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Banking digitalisation in Africa: confirmatory validation of the TAM model amongst banking executives

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ABSTRACT

This confirmatory study aims to analyse the determinants of the adoption of digital banking in Africa, drawing on the Technology Acceptance Model (TAM), enriched by contextual variables specific to the African environment. It seeks to examine the role of factors such as perceived usefulness, perceived ease of use, technological infrastructure, costs, security and financial inclusion issues in banking executives' decisions to adopt digital technologies.

The study adopts a quantitative approach based on a survey of banking sector executives. The questionnaire is the primary data collection tool and enables the various variables of the model to be operationalised through structured measurement scales. A pre-test phase and reliability and validity analyses are carried out to ensure the quality of the measurement instruments. The statistical analysis aims to examine the relationships between the various variables and to empirically evaluate the research model.

The results highlight the importance of perceived usefulness and ease of use in the adoption of digital technologies. They also emphasise the influence of structural conditions, notably the quality of infrastructure, investment costs, security issues and constraints related to financial inclusion. The study thus shows that the adoption of digital banking does not depend solely on technological characteristics, but also on the organisational and institutional context in which it is implemented.

This research contributes to an understanding of the specific characteristics of the adoption of digital banking technologies in Africa and highlights the importance of adapting theoretical models to the realities of the context under study.

Keywords: Digital Banking; Technology Acceptance Model (TAM); Digital Transformation; Technology Adoption; Perceived Usefulness; Perceived Ease of Use; Perceived Security; Banking Executives; Financial Inclusion; Africa.

1. Introduction

The digital transformation of the banking sector is now a major strategic challenge for financial institutions. In Africa, this transformation is of particular importance due to the rapid evolution of digital technologies, the development of mobile and online banking services, and the persistent challenges related to financial inclusion. Digitalisation offers banking institutions new opportunities to improve operational efficiency, optimise processes and broaden access to financial services.

However, the adoption of digital technologies in the African banking sector remains uneven. It depends on several factors linked to perceptions of technology, organisational characteristics and the environmental conditions in which banks operate. These factors include, in particular, perceived usefulness, ease of use, system security, the availability of technological infrastructure and the resources required to implement digital solutions. These various dimensions can influence management decisions and determine the success of digital transformation projects.

In this context, understanding the mechanisms that determine the adoption of technologies is a key issue for both academic research and managerial practice. The Technology Acceptance Model (TAM), proposed by Davis (1989), provides a theoretical framework for explaining the acceptance of technologies, based in particular on perceived usefulness and perceived ease of use. This model has been the subject of numerous extensions to incorporate additional factors that may explain technological adoption behaviour.

However, applying the TAM model to the African banking sector requires taking into account the specific characteristics of the context under study. Constraints relating to digital infrastructure, security, available resources and organisational transformations may indeed complement the model's traditional variables and contribute to a better understanding of the mechanisms of adoption.

With this in mind, this research examines the determinants of the adoption of digital banking in Africa from the perspective of bank executives. These executives play a central role in decisions relating to technological investment, strategic direction and the implementation of digital transformation projects.

The aim of this study is therefore to examine empirically the relationships between the various variables in the research model and to assess the relevance of the TAM model in the African banking context. To achieve this objective, a quantitative and confirmatory approach is adopted, based on a survey of banking executives and the use of statistical analysis methods to assess the reliability, validity and fit of the proposed model.

2. Theoretical framework: the Technology Acceptance Model

The adoption of technologies is a major area of study in the field of information systems. Several theoretical models have been developed to explain the factors likely to influence the acceptance and use of new technologies. Among these models, the Technology Acceptance Model (TAM), proposed by Davis (1989), occupies a central place in the literature on technology acceptance.

The TAM model is based primarily on two determinants: perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which an individual believes a technology can improve their performance or facilitate the completion of their tasks. Perceived ease of use, on the other hand, refers to the extent to which the use of a technology is considered straightforward and does not require significant effort. These two dimensions influence attitudes and intentions regarding the use of a technology.

In the banking sector, the TAM model thus enables us to understand perceptions associated with digital technologies and to examine their influence on adoption. However, the characteristics of the context in which the technology is introduced can also play a decisive role. In the African context, technological infrastructure, the costs associated with digitalisation, the security of information systems and the

challenges of financial inclusion are, in particular, dimensions that can enrich the analysis of the model.

Adapting the TAM model to these specific characteristics therefore makes it possible to move beyond an interpretation focused exclusively on individual perceptions and to incorporate the organisational and contextual dimensions likely to influence the adoption of digital banking. This approach leads us to view technology adoption as the result of an interaction between the perceived characteristics of the technology and the conditions under which it is implemented.

On this basis, this research utilises the TAM model as its main theoretical framework and enriches it with variables that take into account the specific characteristics of the African banking sector. The model thus constructed is subjected to empirical validation amongst banking executives through a confirmatory quantitative approach.

3. Methodology

This research follows a quantitative and confirmatory approach based on a survey of executives and managers in the banking sector involved in decisions relating to digital transformation and the adoption of digital technologies. The questionnaire is the main data collection tool and enables the various constructs of the research model to be operationalised through structured measurement scales. A pre-test phase, together with reliability and validity analyses, was carried out to assess the quality of the measurement instruments. The confirmatory analysis then aimed to examine the structure of the measurement model and the fit of the structural model.

The study population consists of executives and managers in the banking sector who are directly involved in decisions regarding the investment in, adoption and implementation of digital technologies. The sample selected for the analysis comprises 33 executive respondents. The socio-demographic and institutional characteristics presented in the following tables describe the composition of this sample and highlight its diversity.

The methodological literature drawn upon in this research emphasises the importance of an adequate sample size for carrying out structural equation modelling. In this study, the analysis is based on 33 respondents, corresponding to the sample size actually presented in the statistical tables and in the psychometric analyses.

The data were collected using a structured questionnaire designed for bank executives. This questionnaire covers the various dimensions of the research model as well as their measurement indicators. In its initial configuration, the model comprises 20 indicators: six indicators relating to perceived utility (PU1 to PU6), five relating to perceived ease of use (FUP1 to FUP5), four to information system usage (USI1 to USI4), two to attitude towards usage (AEU1 to AEU2) and three to perceived security (SP1 to SP3).

The application of the LISREL approach within the framework of the confirmatory study requires, as a preliminary step, verification of the quality of the data and the measurement scales, in particular their unidimensionality and the main characteristics of their distribution. These preliminary checks ensure the relevance of the data prior to model estimation.

The operationalisation of the model is based on several constructs. Perceived usefulness (PU) and perceived ease of use (PEU) are the core dimensions derived from the Technology Acceptance Model (TAM). In addition to these dimensions are information system usage (ISU), attitude towards usage (ATU) and perceived security (PS), in accordance with the variables selected for the research model and presented in the measurement and analysis tables. Each construct is measured using a set of indicators coded in accordance with the questionnaire. To ensure the traceability and consistency of the measurements, the wording of the various indicators is set out in the operationalisation table.

Prior to confirmatory validation of the model, the measurement instruments are assessed for reliability and validity. Discriminant validity is examined in particular on the basis of the factor loadings of the indicators on the various constructs and by comparing these loadings with cross-loadings.

Data analysis is carried out in several complementary stages. The first involves assessing the quality of the measurement instruments by examining their reliability and validity. The second focuses on analysing the factor loadings and cross-loadings in order to evaluate the discriminant validity of the constructs. The third stage is devoted to evaluating the structural model and examining several fit indices, notably the CFI, TLI, NFI, PNFI, RFI, IFI, RNI and RMSEA. Finally, modification indices are examined to identify any additional relationships that might improve the model's fit. However, any modification to the model must be approached with caution and be based on theoretical justification as well as the conceptual consistency of the content of the indicators concerned.

4. Confirmatory analysis of the technology adoption model

In order to assess the discriminant validity of the measurement model, we examine the loadings of the indicators on the various factors using the cross-loadings table generated by the JASP software. Discriminant validity is considered to be supported when each indicator shows a stronger association with the construct to which it is theoretically linked than with the other constructs.

The indicators for the 'perceived ease of use' variable, which had shown weaker or more scattered loadings during the exploratory analysis, show associations in the confirmatory analysis that are primarily with their respective constructs. On this basis, and given their consistency with the theoretical framework adopted, these indicators are retained for the remainder of the analysis.

Overall, the results of the cross-loadings provide evidence in favour of the discriminant validity of the measurement model: the indicators generally show stronger associations with their respective factors than with other factors.

Table 1: Cross-loading table – executive survey.

UP1	UP2	UP3	UP4	UP5
< 0.001				
< 0.001	< 0.001			
< 0.001	< 0.001	< 0.001		
< 0.001	< 0.001	< 0.001	< 0.001	
< 0.001	< 0.001	< 0.001	0.033	< 0.001
< 0.001	< 0.001	< 0.001	0.074	0.810
< 0.001	< 0.001	< 0.001	< 0.001	0.127
0.018	0.135	0.108	0.144	0.264
0.095	0.107	0.034	< 0.001	0.277
< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
0.098	< 0.001	< 0.001	0.021	< 0.001
< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
< 0.001	0.015	< 0.001	< 0.001	< 0.001
< 0.001	0.037	0.038	< 0.001	< 0.001
< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
0.159	0.146	0.136	0.146	0.094
< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
< 0.001	< 0.001	< 0.001	0.052	< 0.001
0.243	0.389	0.369	0.403	0.314
UP6	**FUP1**	**FUP2**	**FUP3**	**FUP4**
< 0.001				
0.297	< 0.001			
0.404	< 0.001	< 0.001		
0.496	< 0.001	0.109	< 0.001	
< 0.001	0.319	< 0.001	< 0.001	< 0.001
< 0.001	0.023	< 0.001	< 0.001	0.363
< 0.001	0.240	0.138	< 0.001	0.516
< 0.001	0.153	< 0.001	< 0.001	0.134
0.034	0.264	0.263	0.112	0.195
0.148	0.042	< 0.001	< 0.001	< 0.001
0.356	0.080	0.071	0.290	< 0.001
< 0.001	0.190	< 0.001	< 0.001	< 0.001
< 0.001	0.213	< 0.001	< 0.001	< 0.001
0.026	0.752	0.302	0.331	0.562
0.539	0.414	0.329	0.443	0.061
FUP5	**USI1**	**USI2**	**USI3**	**USI4**

< 0.001				
1.098	< 0.001			
0.546	0.444	< 0.001		
0.254	< 0.001	0.265	< 0.001	
0.118	< 0.001	< 0.001	< 0.001	< 0.001
0.161	< 0.001	< 0.001	< 0.001	0.034
0.026	< 0.001	< 0.001	< 0.001	0.013
< 0.001	< 0.001	< 0.001	< 0.001	0.057
0.252	0.166	0.259	0.154	0.124
0.035	< 0.001	0.086	0.203	0.251
AEU1	**AEU2**	**SP1**	**SP2**	**SP3**

< 0.001				
0.015	< 0.001			
0.002	0.001	< 0.001		
< 0.001	0.043	< 0.001	< 0.001	
< 0.001	0.003	< 0.001	0.562	< 0.001

4.1. Structural model evaluation

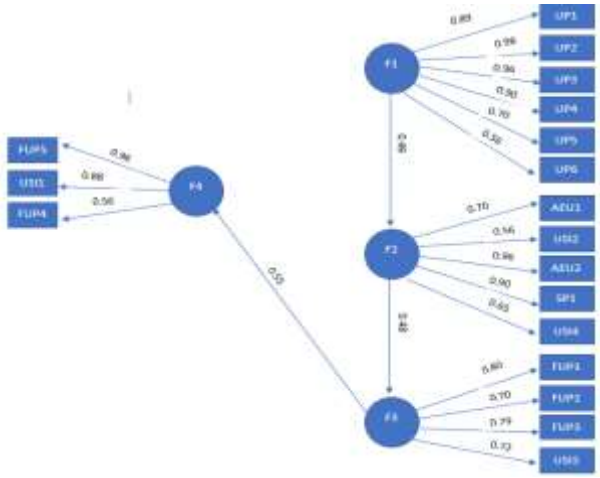

Figure 1: Structural model for senior executives in AMOS.

Variables UP2 to UP6 make significant contributions to factor F1, indicating that the banking executives surveyed associate digitalisation with significant benefits for banking activities. These results suggest that the perception of the benefits brought by digital technologies constitutes an important dimension of the model under study.

Factor F2 comprises variables associated with the perceived effectiveness of digital services. The coefficient of 0.45 linking F1 to F2 suggests a positive relationship between perceived utility and perceived effectiveness in the estimated model. However, this relationship should be interpreted as a

statistical association within the model and not, in itself, as evidence of a causal link.

The variables associated with F3 relate to satisfaction with digital services. The relationship observed with F2 suggests an association between perceived efficiency and satisfaction within the structural model.

Overall, the structural model highlights several interconnected dimensions of banking digitalisation, notably perceived utility, efficiency, satisfaction and technical. These relationships must be interpreted in the light of the specified statistical structure and the cross-sectional nature of the study.

4.2. Fit indices for the initial research model

An examination of the fit indices for the initial model reveals insufficient fit with regard to several incremental indices. The CFI (0.799), TLI (0.765), NFI (0.742) and IFI (0.802) remain below the values generally sought, whilst the RMSEA (0.072) falls within a more favourable range. These results indicate that the initial model requires further analysis before it can be accepted.

Table 2: Model fit indices.

Index	Value
Comparative Fit Index (CFI)	0.799
Tucker-Lewis Index (TLI)	0.765
Bentler-Bonett Non-normed Fit Index (NNFI)	0.765
Bentler-Bonett Normed Fit Index (NFI)	0.742
Parsimony Normed Fit Index (PNFI)	0.633
Bollen's Relative Fit Index (RFI)	0.698
Bollen's Incremental Fit Index (IFI)	0.802
Relative Noncentrality Index (RNI)	0.799
RMSEA	0.072

Modification indices were then examined to identify additional relationships that might improve the model's fit. However, these statistical indications should only be taken into account when they can be justified by theory and by the content of the items.

4.3. Analysis of modification indices

Table 3: Covariances to be estimated to improve the fit indices using JASP.

Cross-loadings	Industrial Mod.	EPC
Factor 2 → USI2	23.897	0.665
Factor 3 → USI4	14.003	0.374
Factor 3 → USI2	13.985	0.644
Factor 4 → FUP4	12.044	0.617
Factor 4 → USI4	10.708	0.257
Factor 1 → USI2	9.579	0.423
Factor 2 → FUP4	9.000	-0.535
Factor 2 → SP2	8.847	0.511
Factor 1 → FUP4	8.673	-0.525
Factor 2 → USI3	8.464	0.452
Factor 4 → SP1	7.928	-0.141
Factor 4 → UP3	4.380	-0.166
Factor 1 → USI1	4.197	-0.179
Factor 3 → USI1	3.894	-0.265
Factor 1 → USI4	3.879	0.174

The suggested link between Factor 2 and USI2 has a high modification index (MI = 23.897; EPC = 0.665). This statistical indication suggests that such a link could help improve the model's fit. However, it should only be retained if it is consistent with the theoretical framework and the definition of the USI2 item.

The suggested link between Factor 3 and USI2 also has a high modification index (MI = 13.985; EPC = 0.644), indicating a potential improvement in the fit if this relationship were specified, subject to theoretical justification.

The suggested link between Factor 1 and USI2 has a modification index of 9.579 (EPC = 0.423). Its statistical significance is lower than that of the two previous relationships, and its inclusion should therefore be justified with particular attention to the conceptual content of the constructs.

4.4. Fit indices following modification

The modifications adopted have led to an improvement in several fit indices. However, this improvement must be interpreted with caution, as modifications based on modification indices are post hoc in nature and may increase the risk of the model being over-fitted to the observed data.

Table 4: goodness-of-fit indices after modification.

Cross-loadings	Mod. Ind.	EPC
PERCEIVED SAFETY → USI4	32,987	1,272
PERCEIVED SAFETY → USI1	14,642	-0.922
PERCEIVED EASE OF USE → USI4	13.672	-0.528
PERCEIVED UTILITY → SP3	13.283	0.437
USE OF INFORMATION SYSTEM → SP3	12,844	0.682
PERCEIVED EASE OF USE → SP3	11.954	0.370
PERCEIVED UTILITY → FUP4	9.170	-0.492
PERCEIVED EASE OF USE → USI3	9.164	0.423
PERCEIVED EASE OF USE → SP2	8.874	0.413
PERCEIVED SAFETY → USI2	8.675	-0.615
USE OF INFORMATION SYSTEM → AEU2	6.516	-0.264
PERCEIVED EASE OF USE → USI1	5.984	0.438
PERCEIVED SAFETY → USI3	5.937	-0.483
PERCEIVED SAFETY → FUP4	4.753	-0.281
PERCEIVED SAFETY → FUP1	4.661	0.271
PERCEIVED UTILITY → FUP2	4.174	0.297
USE OF INFORMATION SYSTEM → SP2	4.063	0.497

The modification indices reveal several potential relationships involving perceived usefulness. These results alone do not allow us to conclude that perceived usefulness has a causal influence on the other variables; rather, they point to avenues for statistical improvement of the model.

Similarly, several potential relationships involving perceived ease of use are identified. These associations must be examined in the light of the item content and the theoretical framework before any definitive changes are made to the model.

4.5. Analysis of modification indices

An examination of the residual covariances between certain indicators highlights several relationships suggested by the modification indices. These covariances relate in particular to certain items within the UP, FUP, USI and AEU constructs. Their inclusion must be based on a theoretical justification or on a similarity in the wording of the items, and not solely on their contribution to improving the fit indices.

Table 5: Analysis of covariances between the external variables of the model.

Residual covariances	Ind. Mod.	EPC
UP5 ↔ UP6	35.097	0.914
FUP1 ↔ FUP4	13,970	0.464
USI4 ↔ USI2	13,551	0.267
FUP2 ↔ FUP3	13.494	0.434
FUP5 ↔ USI1	13,187	1.268
AEU1 ↔ USI3	13,123	-0.397
USI4 ↔ USI1	11.587	0.145
UP1 ↔ UP3	9,831	-0.200
UP2 ↔ UP6	9.296	-0.231
AEU1 ↔ FUP4	9.283	-0.392
AEU1 ↔ FUP3	9.180	0.350
UP2 ↔ UP3	9.087	0.181
USI2 ↔ USI3	8.845	0.326
FUP3 ↔ USI1	8.827	-0.204
UP2 ↔ UP4	7.884	-0.159
UP4 ↔ AEU2	7.384	0.075
AEU2 ↔ SP1	7.033	0.185
FUP3 ↔ USI3	6.911	-0.278
USI2 ↔ AEU2	6.076	-0.114
USI4 ↔ USI3	5.342	0.147
UP1 ↔ FUP5	5.239	0.132
UP3 ↔ USI1	5.224	-0.113
UP2 ↔ AEU2	5.176	-0.052
USI2 ↔ FUP3	4.859	-0.254
UP1 ↔ UP2	4.685	0.132
UP2 ↔ UP5	4.355	-0.144
UP4 ↔ USI1	4.330	0.100
UP4 ↔ UP6	4.229	0.184
UP4 ↔ SP1	3.919	-0.051
UP4 ↔ FUP3	3.866	-0.142

The table highlights several potential residual covariances, notably between UP5 and UP6, as well as between certain indicators of the USI, FUP and AEU constructs. These relationships may indicate shared variance amongst certain items. They must, however, be introduced sparingly and justified conceptually.

The modifications adopted have led to an improvement in several fit indices. This improvement must, however, be interpreted with caution, as modifications based on modification indices are post hoc in nature and may increase the risk of the model being over-fitted to the observed data.

Table 6: Model fit indices after applying the 'index modifications'.

Fit indices	(CFI)	(TLI)	(NNFI)	(NFI)	(PNFI)	(RFI)	(IFI)	(RNI)	RMSEA
Result	0.912	0.96	0.831	0.821	0.721	0.741	0.936	0.862	0.072

Following the selected modifications, the CFI (0.912), TLI (0.960) and IFI (0.936) indices exceed 0.90, indicating a substantial improvement in the model's fit. However, the NFI (0.821), RFI (0.741), PNFI (0.721) and RNI (0.862) remain below 0.90. The overall fit should therefore be interpreted with caution rather than presented as uniformly satisfactory.

The persistence of values below the thresholds generally sought for certain indices shows that the improvement in the model is not uniform. The results thus call for a nuanced interpretation of the overall fit and for subsequent validation of the model on another sample.

4.6. The goodness-of-fit indices after removing the UP5 and FUP5 indicators

The UP5 and FUP5 indicators were subsequently removed from the model. According to the results presented, this removal did not alter the main fit indices obtained previously. This decision must nevertheless be supported by an explicit statistical and theoretical justification (e.g. low item contribution, validity issues or redundancy), to ensure that the removal is not perceived as a modification guided solely by the fit indices.

Table 7: Model fit indices after removing 'UP5, FUP5'.

Fit indices	(CFI)	(TLI)	(NNFI)	(NFI)	(PNFI)	(RFI)	(IFI)	(RNI)
Result	0.912	0.96	0.831	0.821	0.721	0.741	0.936	0.862

5. Conclusion

The aim of this research was to analyse the determinants of the adoption of digital banking in Africa using the Technology Acceptance Model (TAM), whilst taking into account certain specific features of the African banking context. The study employed a confirmatory quantitative approach involving bank executives in order to empirically evaluate the structure of the proposed model.

The results highlight several dimensions associated with the adoption of digital banking, notably perceived usefulness, ease of use, security and the use of information systems. The confirmatory analyses also provide evidence in favour of the discriminant validity of the measurement model, with the indicators generally showing stronger associations with their respective factors.

The evaluation of the structural model also highlights the interconnection between perceived usefulness, effectiveness and satisfaction associated with the use of digital services. The fit indices obtained after modifying the model show satisfactory values for the CFI (0.912), the TLI (0.960) and the IFI (0.936), whilst some other indices remain below the generally accepted thresholds, which suggests that the overall fit should be interpreted with caution.

From a theoretical perspective, this research demonstrates the value of the TAM model for studying technology adoption in the banking sector, whilst highlighting the importance of incorporating organisational and contextual dimensions specific to the field under study. From a managerial perspective, the results highlight the importance placed on ease of use, system security and improving process efficiency in digital transformation strategies.

Finally, certain limitations must be taken into account, notably the sample size and the cross-sectional nature of the study. These limitations call for further research through longitudinal studies and the inclusion of other variables that may explain the adoption of digital banking, particularly cultural, institutional and regulatory factors.

Ultimately, the study shows that the adoption of digital banking in Africa must be understood through a multidimensional approach combining perceptions of technology, organisational characteristics and the specific features of the context in which digital transformation is being implemented.

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