking as well. It indicates that customer's experience of speed, ease, and security builds the expectation, and loyalty can be achieved when the expectation is confirmed, which broadens resource-based view that accounts for how BDT develops capabilities and finds the mechanism on the customer side through which those capabilities develop loyalty. Third, the measurement structure is important. Since the three BDT dimensions and the four CX dimensions are highly correlated, the model cannot distinguish their individual effects. Future research should examine whether the mediation holds at the dimension level. A second-order specification produces path estimates nearly identical to those of the first-order model (Table 7), indicating that the conclusions do not depend on this modeling choice (Becker et al., 2012).

5.3 Practical implications for banks and regulators

Given the mediating effect, banks might also consider using digital investment to influence customer experience directly rather than primarily through improving capabilities. In this research, the four dimensions of experience exhibited comparable relationships with loyalty, indicating that a bank should not be pursuing any one over another. The descriptive correlations offer some guidance on which experiences are most compelling, from the perspective of improving loyalty satisfaction and ease of use until a more definitive test at the dimension level can be performed.
Banks should also keep strengthening the features that customers rely on most, such as a broad range of digital products and consistent service across channels. Security is the experience dimension most closely linked with data privacy and cyberthreats, and it's the lowest of the four means (3.28), albeit by a slim margin. If trust is a barrier to digital-payment adoption in Iraq (Shafaq News, 2026), describing security features will be even more critical than in countries where digital trust is high. For regulators and policymakers, these results imply that while electronic payment goals may be set, it may also be helpful to show customer experience – rather than just numbers of cards and transactions. A nationwide drive towards electronic government payments can be sustained if the experience is quick, easy and safe.

5.4 Relation to earlier findings and the Iraqi context

The results are similar overall to the positive relationships between digital transformation and bank results reported by Do et al. (2022), Zhu and Jin (2023) and Zhu and Jin (2025) although the comparison is not direct, as outcome measures are different. This study does not account for the negative effect on performance found by Nguyen-Thi-

Huong et al. (2023). One potential explanation, which the design of this study cannot rule out, is that digital transformation benefits customers even where the bank has not (yet) achieved positive financial results. This would reflect the divergence which underpins the emphasis on customers.

The pattern of mediation is like that found by Setiawan et al. (2026) among Indonesian banks where the co-created service experience mediated 42.6% of the relationship between digital transformation and loyalty, compared to 52% for customer experience in the present sample. Finding that two different types of experience, in two different markets, both carry roughly half the total relationship suggests that the route through experience is a stable aspect of the overall relationship between digital transformation and loyalty. The remaining direct link accounts for a portion of the relationship and may occur through channels that neither investigation considers such as reputation or perception of reliability. Their model accounted for a greater proportion of the variance in loyalty (67.8%, versus 45% here), perhaps as a result of the participatory nature of their mediator or other market differences.

Both paths hold in state-owned and private banks, and the between-group differences are not statistically significant. Thus, the data reveal no difference in the customer-experience pathway for the two types of banks, although we can neither confirm nor exclude smaller differences that could emerge with a larger sample. The direct effect is larger in private banks, but this difference is not statistically reliable.

6. Conclusions

The findings answer the research questions as follows. Customers rated digital transformation, customer experience and loyalty at moderately positive levels, with dimension means between 3.27 and 3.35 on the five-point scale. Bank digital transformation has a significant positive direct effect on customer loyalty (H1 supported) and a significant positive effect on customer experience (H2 supported). Customer experience partially and complementarily mediates the relationship between digital transformation and loyalty, explaining approximately 52% of the total effect (H3 supported). These results were obtained without any control variables, when intention to continue was the sole indicator of loyalty, and in both private and state-owned banks.

Theoretically, the paper demonstrates that the value of bank digital transformation can be tracked from the customer's perspective. Customers' perceptions of the bank's digital capabilities are associated with their loyalty and about half of this association is mediated by the experience those capabilities provide. In term of expectation confirmation, this specifies the customer-side process through which those resource-based view capabilities become patronage. Practically, banks and the Central Bank of Iraq can consider customer experience as a tangible intermediate outcome of digital investment, on par with counts of cards, accounts and transactions. Given the cross-sectional nature of the design and the limited sample of digital users in central and southern Iraq, these results are limited to associations among those variables in the studied population, and should be validated by longitudinal and bank-level data.

7. Limitations

- **Sample and setting.** The use of a convenience sample includes 20 bank branches in central and south Iraq but does not include the Kurdistan Region, and the results should not be extrapolated to Iraq or to banks outside the sample frame. The survey locations are restricted mostly to the Baghdad area, and the results may be more indicative of the Baghdad market than the market of other governorates.
- **Sample restriction.** However, only customers who used at least one digital service were eligible. As a result, the findings depict digital users, and effects may vary among non-digital channel users.
- **Clustering.** Customers are in 20 collection sites (bank branches). Intra-class correlations are near zero, and results from bank-level cluster bootstrap and random-intercept models are consistent (Section 4.7). As indicated by the design-effect analysis, the direct effect is unlikely to be rendered insignificant for an intra-class correlation as high as approximately 0.36.

- **Collection period.** The data were collected during a period of approximately 8 months. Changes in the way that banks offered services, the economy or the public message over this period may have influenced the results and this is not modelled.
- **Collection mode.** Responses were obtained via an online Google Form, or via paper questionnaires in branch. Mode effects could not be tested as the dataset is not coded by mode of response. The branch distributing the link for the online responses can be obtained using the site code of online responses.
- **Common-method risk.** Perceptual self-reported data from a single informant is liable to common-method bias. The Harman test (42.4%), as well as the full collinearity test and the marker variable test (with a proxy marker) mitigate this concern but do not remove it.
- **Causality.** A cross-sectional design cannot establish causation, and stronger designs, such as longitudinal data or instrumental-variable estimation, were not available. The reported paths should therefore be read as associations consistent with the proposed mechanism.
- **Measurement.** Digital transformation is measured by how customers experience it, not at a bank level (e.g. spend on technology, infrastructure investment). To demonstrate that customer perceptions are related to the state of the bank, we would need to benchmark against bank level evidence (e.g. managers' assessment, number of digital offerings) but as we have only 20 collection sites, this could only be descriptive. Because the respondent's own bank was not recorded and cannot be recovered, perceptions of 'my bank' cannot be linked to that bank's indicators, and the validity of the perceptual measure against bank-level evidence remains untested. In addition, the three BDT dimensions overlap heavily ($r = 0.82–0.83$), so the model treats BDT as a single construct and cannot separate dimension-level effects.
- **Predictive assessment and fit.** SRMR is provided only for information as it is not a valid fit criterion in PLS-SEM (Henseler et al., 2014). The predictive relevance (Table 7) relies on a custom implementation of PLS-predict, which might slightly deviate from off-the-shelf software.
- **Instrument.** The study items were developed by the authors for this study and have not been pilot tested prior to the main study except for the survey modified by the expert test panel discussed in 3.3. The Arabic translation was conducted by professional translation services and was not pilot tested for equivalence with the English version.
- **Coding of categorical controls.** The age, education and sex were entered as numeric category codes according to the design. The variables are categorical so their coefficients are of little use and in fact, none are significant, so the main results remain the same.
- **Between-group tests.** Between-group differences were tested using bootstrap-based difference tests and a permutation-based PLS-MGA (Table 7). Due to the small number of customers (200) in each group, the bootstrap-based difference tests are underpowered; non-significant results do not imply that the groups are interchangeable. As the degree of clustering by collection site is minimal (Section 4.7), false precision due to treating customers as independent observations was unlikely.
- **Implementation.** The analyses were run in custom code (Section 3.8). The core estimates were replicated with SEMinR 2.6.0 (Ray et al., 2026): the outer loadings, reliability, discriminant validity, path coefficients, R^2, f^2, group-specific paths and the PLSpredict comparison with the linear benchmark all agree with those reported, and the bootstrap standard errors differ by no more than 0.001 owing to resampling. SEMinR's two-stage second-order model gives nearly identical estimates (differences of 0.003 or less). Blindfolding Q^2, MICOM and the permutation-based PLS-MGA are not available in that package and therefore rest on the custom implementation.
- **Non-response bias.** The dataset does not record when each questionnaire was returned, so early and late respondents could not be compared. The high response rate (88.9%) reduces, but does not eliminate, the risk of non-response bias.

8. Future Research

Future research should collect each participant's bank and combine customer and bank-level data so that users can compare their perceptions with the bank's actual level of transformation. They could also specify BDT and CX as second-order constructs and then estimate a dimension-level model to examine what experience dimensions mediate. A panel study would enable testing the constructs' causal order, and a larger sample would provide greater statistical power to reveal the less common state–private differences than the data used here could statistically exclude. Conducting the research on a probability sample of banks and participants from all of Iraq's governorates, including the Kurdistan Region, would reveal the extent of the generalizability. Finally, including financial performance as an outcome would associate the customer-level insights with the bank-level results of Zhu and Jin (2025) and Zhang (2026).

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