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Development and validation of a multi-dimensional scale to measure the factors influencing fintech firms' capacity to impact digital financial inclusion

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ABSTRACT

The purpose of the present study is to develop a multi-item scale to measure the factors that affect fintech firms' capacity to impact digital financial inclusion. Fintech, or financial service delivery supported by advanced technology, has tremendously changed the financial services landscape. It has a potential to improve digital financial inclusion and help the poor. Digital financial inclusion is important since it ensures cost-saving digital mechanisms to provide financial services to the financially excluded and underserved populations. Following an inductive method, a qualitative study was undertaken among managerial staff in fintech firms. The scale development process involved the collection of primary data for pre-testing the questionnaire. The study identified four factors that affect a fintech firm's capability of impacting digital financial inclusion: resources and capabilities, business models, networks and partnerships, and market and environment. Digital financial inclusion scale is composed of digital skills, access, and quality of access. The final scale consisted of sixty-four items. Though financial inclusion is usually measured from a demand-side perspective, this study provides a supply-side measure for digital financial inclusion. Thus, it can help in identifying and understanding the factors that may hamper fintech firms' capability to attain desirable outcomes with respect to digital financial inclusion.

Contribution/Originality: This study contributes to the fintech literature by introducing supply-side indicators of digital financial inclusion. The study established the existence of four factors that affect digital financial inclusion in fintech firms, namely, resources and capabilities, business models, networks and partnerships, and market and environment.

1. INTRODUCTION

The major function of financial service firms is to consolidate and transform risks and act as dealers in credit markets. Risks in financial services may include default risk or investment risk, which is related to the assets held by the firm, and liquidity risk, which is related to the liabilities held by the firm. The management of these risks and the creation of financial contracts are performed by the financial firms through large quantities of real assets (e.g., labor) (Baltensperger, 1980). There are a number of procedural intricacies related to the functions of financial services firms. There may be agent-principal challenges, incomplete or asymmetric information, costs related to reducing risks and creating trusts, risk profiling of potential borrowers, monitoring of changes in repayment

capacity of borrowers, verifying the identification of customers, etcs (Feyen, Frost, Gambacorta, Natarajan, & Saal, 2021; Hye, 2022). These difficulties create friction in financial services. Fintech has been perceived as a solution to many of the difficulties encountered in traditional financial service delivery. Though the concept of fintech has been in existence for a number of years, due to the rapid advancements in technology and the entry of a large number of new players, the landscape of fintech remains fresh and rapidly evolving (Bennet, 2016).

Financial technology means delivery of financial services by technology-enabled financial service companies to the customers, as well as delivery of technology services by firms directly to financial service firms. Thus, fintech companies make use of technology to support financial transactions and services among customers and businesses (Bennet, 2016). The application of technology in financial services has the effect of reshaping the way services are delivered with revolutionary changes in payments, lending, investment, insurance, and other financial services (Feyen et al., 2021). Digital technology in finance has the potential to transforms how financial services are delivered. It can develop new or modify existing business models, applications, processes, and products (IMF, 2018). Developments in technology like mobile phones, cloud computing, artificial intelligence, etc. have now enabled everyone to have seamless access to financial services. Not only has access become faster, but it has also become cheaper, more efficient, and more transparent in comparison with traditional financial services. Reports state that mobile technology can potentially reduce the cost of providing financial services by 80 to 90 percent.

In emerging markets, mobile phone penetration averages around 80 percent, though the average banked adult population is below 40 percent. This points to the fact that mobile phones can become a key instrument for accessing financial services for the unbanked (Soriano, 2017). Given the importance of digital technology in financial service delivery, the question arises as to how these new technologies can lead to financial inclusion. Extant literature evidences that all the previous studies on the topic have used demand-side factors influencing fintech firms' capacity to impact digital financial inclusion. However, it is essential to understand the supply-side factors influencing fintech firms' capacity to impact digital financial inclusion. To shed some light on this crucial point, we try to answer the research question of what the supply-side indicators of fintech firms' capability to influence digital financial inclusion are. Thus, to answer this research question and to fill this research gap in the literature, we tried to develop and validate a multi-dimensional scale to measure the factors influencing fintech firms' capacity to impact digital financial inclusion. Hence the objective of the current study paper is to find out the supply-side indicators of fintech firms' capability to influence digital financial inclusion. The study contributes to the existing literature on fintech as it tries to identify the supply-side indicators of digital financial inclusion, which have not yet been explored in previous literature. It also helps policymakers develop appropriate policy-level interventions to improve the contribution of fintech firms to digital financial inclusion. The paper is divided into five sections, such as introduction, theoretical framework, methodology, results, discussion, and conclusion.

2. THEORETICAL FRAMEWORK

Fintech and its adoption can have a significant effect on financial development. Governments across the globe are adopting financial stability, inclusion, innovation, and completion as their core policy objectives. The use of technology in finance can provide strong foundations to achieve these policies (World Bank, 2022). Thus, fintech is being considered an important participatory tool in the financial inclusion agenda (Makina, 2019). Zetzsche, Buckley, and Arner (2019) identified that fintech has the potential to contribute directly and indirectly towards the achievement of sustainable development goals of the UN. Adoption of fintech is driven by two factors: (a) seamless connectivity through digital devices like mobiles and communication networks; and (b) low-cost computing and data storage. Connectivity, computing, and storage have helped both customers and service firms. Customers now have better access to information on providers available in markets and can interact with them. Choosing the best provider has become very easy. On the other hand, service providers have unlimited access to information about existing and potential customers. They can now target their marketing strategies effectively and sell their products

directly. The development of digital ecosystems, which are networks of connected actors (such as businesses, clients, and regulators) working together to generate value using digital platforms and technology, is one important part of digital innovation. These ecosystems could spur innovation, boost productivity, and open up new doors for SMEs, but they also bring with them new problems in terms of competition, data protection, and regulatory compliance (Sirait, Rosalina, & Sari, 2023). Literature provides support for the theory that fintech companies hold the key to achieving higher levels of financial inclusion in emerging markets. These fintech firms have started the drive through innovative products and business models. The high-tech financial services landscape has made it easy for technology-driven firms to overlook the role played by traditional banking service firms. The brick-and-mortar physical branches of traditional banks were typically very expensive to operate, particularly in rural, unbanked areas. Where the focus of financial inclusion was particularly to serve such rural, unbanked areas, traditional financial service firms failed to be the vehicles of financial inclusion. It is also known that these traditional financial service forms were very slow to adapt to the emerging technological innovations in service delivery. Fintech companies were providing straightforward, affordable, and accessible financial services with quick and automated onboarding thanks to technology. In short, fintech firms effectively provided simple solutions to the three vital problems of traditional financial service firms that acted as barriers to financial inclusion: (i) expensive services, (ii) limited service access points, and (iii) strict know-your-customer requirements (Jenik, 2022).

Appaua (2021) argues that fintech has the ability to democratize access to finance, thereby assisting in the world's move towards achieving financial inclusion. Even during the crisis of COVID-19, fintech and its digital delivery channels helped governments provide assistance to vulnerable communities with cash transfers and liquidity without any need for physical contact (Pazarbasioglu et al., 2020).

There is evidence in the literature that fintech has the ability to ensure digital financial inclusion. In this context, it is important to examine the factors that determine the ability of fintech firms to ensure digital financial inclusion. Soriano (2017) identified that there are four major factors that drive fintech firm's capability to ensure digital financial inclusion. These factors are: (a) the resources and capabilities of firms, (b) business models, (c) networks and strategic partnerships, and (d) the market and environment. Many theorists like Barney (1991); Day (1994); Hamel and Prahalad (1990); Hunt (2013); Hooley, Broderick, and Möller (1998); Grant (1991); Kamal, Rizki, and Aulia (2023) and Prahalad and Hamel (1990) have immensely contributed to the theory of resource-based view, which provides the framework that a firm's strategic resources can help the firm achieve strategic advantages and accomplish its goals. Based on the theory of the resource-based view the study attempted to develop a multi-item scale for the four factors suggested by Soriano (2017) to measure digital financial inclusion in fintech firms.

3. METHODOLOGY

The current study has adopted the scale development methodology for the development and validation of the scale. For the evaluation of the scale developed, we have used the survey method.

3.1. Data Collection

Participants in the survey were employees of fintech firms in Kerala. Questionnaires were distributed among 241 employees. 213 were received back as responded. A careful screening of the responses identified the existence of missing values in 13 filled questionnaires, thus making them unusable for the study. So, the final sample for the study consisted of 200 employees from various fintech firms in Kerala. Sample respondents were selected based on their convenience and availability for responding to the questions.

3.2. Procedure

Based on the recommendations of Boateng, Neilands, Frongillo, Melgar-Quiñonez, and Young (2018), the scale development process was divided into three phases:

(1) Item development.
(2) Scale development.
(3) Scale evaluation.

3.3. Phase One: Item Development

Item development phase is composed of domain identification, item generation, and assessment of the content validity of items. The domain for the present study is identified as digital financial inclusion in fintech firms. Though there have been studies in the domain, to our understanding, there are no scales that have been developed to specifically measure how fintech firms can affect digital financial inclusion. To provide clarity to the domain, the present study defines fintech as the application of digital technology to financial services, based on the (World Bank, 2022). Digital financial inclusion is defined as the deployment of cost-saving digital means to provide financial services to excluded and underserved populations suited to their needs, based on the World Bank (2015). Based on Soriano (2017), the study defines the capability of fintech firms to affect digital financial inclusion as composed of four factors. The first factor, resources and capabilities of firms, is the intangible and tangible assets linked to the firm that help the firm accomplish different activities (Grant, 1991). The second factor, business models, is defined as the new methods by which digital innovations allow financial services firms to deliver services to a wider base of customers, helping both the service provider and the customer (Soriano, 2017), including operating strategies, revenue sources, and the intended customer base (Lee & Shin, 2018). The third factor, networks and strategic partnerships, is defined as the professional alliances and acquaintances developed by fintech firms that can potentially affect the firms' performance (Ostgaard & Birley, 1996; Soriano, 2017). The fourth factor, market and environment, is defined as the diversity and competitiveness of the marketplace with a range of providers characterized by financial infrastructure and regulatory environments (Soriano, 2017).

In the item generation stage, it was decided that deductive methods could not be adopted since there were no existing scales to measure the relevant construct. Hence, the inductive method had to be followed by an exploratory method. A qualitative study was undertaken to obtain an in-depth understanding of the factors under study. An interview guide was developed, drawing input from Nijssen and Frambach (2001) and Soriano (2017). The guide was composed of seven themes: (1) experience or knowledge in financial services, poverty alleviations, and technology (2) ability for analysis and product development (3) capability to raise capital and other resources, (4) business performance, (5) knowledge of customer needs and behaviour; (5) strategic partnerships with other technology platform providers; (6) status and nature of markets; and (7) status of existing customers. In-depth expert interviews were conducted on a purposively selected sample of 20 managerial-level staff in fintech firms in Kerala with a minimum professional experience of five years in a digital technology-related field. Data analysis commenced with making a summary of interviews to identify broad themes or items that were considered important by the interviewees. Next, a table was created for listing out the initial set of items in the order of importance attached by the experts. There were eighty-one items on the list. The assessment of content validity followed the guidelines proposed by Guion (1977). This included examination of (a) generally acceptable definition or meaning for the phenomenon under study; (b) the absence of ambiguous meanings of the phenomenon; (c) the relevance of measurement of the phenomenon; and (d) the responses of experts being elicited and evaluated properly. For this purpose, a second set of five experts, drawn from the financial services and digital technology sectors, were purposefully selected. The information provided by the experts was collected individually. Content validity index was computed for items, which was found to be very high and hence acceptable, based on Shi, Mo, and Sun (2012) and Polit, Beck, and Owen (2007). This process resulted in removal of some items based on the opinions of experts on their appropriateness and interpretability. With four items removed from the initial list, based on the opinion of the experts, seventy-seven items were retained.

3.4. Phase Two: Scale Development

Scale development phase is composed of pre-testing the questionnaire, survey administration, sample size selection, item reduction, and factor extraction. In the pre-testing stage, the draft questionnaire prepared after the confirmation of content validity was employed to conduct cognitive interviews with a set of twelve interviewees selected from managerial-level staff in fintech firms. The guidelines proposed by Fowler (1995) and Morris et al. (2017) were followed. These interviewees were selected keeping in mind the demographic features of the population. The interviews enabled ensuring that the questions are capable of producing data that would measure digital financial inclusion; identifying questions that are confusing to participants that require improvement for clarity; identifying questions that are difficult to answer that require removal; ensuring the options available for response are adequate and appropriate; and identifying problems with the order of questions that require re-order. Based on the results, seven items were dropped due to a lack of clarity or importance. Modifications in grammar and the choice of wording for questions were also made based on the feedback from cognitive interviews. Finally, this stage resulted in a complete item pool consisting of seventy items. This item pool was used in the final survey to finalize the scale.

3.5. Phase Three: Scale Evaluation

Scale evaluation phase was composed of testing dimensionality, scoring scale items, reliability and validity. The test of dimensionality involved testing the factor model hypothesized from the exploratory factor analysis in the previous phase. This was tested using an independent cluster model involving confirmatory factor analysis on the second set of longitudinal data collected. Dimensionality, validity, and reliability of the scale were examined using structural equation modelling using the partial least squares method with SPSS 20 and SmartPLS 4.0. All the factors extracted during the exploratory factor analysis stage were confirmed in the confirmatory factor analysis. The results given in Tables 1 to 5 relate to the extraction of factor structure from the item pool in the exploratory factor analysis stage in phase two of scale development.

4. RESULTS AND DISCUSSION

In the next stage, the potential items were administered to a sample that reflected the heterogeneity of the target population. Based on the recommendations of MacCallum, Widaman, Zhang, and Hong (1999) and Osborne and Costello (2004), the sample size was set at 200, considering the resources available, minimization of measurement errors, stability of factor loadings, and generalizability of findings. It was decided to collect longitudinal data from the same sample spread over a 14-day interval period. This was done with the following objectives in mind: (a) conduct exploratory factor analysis on the first data set to uncover the underlying factor structure and reduce the dimensions of data relating to the phenomena under study (b) conduct confirmatory factor analysis (CFA) on the second data set to verify and cross-examine the existence of factors revealed by the Exploratory Factor Analysis, and (c) to conduct test-retest reliability.

As part of developing the scale, item reduction analysis was used to make sure that only the most basic items were included in the final scale (Thurstone, 1947). This meant getting rid of any items that didn't have anything to do with the phenomenon being studied (Boateng et al., 2018). Since the data collected was categorical in nature, the reduction of the item pool was based on inter-item and item-total correlations, as recommended by Raykov and Marcoulides (2011). Röschel, Wagner, and Dür (2021) recommended using inter-item correlations (within a range of 0.20 and 0.50 and positive) and item-total correlations (within a range of 0.30 and 0.70 and positive) to reduce the number of items. Exploratory factor analysis was performed on the final complete item pool of seventy items. The extraction method used was unweighted least squares based on the recommendations of Gaskin and Happell (2014) and Lloret-Segura, Ferreres-Traver, Hernandez-Baeza, and Tomas-Marco (2014). The number of factors to be retained was decided based on the Kaiser (1960), which is based on eigenvalues above 1.0. Items with communalities

below 0.70 based on Eaton, Frank, Johnson, and Willoughby (2019), factor loadings below 0.40 based on Nunnally (1978), and items with cross-loadings of above 0.32 with more than one factor based on Tabachnick and Fidell (2001) were also considered for deletion. It was also decided that the extracted components should account for a cumulative variance of 60 percent in the entire factor based on the recommendations of Hair, Black, Babin, and Anderson (2014). In the complete item pool of seventy items, the resources and capabilities dimension had 20 items, business model had 15 items, networks and partnerships had 11 items, market and environment had five items, and digital financial inclusion had 19 items. Loadings and cross-loadings came after communalities in the analysis results check. It was found that an optimal factor structure was not obtained due to low values of communalities and item loadings and in some cases, high values of cross-loadings. Based on this result, it was decided to drop some items from the item pool. After this, 64 items remained in the item pool. The exploratory factor analysis procedure was re-run with the reduced item pool. Based on the results of correlations and exploratory factor analysis, the following latent factor structure emerged for digital financial inclusion and its four influencing factors: The results of exploratory factor analysis for the items of resources and capabilities are given in Table 1.

Table 1. Exploratory factor analysis: Resources and capabilities.

Factor	Initial eigen values			Extraction SUM of squared loadings		
	Total	% of variance	Cum %	Total	% of variance	Cum %
1	4.440	24.67	24.67	4.440	24.67	24.67
2	3.354	18.63	43.30	3.354	18.63	43.30
3	2.374	13.19	56.49	2.374	13.19	56.49
4	1.809	10.05	66.54	1.809	10.05	66.54
5	0.892	4.95	71.49			
6	0.804	4.47	75.96			
7	0.713	3.96	79.92			
8	0.619	3.44	83.36			
9	0.518	2.88	86.24			
10	0.457	2.54	88.78			
11	0.401	2.23	91.00			
12	0.353	1.96	92.96			
13	0.321	1.78	94.75			
14	0.271	1.51	96.25			
15	0.203	1.13	97.38			
16	0.176	0.98	98.36			
17	0.166	0.92	99.28			
18	0.1302	0.72	100.00			

Note: Extraction method: Unweighted least squares.

Table 1 shows that using the unweighted least squares method for extraction, four components was extracted from the pool of 18 items of resources and capabilities. The eigenvalues of these four components were above 1.0. The first component (eigenvalue = 4.440) accounted for 24.67 percent of the variance in the resources and capabilities factor. The remaining three components (eigenvalues of 3.354, 2.374, and 1.809, respectively) individually accounted for 18.63 percent, 13.19 percent, and 10.05 percent variances in the factor. The cumulative variance accounted for by the extracted four components was 66.54 percent, which was acceptable.

The results of exploratory factor analysis for the 14 items of the business models are given in Table 2.

Table 2 shows the extraction of two components from the 14 items of business model factor. The eigenvalues of these two components were above 1.0. The first component (eigenvalue = 4.738) accounted for 33.54 percent of variance in the business model's factor. The second component (eigenvalues of 3.245) individually accounted for 23.18 percent of variance in the factor. The cumulative variance accounted for by the extracted two components was 57.02 percent, which was very close to the acceptable level.

Table 2. Exploratory factor analysis: Business models.

Factors	Initial eigen values			Extraction SUM of squared loadings		
	Total	% of variance	Cum%	Total	% of variance	Cum%
1	4.738	33.84	33.84	4.738	33.84	33.84
2	3.245	23.18	57.02	3.245	23.18	57.02
3	0.923	6.59	63.61			
4	0.806	5.76	69.37			
5	0.675	4.82	74.19			
6	0.554	3.96	78.15			
7	0.512	3.66	81.81			
8	0.459	3.28	85.08			
9	0.436	3.12	88.20			
10	0.401	2.87	91.07			
11	0.349	2.49	93.56			
12	0.313	2.24	95.80			
13	0.302	2.16	97.95			
14	0.287	2.05	100.00			

Note: Extraction method: Unweighted least squares.

The results of exploratory factor analysis for the items of networks and partnerships are given in Table 3.

Table 3. Exploratory factor analysis: Networks and partnerships.

Factor	Initial eigen values			Extraction SUM of squared loadings		
	Total	% of variance	Cum%	Total	% of variance	Cum%
1	3.390	37.67	37.67	3.390	37.67	37.67
2	2.211	24.57	62.23	2.211	24.57	62.23
3	0.901	10.01	72.24			
4	0.718	7.98	80.22			
5	0.604	6.72	86.93			
6	0.530	5.89	92.83			
7	0.324	3.60	96.43			
8	0.214	2.38	98.81			
9	0.107	1.18	100.00			

Note: Extraction method: Unweighted least squares.

The networks and partnerships factors were reduced to two latent components. The eigenvalues of these two components were above 1.0. The first component (eigenvalue = 3.390) accounted for 37.67 percent of the variance in the networks and partnerships factor. The second component (eigenvalues of 2.211) individually accounted for 24.57 percent of the variance in the factor. The cumulative variance accounted for by the extracted two components was 62.23 percent, which was above the acceptable level.

The results of exploratory factor analysis for the items of market and environment are given in Table 4.

Table 4. Exploratory factor analysis: Market and environment.

Factor	Initial eigen values			Extraction SUM of squared loadings		
	Total	% of variance	Cum %	Total	% of variance	Cum %
1	3.102	62.04	62.04	3.102	62.04	62.04
2	0.914	18.29	80.33			
3	0.455	9.11	89.44			
4	0.310	6.21	95.64			
5	0.217	4.35	99.99			

Note: Extraction method: Unweighted least squares.

The market and environment factor retained all the five items of the scale. The eigenvalue of the factor was 3.102 with a variance of 62.04 percent explained by it.

The results of exploratory factor analysis for the items of digital financial inclusion are given in Table 5.

Table 5 shows that using the unweighted least squares methods for extraction, three components were extracted from the pool of 18 items of digital financial inclusion. The eigenvalues of all three components were above 1.0. The first component (eigenvalue = 5.171) accounted for 28.73 percent of the variance in the digital financial inclusion factor. The remaining two components (eigenvalues of 4.134, and 2.948, respectively) individually accounted for 22.97 percent, and 16.38 percent of the variance in the factor. The cumulative variance accounted for by the extracted three components was 68.07 percent, which was acceptable.

Table 5. Exploratory factor analysis: Digital financial inclusion.

Factor	Initial eigen values			Extraction SUM of squared loadings		
	Total	% of variance	Cum %	Total	% of variance	Cum %
1	5.171	28.73	28.73	5.17	28.73	28.73
2	4.134	22.97	51.69	4.13	22.97	51.69
3	2.948	16.38	68.07	2.95	16.38	68.07
4	0.889	4.94	73.01			
5	0.781	4.34	77.35			
6	0.674	3.74	81.09			
7	0.563	3.13	84.22			
8	0.586	3.26	87.48			
9	0.419	2.33	89.80			
10	0.355	1.97	91.77			
11	0.302	1.68	93.45			
12	0.255	1.41	94.86			
13	0.235	1.31	96.17			
14	0.182	1.01	97.18			
15	0.155	0.86	98.04			
16	0.132	0.73	98.78			
17	0.117	0.65	99.43			
18	0.103	0.57	100.00			

Note: Extraction method: Unweighted least squares.

Table 6. Confirmatory factor analysis: Item loadings and cross loadings of factors of resources and capabilities.

Items	Past experience	Capabilities	Performance	Resources
Pa_Exp_01	0.693	0.303	0.035	0.258
Pa_Exp_02	0.832	0.320	0.240	0.308
Pa_Exp_03	0.803	0.150	0.233	0.264
Pa_Exp_04	0.810	0.133	0.246	0.138
Pa_Exp_05	0.796	0.257	0.035	0.242
Pa_Exp_06	0.734	0.283	0.241	0.054
Pa_Exp_07	0.722	0.268	0.145	0.307
Cap_01	0.147	0.647	0.042	0.257
Cap_02	0.029	0.742	0.146	0.205
Cap_03	0.249	0.751	0.143	0.049
Cap_04	0.037	0.682	0.136	0.040
Cap_05	0.248	0.809	0.035	0.298
Perf_01	0.142	0.137	0.683	0.244
Perf_02	0.142	0.139	0.713	0.031
Perf_03	0.045	0.248	0.760	0.142
Perf_04	0.134	0.243	0.665	0.297
Res_01	0.047	0.038	0.134	0.756
Res_02	0.248	0.288	0.210	0.680

The results of scale validation are given in Tables 6 to 10 as confirmation of the previous phase results–confirmation of the dimensionality of the factors in the proposed model, where the components extracted during the

exploratory factor analysis stage for each factor were confirmed to be true. The results of the confirmatory factor analysis of resources and capabilities are given in Table 6.

Based on communalities and eigenvalues, the four components that were extracted from the eighteen items of resources and capabilities during the previous phase (given in Table 1, accounting for 66.54 percent of the cumulative variance) were found to be true. These four retained components were identified as past experience (7 items), capabilities (five items), performance (four items), and resources (two items). From Table 6, it can be seen that all seven items of the past experience had item loadings in the range of 0.693 to 0.832. Moreover, the cross-loadings of the items of past experience component with the other three components were in the range of 0.035 to 0.320. The five items in the capabilities component had item loadings in the range of 0.647 to 0.809. The cross-loadings of the items in the capabilities component with the other three components were in the range of 0.029 to 0.298. The four items of performance component had item loadings in the range of 0.665 to 0.760. The cross-loadings of the items in the performance component with the other three components were in the range of 0.045 to 0.297. The two items of resources component had item loadings of 0.756 to 0.680. The cross-loadings of the items of capabilities component with the other three components were in the range of 0.038 to 0.288. In all cases of components extracted, since the item loadings were above 0.40 recommended by Nunnally (1978) and cross-loadings were below 0.32 recommended by Tabachnick and Fidell (2001), the four-component structure of the resources and capabilities factor was confirmed.

The results of the confirmatory factor analysis of business models are given in Table 7.

Table 7. Confirmatory factor analysis: Item loadings and cross loadings of factors of business models.

Items	Customer centricity	Interoperability
Cus_Cen_01	0.729	0.223
Cus_Cen_02	0.787	0.161
Cus_Cen_03	0.786	0.023
Cus_Cen_04	0.787	0.163
Cus_Cen_05	0.688	0.170
Cus_Cen_06	0.687	0.023
Cus_Cen_07	0.795	0.172
Cus_Cen_08	0.718	0.123
Int_Op_01	0.281	0.782
Int_Op_02	0.221	0.726
Int_Op_03	0.030	0.677
Int_Op_04	0.166	0.709
Int_Op_05	0.222	0.709
Int_Op_06	0.224	0.683

The results in Table 7 show that, based on communalities and eigenvalues, the two components that were extracted from the fourteen items of the business model factor during the previous phase (given in Table 2, accounting for 57.20 percent of the cumulative variance) were true. These two extracted components were identified as customer centricity (8 items) and interoperability (six items). From Table 7, it can also be seen that all eight items of the customer-centricity had item loadings in the range of 0.687 to 0.795. Moreover, the cross-loadings of the items of customer centricity component with the other component were in the range of 0.023 to 0.223. The six items of the interoperability component had item loadings in the range of 0.677 to 0.782. The cross-loadings of the items of interoperability component with the customer centricity component were in the range of 0.030 to 0.281. In both components extracted, since the item loadings were above 0.40 recommended by Nunnally (1978) and cross-loadings were below 0.32 recommended by Tabachnick and Fidell (2001), the two-component structure of the business model factor was confirmed.

The results of the confirmatory factor analysis of networks and partnerships factor are given in Table 8.

Table 8. Confirmatory factor analysis: Item loadings and cross loadings of factors of networks and partnerships.

Items	Strategic partnerships	Networks
Str_Pa_01	0.759	0.206
Str_Pa_02	0.872	0.199
Str_Pa_03	0.849	0.214
Str_Pa_04	0.749	0.242
Str_Pa_05	0.774	0.189
Netw_01	0.187	0.660
Netw_02	0.177	0.790
Netw_03	0.204	0.728
Netw_04	0.253	0.631

The results in Table 8 show that, based on communalities and eigenvalues, the two components that were extracted from the nine items of networks and partnerships factor during the previous phase (given in Table 3, accounting for 62.23 percent of cumulative variance) were true. These two extracted components were identified as strategic partnerships (5 items) and networks (four items). From Table 8, it can also be seen that all five items in strategic partnerships had item loadings in the range of 0.749 to 0.872. Moreover, the cross-loadings of the items of the strategic partnerships component with the other component were in the range of 0.189 to 0.242. The four items of the networks component had item loadings in the range of 0.660 to 0.790, and the cross-loadings with the other component were in the range of 0.189 to 0.242. In both components extracted, since the item loadings were above 0.40 recommended by Nunnally (1978) and cross-loadings were below 0.32 recommended by Tabachnick and Fidell (2001), the two-component structure of the networks and partnerships factor was confirmed.

The results of the confirmatory factor analysis of the market and environment factors are given in Table 9.

Table 9. Confirmatory factor analysis: Item loadings market and environment.

Items	Loadings
Mar_Env_01	0.876
Mar_Env_02	0.729
Mar_Env_03	0.785
Mar_Env_04	0.749
Mar_Env_05	0.792

The results in Table 9 show that, based on communalities and eigenvalues, the one component that was extracted from the five items of market and environment factors during the previous phase (given in Table 4 and accounting for 62.04 percent of the cumulative variance) was true. This one extracted component was identified as market and environment (5 items). From Table 9, it can also be seen that all five items of the market and environment factor had item loadings in the range of 0.729 to 0.876. Since the item loadings were above 0.40, as recommended by Nunnally (1978), the one-component structure of the market and environment factor was confirmed. The results of the confirmatory factor analysis of digital financial inclusion factor are given in Table 10.

The results in Table 10 show that, based on communalities and eigenvalues, the three components that were extracted from the eighteen items of digital financial inclusion factors during the previous phase (given in Table 5, accounting for 68.07 percent of the cumulative variance) were true. These three extracted components were identified as digital skills (seven items), access to services (six items), and quality of access (five items). From Table 10, it can also be seen that all seven items of digital skills had item loadings in the range of 0.744 to 0.871. Moreover, the cross-loadings of the items in the digital skills component with the other two components were in the range of 0.023 to 0.319. The six items of the access to services component had item loadings in the range of 0.639 to 0.791, and the cross-loadings with the other components were in the range of 0.029 to 0.304.

Table 10. Confirmatory factor analysis: Item loadings and cross loadings of factors of financial inclusion.

Items	Digital skills	Access to services	Quality of access
Di_Sk_01	0.744	0.303	0.035
Di_Sk_02	0.835	0.319	0.240
Di_Sk_03	0.846	0.150	0.023
Di_Sk_04	0.871	0.133	0.025
Di_Sk_05	0.766	0.257	0.035
Di_Sk_06	0.839	0.283	0.241
Di_Sk_07	0.867	0.268	0.145
Acc_01	0.147	0.749	0.042
Acc_02	0.029	0.872	0.146
Acc_03	0.249	0.783	0.143
Acc_04	0.304	0.639	0.136
Acc_05	0.248	0.791	0.035
Acc_06	0.142	0.752	0.122
Qu_Acc_01	0.142	0.139	0.680
Qu_Acc_02	0.205	0.248	0.753
Qu_Acc_03	0.134	0.243	0.777
Qu_Acc_04	0.047	0.038	0.761
Qu_Acc_05	0.248	0.029	0.718

The five items in the quality of services component had item loadings in the range of 0.680 to 0.777, and the cross-loadings with the other components were in the range of 0.029 to 0.248. In all three components extracted, since the item loadings were above 0.40 recommended by Nunnally (1978) and cross-loadings were below 0.32 recommended by Tabachnick and Fidell (2001), the three-component structure of the digital financial inclusion factor was confirmed.

Reliability of the scale was examined using Cronbach's alpha (Cronbach, 1951). In all twelve constructs, the alpha values computed (ranging from a low of 0.718 to a high of 0.923) are very high based on Zeller (2005), and is greater than the acceptable range of 'above 0.70' suggested by Nunnally (1978) and Hair, Black, Babin, and Anderson (2010). Correlation coefficients between the mean responses of the longitudinal data collected from the same sample spread over a 14-day interval period were computed to assess the test-retest reliability. The correlation computed was 0.776, which was above 0.75, recommended as an excellent measure of reliability by Cicchetti (1994). Based on the above two results, the reliability of the multi-item scale was proven. Table 11 gives the Cronbach's alpha values.

Table 11. Reliability and convergent validity of latent variables.

Constructs	Cronbach's alpha	Average variance extracted
Past experience	0.805	0.585
Capabilities	0.722	0.687
Performance	0.797	0.667
Resources	0.923	0.676
Customer centricity	0.795	0.518
Interoperability	0.827	0.550
Strategic partnerships	0.718	0.637
Networks	0.814	0.564
Market and environment	0.819	0.702
Digital skills	0.880	0.692
Access to services	0.808	0.684
Quality of access	0.831	0.542

The converging validity of the scale was measured using item loadings and average variance extracted (AVE), as recommended by Hair, Hult, Ringle, and Sarstedt (2017). Loadings of all items related to a construct should be high: 0.708 or higher (Hair et al., 2017), while AVE should be above 0.50 (Hair et al., 2017). Items loadings are

given in Tables 6 to 10. All items related to a component have very high loadings for the corresponding component and very low loadings for the other components to which is not related. AVE results are given in Table 11. In all cases, the computed values are above 0.50. Thus, the results show that the convergent validity is achieved.

Discriminant validity is examined using the Heterotrait-Monotrait Ratio (HTMT) recommended by Henseler, Ringle, and Sarstedt (2015). For the achievement of discriminant validity, the threshold of 0.85 suggested by Kline (2011) is adopted in the present study. Table 12 gives the results. In all cases, the values are below the threshold limit, suggesting the achievement of discriminant validity.

Table 12. Discriminant validity (Heterotrait-Monotrait ratio) of latent variables.

Components		1	2	3	4	5	6	7	8	9	10	11	12
Past experience	1	--											
Capabilities	2	0.191	--										
Performance	3	0.334	0.245	--									
Resources	4	0.389	0.199	0.308	--								
Customer centricity	5	0.230	0.246	0.257	0.399	--							
Interoperability	6	0.373	0.209	0.277	0.236	0.275	--						
Strategic partnerships	7	0.244	0.518	0.221	0.530	0.511	0.458	--					
Networks	8	0.503	0.257	0.440	0.362	0.201	0.391	0.284	--				
Market and environment	9	0.271	0.485	0.251	0.492	0.276	0.340	0.487	0.340	--			
Digital skills	10	0.356	0.550	0.237	0.184	0.475	0.416	0.248	0.310	0.471	--		
Access to services	11	0.450	0.435	0.153	0.409	0.375	0.280	0.357	0.319	0.237	0.227	--	
Quality of access	12	0.495	0.353	0.379	0.498	0.189	0.471	0.541	0.273	0.553	0.178	0.184	--

The overall results in phase three of the scale development process exhaustively evaluated the psychometric properties of the scale. The dimensionality of the components and factors and the reliability and validity of the scale were established. Finally, the multi-dimensional scale to measure the factors influencing fintech firms' capacity to impact digital financial inclusion was composed of total of a, sixty-four items as is given in Table 13.

Table 13. Finalized Scale for digital financial inclusion in fintech firms.

1.0	Past experience
1.1	Founding team is well known to each other
1.2	Founding team possess experience in financial service industry
1.3	Founding team possess experience in financial inclusion and poverty alleviation related activities
1.4	Founding team possess technology industry experience (Software, mobile, data analytics)
1.5	Founding team possess experience in digital inclusion and development sector
1.6	Founding team possess experience in dealing with innovative financial products
1.7	Founding team possess experience in working with limited financial resources
2.0	Capabilities
2.1	At least one of our founding members have technical capabilities in the field
2.2	At least one of our founding members have experience in startup firms
2.3	We have full-fledged data analysis capabilities in place
2.3	Our team is capable of developing innovative products
2.5	We have good compliance knowledge or capabilities
3.0	Resources
3.1	We have investments from venture capital firms
3.2	We have investments from development organizations in digital/Financial inclusion like Bill & Melinda Gates Foundation and MasterCard Foundation
4.0	Performance
4.1	Recorded continuous monthly growth in business volume
4.2	Recorded continuous monthly growth in number of customers
4.3	Recorded continuous monthly growth in number of active customers
4.4	Recorded continuous monthly growth in number of merchants accepting our service
5.0	Customer centricity
5.1	We ensure ease of use or Simplicity in all the services offered by the firm

1.0	**Past experience**
5.2	Our customers will have positive experience while accessing our services
5.3	We do detailed market research on customers and derive insights to better target our customers
5.4	We have mechanisms for gathering customer insights from front line staff
5.5	Our business innovations are influenced by customers
5.6	Our customer service and support systems are frequently used by the customers
5.7	Our fraud detection system is capable of providing prompt and timely communication to the customers
5.8	We do maintain transparency on use of customer data
6.0	Interoperability
6.1	We operate with more than 60% of the mobile network operators in the country
6.2	We have used almost all the mobile technology platforms to provide our services
6.3	Our customer can use the agent networks of other mobile network operators for cash in or Cash out
6.4	Our customer can use our product/service across multiple mobile network operators
6.5	Customer can use our product/Service across any other digital financial service platform which may be similar to ours
6.6	Customer can use only our website or Mobile app or System for accessing our services
7.0	Business networks
7.1	We have more than 5 years' experience in terms of local laws, regulations and how business is done in India
7.2	We have connections with Government or Government-related institutions in the country in the form of prior working relationship and/or friendships with people in these institutions
7.3	We have connections with top businesses in the country
7.4	We have experience on laws and regulations of doing business
8.0	Strategic partnerships
8.1	We have partnerships with banks
8.2	We have partnerships with insurance, microfinance companies etc.
8.3	We have partnerships with mobile network providers
8.4	We have partnerships with e-commerce companies
8.5	We have partnerships with credit card/payment companies
9.0	Market and environment
9.1	Infrastructure and connectivity
9.2	Electronic transactions
9.3	E-payment systems
9.4	Intellectual property rights
9.5	Other barriers to trade in digitally enabled services
10.0	Access
10.1	Majority of the customers own desktop or Laptop computer
10.2	Majority of customers owns personal computer or tablet computer
10.3	Majority of customers owns Mobile phone
10.4	Majority of customers have access to internet at home
10.5	Majority of customers have access to internet at work
10.6	Majority of customers have access to electricity
11.0	Quality of Access
11.1	Majority of our customers are having an average internet bandwidth of more than 100Mbps
11.2	Majority of customers are having an average mobile download speed of more than 25 Mbps
11.3	Majority of customers are having an average mobile upload speed of more than 3 Mbps
11.4	Majority of our customers are using mobile hotspot for accessing various digital services
11.5	Majority of our customers are using Wi-Fi for accessing various digital services
12.0	Digital Skills
12.1	Majority of our customers have "basic" or "above basic" digital skills
12.2	Majority of customers possess Degree in information and communication technology
12.3	Majority of our customers are employed in information and communication technology sector
12.4	Majority of our customers use e-commerce platforms
12.5	Majority of our customers use e-banking services
12.6	Majority of our customers use e-government services
12.7	Majority of our customers are actively using social media platforms

5. CONCLUSION

The present study attempted to develop a model to examine the factors that enable fintech firms to ensure digital financial inclusion. Since literature does not exist on any scales available, the study used an exploratory approach to develop the scale. Drawn from the work of Soriano (2017), the study theorized the existence of four factors that affect digital financial inclusion in fintech firms, namely, resources and capabilities, business models,

networks and partnerships, and market and environment. The process of scale development was based on the recommendations of Boateng et al. (2018). The process is composed of three phases: item development, scale development, and scale evaluation. Finally, the scale was composed of a number of multi-dimensional components. The outcome variable, digital financial inclusion, had three components. The predictors were composed of three multi-dimensional constructs: resources and capabilities (four components), business models (two components), networks and partnerships (two components), and one single-dimensional construct: market and environment. Confirmatory factor analysis provided evidence to confirm the dimensionality of the scale. Reliability and validity were also established. To our knowledge, this is the first supply-side scale to measure digital financial inclusion. The present study is unique in many ways. Generally, financial inclusion is measured from the demand-side perspective. In the present study, digital financial inclusion is measured from the supply-side perspective. Thus, the study contributes to the existing literature by providing a scale to measure digital financial inclusion from the perspective of fintech ventures. Understanding the supply-side indicators of digital financial inclusion can facilitate understanding the constraints of fintech firms in contributing to the digital financial inclusion, which can be resolved with proper policy-level interventions. Despite the contributions, the study has certain limitations. The study was conducted among employees of fintech firms. Their responses may be based on their understanding and involvement in the operations of the fintech firms and thus may be biased. Further, we have not classified employees based on their levels in the organization and collected data from different levels; rather, we have collected data from the employees who are willing to respond. Future studies may thus focus on these research gaps and explore the possibility of getting data from top-level employees of fintech firms.

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