

# Construction of Financial Inclusion Index for Micro, Small, and Medium-Sized Enterprises (MSMEs) in Malaysia

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## ABSTRACT

This study intends to develop a new index for assessing the financial inclusion of the Micro, Small, and Medium-sized Enterprises (MSMEs) in Malaysia. The index includes two important dimensions, namely digital financial technology (fintech) and digital financial literacy, using survey data from selected MSMEs in Malaysia for 2023. A total of 177 firms are voluntarily participated in the study, which were recruited based on the purposive sampling technique's non-probability. This study employed non-parametric approaches using a multidimensional measurement model with Principal Component Analysis (PCA) as a parametric way to assess the index of financial inclusion. The main findings revealed that fintech dimensions and digital financial literacy possess a relative relevance and a substantial association with the level of financial inclusion. The study indicates that a higher index value signifies greater financial inclusion for firms, but a lower index value denotes the opposite. The implication from this study suggest that Malaysian policymakers must formulate policies and strategies pertinent to financial inclusion for MSMEs. Furthermore, the accessibility of digital financial technology services and digital financial literacy must be enhanced to elevate the financial inclusivity of firms.

**Key words:** Financial Inclusion, PCA, Multidimensional, Fintech, Digital Financial Literacy, MSMEs

## INTRODUCTION

Constructing MSME's financial inclusion index tends to reflect the effectiveness of the country's financial landscape to support MSMEs as the primary driver to economic growth (Al-shami et al., 2024; Bu et al., 2024). Given this background, the aim of this study is to contribute to theoretical and practical knowledge by constructing and validating a new measure of financial inclusion for MSMEs in Malaysia. This financial inclusion index development should provide policymakers with fresh insights to develop an efficient, robust, and well-functioning financial market system. Additionally, financial institutions can expect more informed market conditions to provide affordable, quality, and targeted financial products and services to tailor MSMEs' needs.

Research on MSMEs' financial inclusion in Malaysia is fascinating due to the region's rapidly expanding economy towards the establishment of the Sustainable Development Goals (SDGs) and ASEAN Economic Community (AEC). Financial inclusion remains a socio-economic challenge for Malaysian policymakers, financial markets, and institutional players, ensuring full access to and benefits from formal and advanced financial products and services (Nizam et al., 2020). Nevertheless, despite ongoing study on financial inclusion

within the MSMEs sector, the understanding related to its measurement remains underdeveloped. Researchers have previously developed several related indices in both developed and developing countries, but for micro study across firm have not been adequately addressed. The study of such inclusive measurement is crucial, especially with the increased readiness of advanced digital financial products and services for the development of MSMEs (Li et al., 2024).

Financial inclusion itself denotes widespread access to a diverse array of formal financial services at equitable pricing. Recent financial inclusion programs in several nations are associated with the 2030 sustainability goal. The next phase of financial inclusion aims to achieve worldwide sustainable development goals (SDGs) and implement its 2030 plan. Thus, this study focusses on financial inclusion issue by study on the measurement of financial inclusion using the financial inclusion index. The study's findings indicate that a high financial inclusion index value, approaching or equal to 1, reflects a good level of financial inclusion for a firm, while a lower index value indicates the opposite. The fintech and digital financial literacy dimension has also been identified as one of the most important indicators in measuring the financial inclusion index.

To achieve the objectives of this study, a multidimensional non-parametric index method and a parametric method through Principal Component Analysis (PCA) were used. This study is divided into five sections. The second section discusses a review of several previous studies on measuring financial inclusion, while the third section discusses the methodology of the study. The fourth section presents the study's results, and the fifth section summarizes and concludes the findings.

## LITERATURE REVIEW

According to Ozili (2020), financial inclusion refers to the ability of all individuals and firms to access and use financial products and services that meet their specific needs in a way that is both economically viable and environmentally sustainable. Primarily, the theory of financial inclusion encompasses three aspects of its conceptualisation: 1) pertaining to the beneficiaries of financial inclusion; 2) concerning the funding of financial; and 3) addressing the delivery of financial inclusion. Taking a perspective of the institutional theory of financial inclusion, Ozili (2023) highlighted several assumptions that may influence the degree of financial inclusion, including the facts that (a) some individuals and companies are constrained by incomplete information in formal financial services transactions (Ozili, 2020); (b) some individuals and companies are hindered by incomplete information in fulfilling formal financial service transaction standards (Claessens & Tzioumis, 2006); and (c) some individuals and companies are restricted by incomplete information, including income limitations and risks, ethnic discrimination, the possibility of losing deposits when a bank fails, and various transaction costs in formal financial service transactions. Additionally, recent research has shown that the most common experience among MSMEs is that they tend to be constrained by the technical and managerial skills that significantly influence their technology adoption (Barkley & Jokonya, 2024). Specifically, two primary factors impeding technology adoption among MSMEs in developing countries are inadequate funding sources and limited quality of digital literacy.

The degree of financial inclusion may be assessed by the financial inclusion index. The index typically comprises financial indicators that assess access (percentage of firms with a bank loan or credit, and percentage of firms with a checking or savings account) and usage (percentage of firms utilising banks for investment financing, proportion of investment financed by banks, percentage of firms utilising banks for working capital financing, and proportion of working capital financed by banks). Prior studies have employed many indicators to assess the financial inclusion of MSMEs. For example, Agyekum et al. (2022) employed panel logistic regression to assess financial inclusion among 6,805 firms in Southeast Asia in 2009 and 2015. The researchers performed the analysis using a sample of five countries (Timor-Leste, Bhutan, Indonesia, Vietnam, and the Philippines) based on data from the World Bank Group Enterprise Survey (WBES). Three industrial sectors were chosen for analysis: manufacturing, retail, and services. The financial inclusion index is derived from a composite measure of financial inclusion, encompassing access to a line of credit, access to credit, overdraft, and account ownership. In the context of other developing countries, ElDeeb et al. (2021) looked at the financial inclusion of Egyptian SMEs by adopting the principal component analysis (PCA) to develop a financial inclusion model consisting of two indicators: financial services delivered via integrated marketing tools (supply side) and the utilisation of banking services (demand side). This brief assessment of

the financial inclusion index bears similarities to [Danane and Ho's \(2024\)](#) approach, which measured the index in the context of Sub-Saharan Africa by accounting for SME deposit accounts and SME depositors.

Recently, based on a sample of small and medium-sized enterprises (SMEs) listed on the National Equities Exchange and Quotations (NEEQ) of China during the period 2020-2021, [Zhang et al. \(2023\)](#) argued that the degree of digitalisation has significant promotion to financial inclusion. Accordingly, the provision of financial services (payment, money fund, credit, insurance, and investment) can facilitate enhanced access to finance for MSMEs. The digitalisation aspect of financial services may importantly explain financial inclusion propensity, which has been strongly supported by two recent studies of [Bu et al. \(2024\)](#) and [Al-shami et al. \(2024\)](#). The results indicate that financial literacy and digital financial literacy have a significant influence on financial inclusion, affirming that advanced digital financial inclusion positively affects the growth of MSMEs. The research by [Li et al. \(2024\)](#) examined the influence of the increasing prevalence of financial technology (FinTech) on small and medium-sized enterprises (MSMEs) in China from 2011 to 2020. The research findings confirmed that FinTech may improve MSMEs performance, promoting increased financial inclusion, lowering financial costs, and alleviating financing limitations.

Therefore, given the lack of a comprehensive and more complete financial inclusion index, it is indispensable and timely to construct a Malaysian MSMEs sector financial inclusion index. This index should take into account new inclusive indicators that align with the emergence of digital financial markets in the global economy, specifically financial literacy and digital financial literacy ([Rahmawati et al., 2023](#)). [Bernabe and Triviño \(2024\)](#) outlined a few key components that contribute to an understanding of financial literacy, including an awareness of financial instruments, financial skills, and money management abilities. [Dewi et al. \(2020\)](#) categorised these elements as subjective financial knowledge, financial conduct, financial experience, financial awareness, financial skills, and financial competence. Another body of literature focused primarily on digital financial skills. [Uthaileang and Kiattisin \(2023\)](#), for example, traced the determinants of digital financial skills and capabilities for 400 MSMEs in Thailand. The results of the structural equation model (SEM) indicated that digital financial literacy has a positive impact on entrepreneurial competency and the acquisition of digital financial services.

## RESEARCH METHODOLOGY

### Data Description

This study employed cross-firm estimations and utilised microdata from 177 selected Malaysian MSMEs firms (listed in Appendix A) for the year 2023. The selection of firms was primarily obtained from the questionnaire survey on MSMEs firms from all regions in Peninsular Malaysia, including the East, West, North, and South of Malaysia. The financial inclusion index was developed according to four dimensions and a dataset of six indicators: account ownership, access to financial services (credit), utilisation of financial services, access, and usage of digital financial technology (fintech), and digital financial literacy.

### Constructing the Financial Inclusion Index

Many researchers choose to develop a multidimensional financial inclusion index as a composite indicator due to its ability to include diverse information inside a singular aggregate measure. A multidimensional index enhances the comparability of analysis and examines the trends and relative rankings of enterprises' financial inclusion levels. The FII Index is calculated based on a composite index including four dimensions. This new index offers three benefits over alternative financial inclusion measures. This new index addresses possible bias, deficiencies in scientific rigour, and multicollinearity issues in weight assignment, utilising Principal Component Analysis (PCA) as the predominant approach for deriving weights or parameters endogenously.

This study employed the methodology of [Nizam et al. \(2020\)](#) by incorporating a dimension of digital financial literacy to create a financial inclusion index for firms, as digital financial literacy pertains to an individual's comprehension of online transactions, online payment methods, and online banking systems ([Prasad et al., 2018](#)). The FI Index was henceforth computed as a component index including four dimensions. The first dimension was banking penetration, the second dimension was access to credit and financial services, the third

dimension was digital financial technology (fintech) and the last dimension, digital financial literacy, was assessed using 11 indicators established in prior research. Digital financial literacy was categorised into four dimensions: comprehension or knowledge, experience, awareness of possible risks, and skills. [Morgan et al. \(2019\)](#) elucidated digital financial literacy through four conceptual dimensions: comprehension of digital financial products and services, awareness of the associated risks, knowledge of digital financial risk mitigation, and understanding of consumer rights and redress mechanisms.

A mixed methods namely a parametric model (Principal Component Analysis (PCA) and non-parametric model (multidimensional) are used to create a financial inclusion index across firms. This index encompasses comprehensive data on several aspects of financial access for every business, enabling researchers and policymakers to do significant comparisons across economies. This indicator facilitates the examination of the correlation between the financial inclusion of enterprises and other pertinent microeconomic factors. The datasets of MSMESs were selected since 85% of financial inclusion data originated from MSMES sectors, providing adequate material for comparative analysis across businesses. As seen in Table 1, the four dimensions of financial inclusion consist of four aspects and six primary indicators.

Table 1. Dimensions of Financial Inclusion Index

<i>Dimension</i>	<i>Indicator</i>
Banking Penetration	1. Number of account ownership
Access to Finance	2. Percentage access to credit 3. Percentage access to financial services.
Fintech Penetration	4. Percentage of firms have access to fintech. 5. Percentage of firms using digital financial services
Digital Financial Literacy	6. Percentage of firm’s level of digital financial literacy

The computation of the FII Index starts with the calculation of a dimension index for every respective dimension using the formula below,

$$d_i = w_i \frac{A_i - m_i}{M_i - m_i} \quad (1)$$

Where,

$w_i$  = weight attached to the indicator  $i$ ,  $0 \leq w_i \leq 1$

$A_i$  = actual value of indicator  $i$

$m_i$  = minimum value of indicator  $i$ , fixed by pre-specified rule ([Sarma, 2012](#))

$M_i$  = maximum value of indicator  $i$ , fixed by pre-specified rule ([Sarma, 2012](#))

The dimension index,  $d_i$ , quantified the firm’s performance in the  $i$  dimension of financial inclusion. Upon determining the dimension indices, the weight ( $w_i$ ) for every dimension of financial inclusion was calculated endogenously via PCA analysis and assigned to dimension  $i$  signifying its relative relevance. The two-stage PCA method proposed by Nagar and Besu (2002) was employed to mitigate the issue of bias towards the weights of indicators that exhibit significant correlation with one another. The initial stage entailed estimating the parameters or weights of four index dimensions: banking penetration, access and usage of financial services, fintech, and digital financial literacy. The subsequent stage involved estimating the dimension

weights and the overall financial inclusion index, utilising these dimensions as explanatory variables. The latent variable of financial inclusion (FI) was calculated linearly as follows:

$$X_1 = \frac{\sqrt{d_1^2 + d_2^2 + d_n^2}}{\sqrt{w_1^2 + w_2^2 + w_n^2}} \quad (2)$$

$$X_2 = 1 - \frac{\sqrt{(w_1 - d_1)^2 + (w_2 - d_2)^2 + \dots + (w_n - d_n)^2}}{\sqrt{w_1^2 + w_2^2 + \dots + w_n^2}} \quad (3)$$

$X_1$  offered the normalised Euclidian distance between observed positions and the least favourable point inside the n-dimensional space.  $X_2$  denoted the normalised inverse Euclidian distance between the observed location and the optimal scenario. This study designated the worst position as (0,0,0) and the ideal point as (1,1,1) inside a three-dimensional space. The Index of Financial Inclusion (equation 4) was derived from the simple average of equations (2) and (3).

$$FII = \frac{1}{2} [X_1 + X_2] \quad (4)$$

The definitive formula for calculating the FI index for every organisation is presented below:

$$FII_k = \frac{1}{2} \left[ \frac{\sqrt{p_k^2 + a_k^2 + f_k^2 + dfl_k^2}}{\sqrt{n}} + \left( 1 - \frac{\sqrt{(z - p_k)^2 + (z - a_k)^2 + (z - f_k)^2 + (z - dfl_k)^2}}{\sqrt{n}} \right) \right] \quad (5)$$

In this context,  $p_k$ ,  $a_k$ ,  $f_k$  and  $dfl_k$  represented the weighted dimension indices for penetration, access, fintech and digital financial literacy, respectively. Here,  $z$  denoted the weight value for each dimension. A higher value of the financial inclusion index indicated greater inclusivity of financial services inside a specific company.

Depending on the value of FI, all the 177 firms were categorised into different levels of FII:

1.  $0 \leq FII \leq 0.25$ ; Low Financial Inclusion
2.  $0.25 < FII \leq 0.5$ ; Medium Financial Inclusion
3.  $0.5 < FII \leq 0.75$ ; High Financial Inclusion
4.  $0.75 < FII \leq 1$ ; Very High Financial Inclusion

### Principal Component Analysis (PCA)

To measure the relative importance (weight) of financial inclusion indicators and develop a composite index of financial inclusion in a firm, this study used Principal Component Analysis (PCA). PCA evaluates the relative weights of every indicator and enables the creation of a reduced number of uncorrelated variables, termed Principal Components (PCs), from an extensive array of variables.

PCA's application requires four conditions. First, Principal Components are obtained by performing Eigenvalue Decomposition of the covariance matrix to find Eigenvalues and Eigenvectors. Initially, the principal components are extracted based on the Kaiser-Meyer-Olkin (KMO) criteria, considering only Eigenvalues greater than one. However, in non-rotated PCA, Eigenvectors may not align well with data clusters. To address this, rotation methods like Varimax rotation are used to align Eigenvectors with data clusters. Second, the 'rule of thumb' suggests retaining components that capture a cumulative variance of 70% or 90% (Rae & Rea, 2016). Third, a scree plot is employed to ascertain the quantity of pertinent primary components (Hamilton, 2013). Fourth, Kaiser-Meyer-Olkin (KMO) is adopted to ensure sample adequacy with



a coefficient above 50% (Field, 2005). Most previous studies consider two to four of these conditions as the basis for generating an index using PCA.

This study also applied a rotation strategy (Varimax rotation) to maximise the variance of the rotated principal components and identify the most important indicators in the financial inclusion measure. Rotated PCA will provide a fixed number of components, as well as rotated component scores obtained through regression methods.

To reduce bias towards indicator weights that have high correlations with each other, this study used two-stage PCA (Nagar & Basu, 2002). In Stage One, estimations were conducted for four components of the index: credit accessibility, financial service accessibility and utilisation, digital financial technology (fintech), and digital financial literacy, which collectively signified financial inclusion. In Stage Two, estimates of dimension weights and the comprehensive financial inclusion index were derived utilising dimensions as explanatory variables. The latent variables pertaining to financial inclusion are as follows:

$$FII_i = w_1 Y_i^p + w_2 Y_i^a + w_3 Y_i^f + w_4 Y_i^{dfn} + e_i \quad (6)$$

Where,

$i$  = firm

$Y_i^p, Y_i^a, Y_i^f$  and  $Y_i^{dfn}$  = dimension of banking penetration, access, fintech and digital financial literacy

$e_i$  = the total variation divided into two orthogonal parts: the variation caused by causal variables and the variation caused by error.

#### Stage One of PCA

In the first stage, the estimation involved four dimensions of endogenous variables with unknown parameters, denoted as  $\alpha, \beta, \gamma,$  and  $\delta$  as follows:

$$Y_i^p = \alpha_1 \text{account ownership}_i + u_i$$

$$Y_i^a = \beta_1 \text{access credit}_i + \beta_2 \text{access financial services}_i + u_i$$

$$Y_i^f = \gamma_1 \text{access fintech}_i + \gamma_2 \text{usage fintech}_i + \epsilon_i$$

$$Y_i^{dfn} = \delta_1 \text{digital financial literacy}_i + v_i$$

#### Stage Two of PCA

In Stage Two of PCA, the computation entailed ascertaining the whole dimensions of the financial inclusion index by replacing  $Y_i^p, Y_i^a, Y_i^f, Y_i^{dfn}$ , according to the methodology established in Stage One. Following this procedure, the Stage Two of PCA integrated the individual dimensions into a unified measure of financial inclusion, ensuring that the overall index reflected the combined impact of banking penetration, availability, usage, and fintech, adjusted for any biases or errors identified in the first stage. The maximum weight,  $\lambda_1$ , was allocated to the first Principal Component (PC) as it accounts for the greatest share of the overall variance across all causative variables. The second greatest eigenvalue,  $\lambda_2$ , was allocated to the second Principal Component, and so on. Each component,  $P_k$ , was a linear combination of the four sub-indices (where  $p=4$ ) and was represented by the eigenvectors of the correlation matrix as follows:

$$P1_i = \phi_{11} Y_i^p + \phi_{12} Y_i^a + \phi_{13} Y_i^f + \phi_{14} Y_i^{dfn}$$

$$P2_i = \phi_{21} Y_i^p + \phi_{22} Y_i^a + \phi_{23} Y_i^f + \phi_{24} Y_i^{dfn}$$

$$P3i = \emptyset 31Y_i^p + \emptyset 32Y_i^a + \emptyset 33Y_i^f + \emptyset 34Y_i^{df}$$

$$P4i = \emptyset 41Y_i^p + \emptyset 42Y_i^a + \emptyset 43Y_i^f + \emptyset 44Y_i^{df}$$

The relative importance (weights) for each dimension,  $w_k$ , was calculated as follows:

$$w_k = \frac{\sum_{j=1}^4 \lambda_j \phi_{jk}}{\sum_{j=1}^4 \lambda_j}, k = 1,2,3,4$$

## RESULTS AND DISCUSSION

Table 2 displays the descriptive statistics of financial inclusion variables utilised to assess the financial inclusion index across 177 enterprises for the year 2023. The statistics for fintech usage indicated a high level of usage, with a maximum value of 1749 and an average value of 143 firms, while digital financial literacy recorded an average of dummy value of 16 with a maximum value of 99, indicating low awareness and knowledge. The statistics of access to fintech might reflect by the low digital literacy scores, with an average usage of 12.6 and a maximum value of 50. The penetration of traditional financial inclusion measures, as indicated by account ownership and access to financial banking services, was comparatively higher than that of other digital financial services platforms, with an average of 36 and 47, respectively.

Table 2. Descriptive Statistics

Statistics	Account Ownership	Access to Credit	Access to Financial Services	Access to Fintech	Fintech Usage	Digital Financial Literacy
Mean	36.44	11.97	47.12	12.57	142.92	16.01
Std. Dev.	18.26	9.20	24.80	8.37	472.14	32.17
Min	0	0	0	0	1	1.36
Max	100	45.45	100	50	1749	99

Based on the multidimensional index analysis and PCA, this study categorised firms into four groups according to their FII (Financial Inclusion Index) values:

- Very High Financial Inclusion: Firms in this category have an FII value greater than 0.75 and less than or equal to 1 ( $0.75 < FII \leq 1$ ).
- High Financial Inclusion: Firms in this category have an FII value between greater than 0.5 and less than or equal to 0.75 ( $0.5 < FII \leq 0.75$ ).
- Medium/Moderate Financial Inclusion: Firms in this category have an FII value between greater than 0.25 and less than or equal to 0.5 ( $0.25 < FII \leq 0.5$ ).
- Low Financial Inclusion: Firms in this category have an FII value between 0 and less than or equal to 0.25 ( $0 \leq FII \leq 0.25$ ).

Thus, the closer the index value is to 1, the more financially inclusive the firm is, which in turn indicates better and more inclusive financial management and administration. Table 3 displays the financial inclusion index values for 177 Malaysian MSMEs in 2023 using the multidimensional method and PCA. According to the index values, just 12% (21 enterprises) are categorised as having high financial inclusion, while 23% (40 enterprises) are categorised as having poor financial inclusion. The majority of MSMESs in Malaysia, with more than 50% (specifically 66% or 116 firms), are at a moderate level of financial inclusion.

This signifies that the degree of financial inclusion among MSMEs in Malaysia is predominantly classified as medium. Consequently, policymakers must pursue efforts to elevate financial inclusion among enterprises in Malaysia to a superior level.

Table 3. Financial Inclusiveness Index for 177 of Malaysian MSMEs in 2023

Firm ID	FI Index	Firm ID	FI Index	Firm ID	FI Index
1	0.69	60	0.38	119	0.28
2	0.65	61	0.38	120	0.28
3	0.60	62	0.38	121	0.28
4	0.58	63	0.38	122	0.28
5	0.57	64	0.38	123	0.28
6	0.57	65	0.38	124	0.28
7	0.57	66	0.38	125	0.28
8	0.55	67	0.38	126	0.28
9	0.55	68	0.38	127	0.28
10	0.54	69	0.38	128	0.28
11	0.53	70	0.38	129	0.28
12	0.53	71	0.38	130	0.28
13	0.53	72	0.38	131	0.28
14	0.53	73	0.38	132	0.28
15	0.52	74	0.38	133	0.28
16	0.52	75	0.38	134	0.26
17	0.52	76	0.36	135	0.26
18	0.50	77	0.36	136	0.26
19	0.50	78	0.36	137	0.26
20	0.50	79	0.36	138	0.24
21	0.50	80	0.36	139	0.23
22	0.49	81	0.35	140	0.23
23	0.49	82	0.35	141	0.23
24	0.49	83	0.35	142	0.23



25	0.48	84	0.35	143	0.23
26	0.47	85	0.35	144	0.23
27	0.47	86	0.35	145	0.23
28	0.46	87	0.35	146	0.23
29	0.46	88	0.35	147	0.23
30	0.46	89	0.34	148	0.23
31	0.46	90	0.34	149	0.23
32	0.46	91	0.34	150	0.23
33	0.46	92	0.34	151	0.23
34	0.46	93	0.34	152	0.23
35	0.45	94	0.34	153	0.23
36	0.45	95	0.33	154	0.23
37	0.45	96	0.33	155	0.22
38	0.44	97	0.33	156	0.22
39	0.44	98	0.33	157	0.22
40	0.43	99	0.33	158	0.22
41	0.42	100	0.33	159	0.22
42	0.42	101	0.33	160	0.22
43	0.42	102	0.33	161	0.22
44	0.42	103	0.33	162	0.22
45	0.42	104	0.33	163	0.22
46	0.42	105	0.33	164	0.21
47	0.41	106	0.33	165	0.20
48	0.40	107	0.33	166	0.20
49	0.40	108	0.33	167	0.20
50	0.40	109	0.33	168	0.20
51	0.40	110	0.33	169	0.20
52	0.40	111	0.31	170	0.17

53	0.40	112	0.31	171	0.17
54	0.40	113	0.31	172	0.17
55	0.40	114	0.31	173	0.17
56	0.40	115	0.31	174	0.17
57	0.39	116	0.28	175	0.17
58	0.38	117	0.28	176	0.16
59	0.38	118	0.28	177	0.15

In Table 4, the Kaiser-Meyer-Olkin (KMO) value, which measures the overall sampling adequacy, was 0.61. As this value was above 0.5, it signified that the sample size in this study was enough for component analysis.

Table 4. Kaiser-Meyer-Olkin Sampling Adequacy

Indicator	KMO
Account ownership	0.6128
Access to credit	0.6159
Access to financial services	0.5787
Access to fintech	0.7606
Fintech usage	0.5773
Digital financial literacy	0.5873
Overall	0.6112

Table 5 presents detailed results of the Principal Component Analysis (PCA), revealing the variance explained by the components both in the initial state and after extraction. Kaiser’s Criterion guided the extraction of these components. The study identified two principal components with Eigenvalues greater than one. The rotation of the initial major component indicated that it represents 35.48% of the overall variance in financial inclusion within an enterprise. The second principal component’s rotation made up 25.87% of the variance. These two components contributed to 61.35% of the total variation in a firm’s financial inclusion.

Table 5. Results of PCA Analysis

Component	Initial Eigen Values			Extraction Sums of Squared Loadings (KMO)		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	2.129	0.5978	35.48	2.129	35.48	35.48
2	1.552	0.5110	61.35	1.552	25.87	61.35
3	0.837	0.5214	75.31			
4	0.694	0.2425	86.88			
5	0.563	0.1695	96.25			
6	0.225	0.1485	100.00			

Table 6 represents the rotated factor loadings corresponding to selected financial inclusion indicators. The indicators exhibiting the largest factor loadings in Component 1 originated from the first dimension (number of account ownerships) and the third and fourth dimensions (fintech usage and digital financial literacy). These indicators explain the highest percentage of the total variance in financial inclusion. This suggests that they are the most important indicators for measuring financial inclusion among all MSMEs firms in Malaysia. For Component 2, the second-dimension indicator (access to credit) had the highest factor loading, indicating that it explains the second-largest variance in this sample. Hence, this obviously demonstrates that, aside from banking penetration, fintech and digital literacy are presently the most critical factors for assessing the financial inclusion index among enterprises, especially for MSMEs in Malaysia.

Table 6. Component Rotation Matrix

All Factor Loading		Indicator	Highest Factor Loading	
Comp1	Comp2		Comp1	Comp2
0.6083	-0.1721	Account ownership	<b>0.6083</b>	
0.1695	0.5214	Access to credit		0.5214
-0.0805	-0.4978	Access to financial services		
-0.0540	-0.6614	Access to fintech		
0.2833	0.0507	Fintech Usage	<b>0.2833</b>	
0.7153	-0.1032	Digital Financial Literacy	<b>0.7153</b>	

## SUMMARY AND CONCLUSIONS

Financial inclusion is a key driver of inclusive and sustainable growth, particularly for the development of firms in today's economy. The principal conclusions of this study can be encapsulated as follows: First, a high financial inclusion index signifies that a corporation possesses a commendable degree of financial inclusivity. The study's results using the multidimensional approach show that the closer the index value (FII) is to 1, the better the level of financial inclusion for MSMEs. Second, the financial inclusion index depends on the indicators used and their relative importance (weights). The indicators used in this study highlight the relative importance among each other for every firm, and the results from the PCA analysis show that indicators in the dimensions of fintech and digital financial literacy are among the most important indicators in measuring financial inclusion among MSMEs in Malaysia.

The findings of this study indicate that most MSMEs in Malaysia are still in a moderate or medium financial inclusion condition. Therefore, policymakers should play a role in enhancing fintech usage and digital financial literacy levels among MSMEs through various schedule incentives and innovations. This study has important implications for Malaysian policymakers and literature in terms of policy formation. From a policy-making perspective, different dimensions of financial inclusion should be considered to achieve optimal financial inclusion. The varying FII values indicate different levels of inclusion across firms, making it essential for the Malaysian government or policymakers to develop effective initiatives or strategies to improve firms' access to financial technology and enhance their digital financial literacy in various aspects accordance with Bank Negara Framework has released its 2023 – 2026 plan for promoting financial inclusion development in Malaysia. This could involve broadening the reach of online banking service networks and offering regular schedule digital financial literacy training courses.

The involvement of organisations, including statutory agencies and financial institutions together with MSMEs, is crucial in supporting the application of fintech and digital financial literacy among MSMEs, hence encouraging financial inclusion initiatives. The FII measure serves as a comparison instrument for assessing

financial inclusion levels among economies, applicable at both macro and micro levels. Given that this is a pioneering study focused on constructing firms' financial inclusiveness index, the FII index can also serve as a reference for measuring the financial inclusion index among all firms across Malaysia and other countries.

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## REFERENCES

1. Agyekum, F. K., Reddy, K., Wallace, D. & Wellalage, N. H. 2022. Does technological inclusion promote financial inclusion among SMEs? Evidence from South-East Asian (SEA) countries. *Global Finance Journal*, 53, 100618.
2. Al-shami, S. A., Damayanti, R., Adil, H., Farhi, F. & Al mamun, A. 2024. Financial and digital financial literacy through social media use towards financial inclusion among batik small enterprises in Indonesia. *Heliyon*, 10, e34902.
3. Barkley, E. & Jokonya, O. 2024. Factors Affecting SMEs Emerging Technologies Adoption in Developing Countries: A Literature Review. *Procedia Computer Science*, 239, 1966–1973.
4. Bernabe, B.N. & Triviño, J.B. (2024). Explaining Financial Inclusion: A Critical Realist Theory on the Role of Financial Literacy. *Philippine Academy of Management*, 7(1), 46-62.
5. Blancher, N., Appendino, M., Bibolov, A., Fouejieu, A., Li, J., Ndoye, A., Panagiotakopoulou, A., Shi, W. & Sydorenko, T. 2019. Financial Inclusion of Small and Medium-Sized Enterprises in the Middle East and Central Asia. IMF Staff Paper No. 19/02. Washington
6. Bu, Y., Du, X., Wang, Y., Liu, S., Tang, M., & Li, H. 2024. Digital inclusive finance: A lever for SME financing? *International Review of Financial Analysis*, 93, 103115.
7. Damane, M. & Ho, S.-Y. 2024. Effects of Financial Inclusion of Small and medium Sized Enterprises on Financial Stability: Evidence from SSA countries. MPRA Paper, May, 1-35. <https://mpra.ub.uni-muenchen.de/121093/>
8. Dewi, V. I., Febrian, E., Effendi, N., Anwar, M., & Nidar, S. R. 2020. Financial literacy and its variables: The evidence from Indonesia. *Economics and Sociology*, 13(3), 133-154.
9. Efobi, U., Tanankem, B.V., Simplicite, A., & Ibukun, B. (2016): Exploring Multidimensional Financial Inclusion and Manufacturing Firms Performance in a Developing Country: The Case of Nigeria, AGDI Working Paper, No. WP/16/043, African Governance and Development Institute (AGDI), Yaoundé
10. ElDeeb, M. S., Halim, Y. T. & Kamel. E. M. 2021. The pillars determining financial inclusion among SMEs in Egypt: service awareness, access and usage metrics and macroeconomic policies. *Future Business Journal*, 7(1), 32.
11. Li, X., Ye, Y., Liu, Z., Tao, Y. & Jiang, J. 2024. FinTech and SME' performance: Evidence from China. *Economic Analysis and Policy*, 81, 670–682.
12. Morgan, P. J., Huang, B., & Trinh, L. Q. (2019). The Need to Promote Digital Financial Literacy for the Digital Age. The 2019 G20 Osaka Summit, Japan: The Future of Work and Education for the Digital Age, August, 40–46.
13. Nizam, R., Karim, Z. A., Rahman, A. A., & Sarmidi, T. (2020). Financial Inclusion Index in Developing Countries Using Non-Parametric and Parametric Method. *Journal of Nusantara Studies*, 5(1), 80-103.
14. Oshora, B., Desalegn, G., Gorgenyi-Hegyes, E., Fekete-Farkas, M, & Zeman, Z. (2021). Determinants of Financial Inclusion in Small and Medium Enterprises: Evidence from Ethiopia. *Journal of Risk and Financial Management* 14: 286. <https://doi.org/10.3390/jrfm14070286>
15. Ozili, P. K. 2020. Theories of financial inclusion. MPRA Paper, No. 101810.
16. Ozili, P. K. 2023. Institutional theory of financial inclusion. MPRA Paper No. 115770. <https://mpra.ub.uni-muenchen.de/115770>
17. Prasad, H., Meghwal, D., & Dayama, V. (2018). Digital Financial Literacy: A Study of Households of Udaipur. *Journal of Business and Management*, 5, 23–32.

18. Rahmawati, A., Wahyuningsih, S. H. & Garad, A. 2023. The effect of financial literacy, training and locus of control on creative economic business performance. *Social Sciences & Humanities*, 8, 100721.
19. Rasheed, R., Siddiqui, S. H., Mahmood, I., & Khan, S. N. (2019). Financial Inclusion for SMEs: Role of Digital Micro-financial Services. *Review of Economics and Development Studies*, 5(3), 429–439.
20. Sarma, M. (2012). Index of financial inclusion A measure of financial sector inclusiveness. (Working Paper No. 07/2012). Berlin, Germany: Berlin working Papers on Money, Finance, Trade and Development.
21. Uthaileang, W. & Kiattisin, S. 2023. Developing the capability of digital financial literacy in developing countries: A Case of online loan for small entrepreneurs. *Heliyon*, 9, e21961.
22. Zhang, X., Li, J., Xiang, D., & Worthington, A. C. 2023. Digitalization, financial inclusion, and small and medium-sized enterprise financing: Evidence from China. *Economic Modelling*, 126, 106410.