

Analyzing the impacts of the digital payment system on financial inclusion in the Philippines



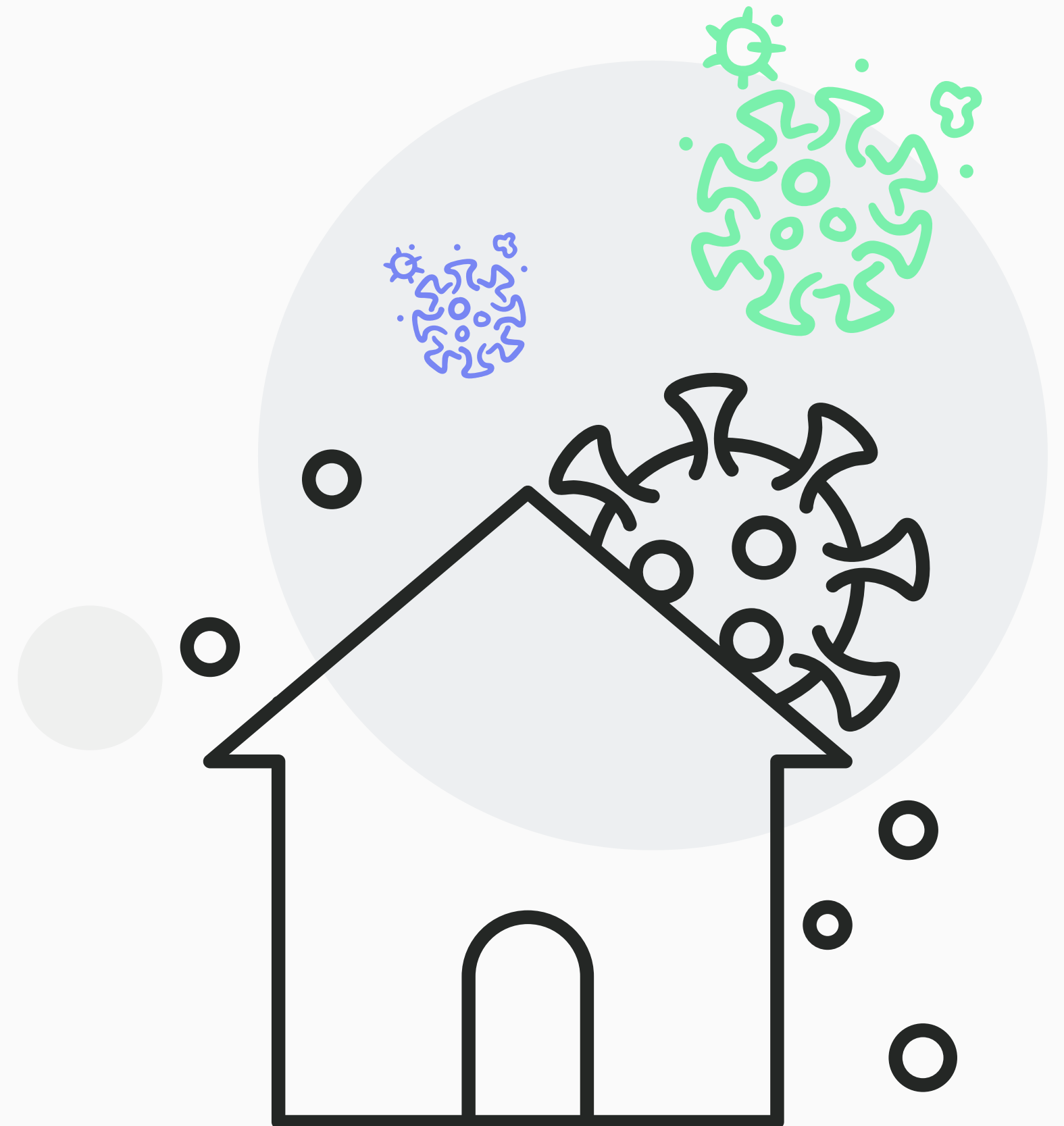
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Philippine Science High School - Central Luzon Campus

At present

"New Normal"



need for accessible,
reliable, and convenient
e-payment services



Digital financial services utilize **electronic means** of transferring money

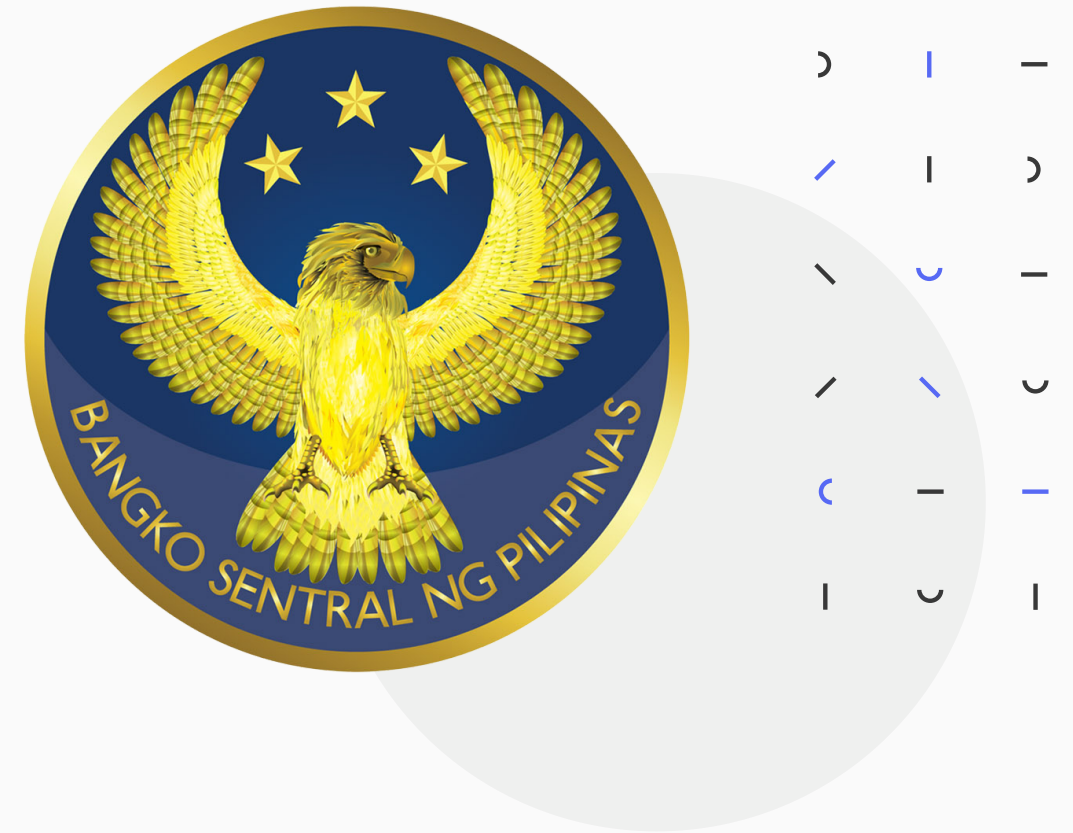
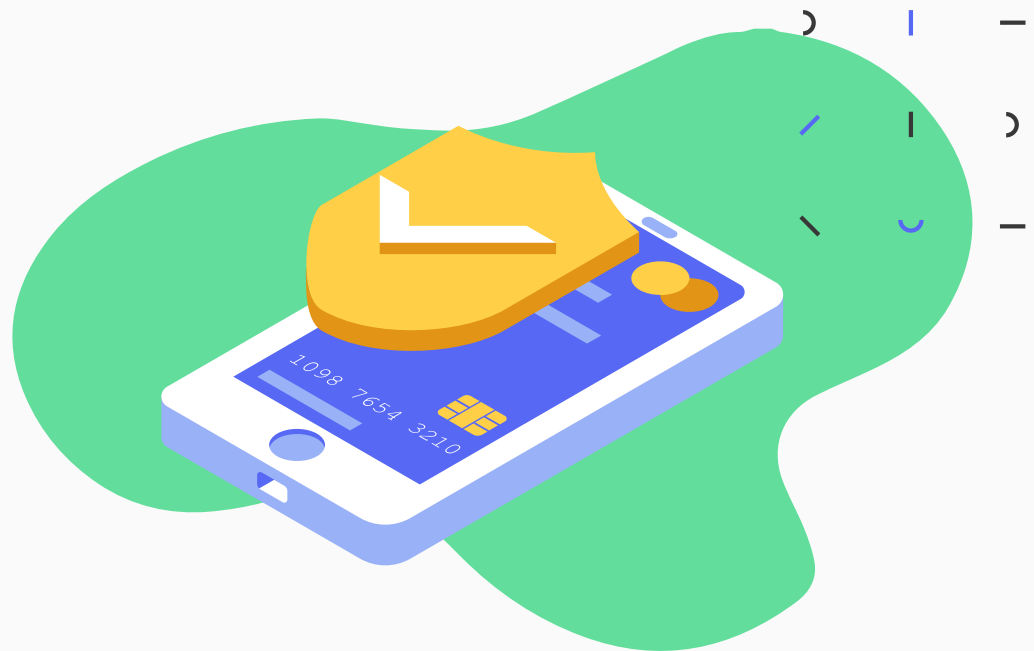


Ranges from established instruments such as **debit and credit cards** to new innovations like **cloud computing, digital platforms, and distributed ledger technologies**, spanning mobile payments, crypto-assets and peer-to-peer applications

At present...

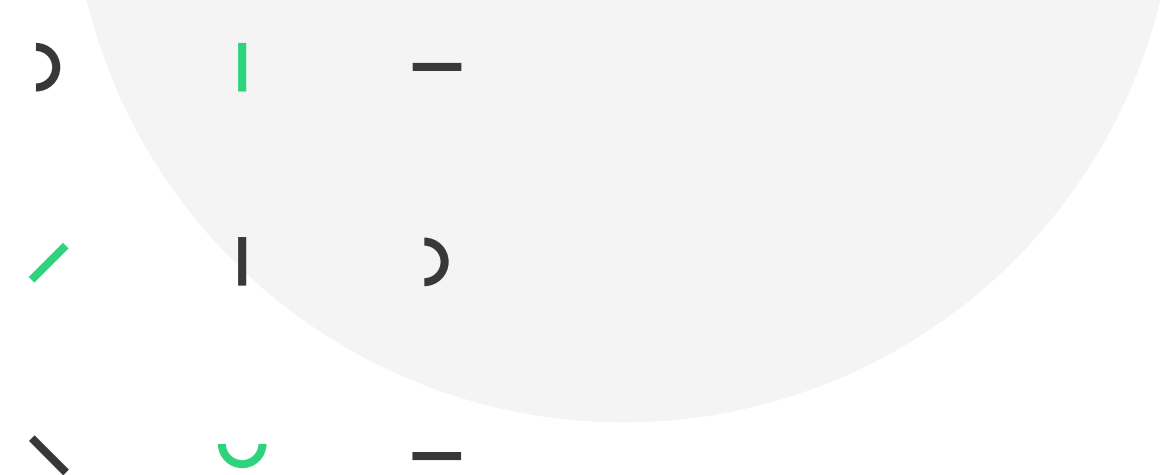
>>> Financial Inclusion <<<

- attainment of a **cash-lite society**
- Financial Inclusion Index
- Republic Act No. 11127 and NRPS



But...

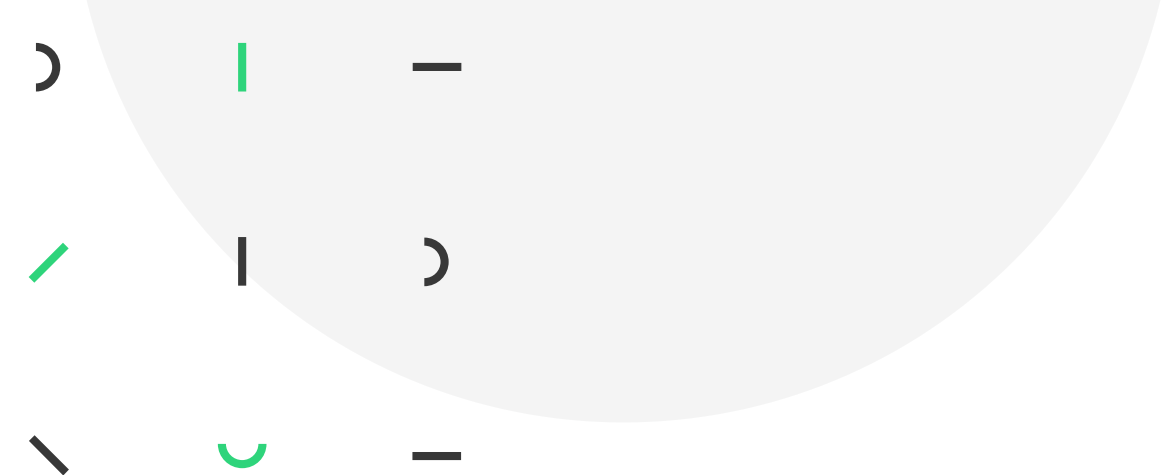
- **Awareness of and trust in digital payments** have not been sufficiently established (BSP, 2020).



PHILIPPINES' PROGRESS TOWARDS A CASH-LITE SOCIETY



Philippines was **one of the first to pioneer** digital payments, with the launch of mobile money in 2001.



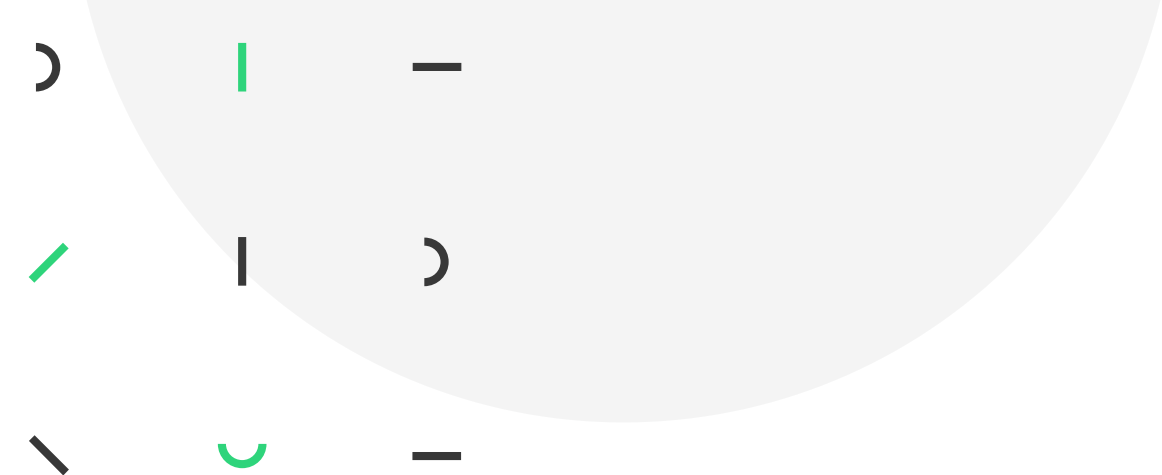
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According to Hokans (2015) and Massally and Ricart (2019), **BSP**, the **government** and **leaders** across financial, retail, and regulatory sectors assume major roles as **key enablers of mobile success**.



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World Bank (2018) cited that the digital payment system **promotes financial inclusion**, as supplemented by Better Than Cash Alliance (n.d.) that specified the advantages of the system such as **convenience, security, and increased efficiency**.

However, Massally and Ricart (2019) also cited costs, lack of trust, and security risks as barriers which prevented people from converting to digital payments.



understand the **implications of digital payment indicators** on the overall level of financial inclusion



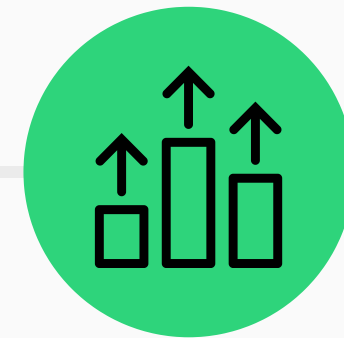
OBJECTIVE 1

Conduct **Principal Components Analysis** to determine possible correlation between the FII and digital payment indicators



OBJECTIVE 2

Study and explain **trends, changes, and inconsistencies** in time-series data



OBJECTIVE 3

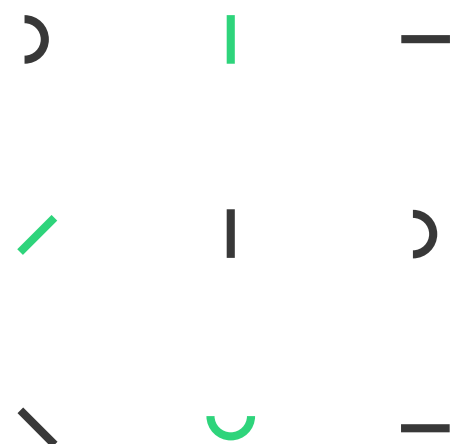
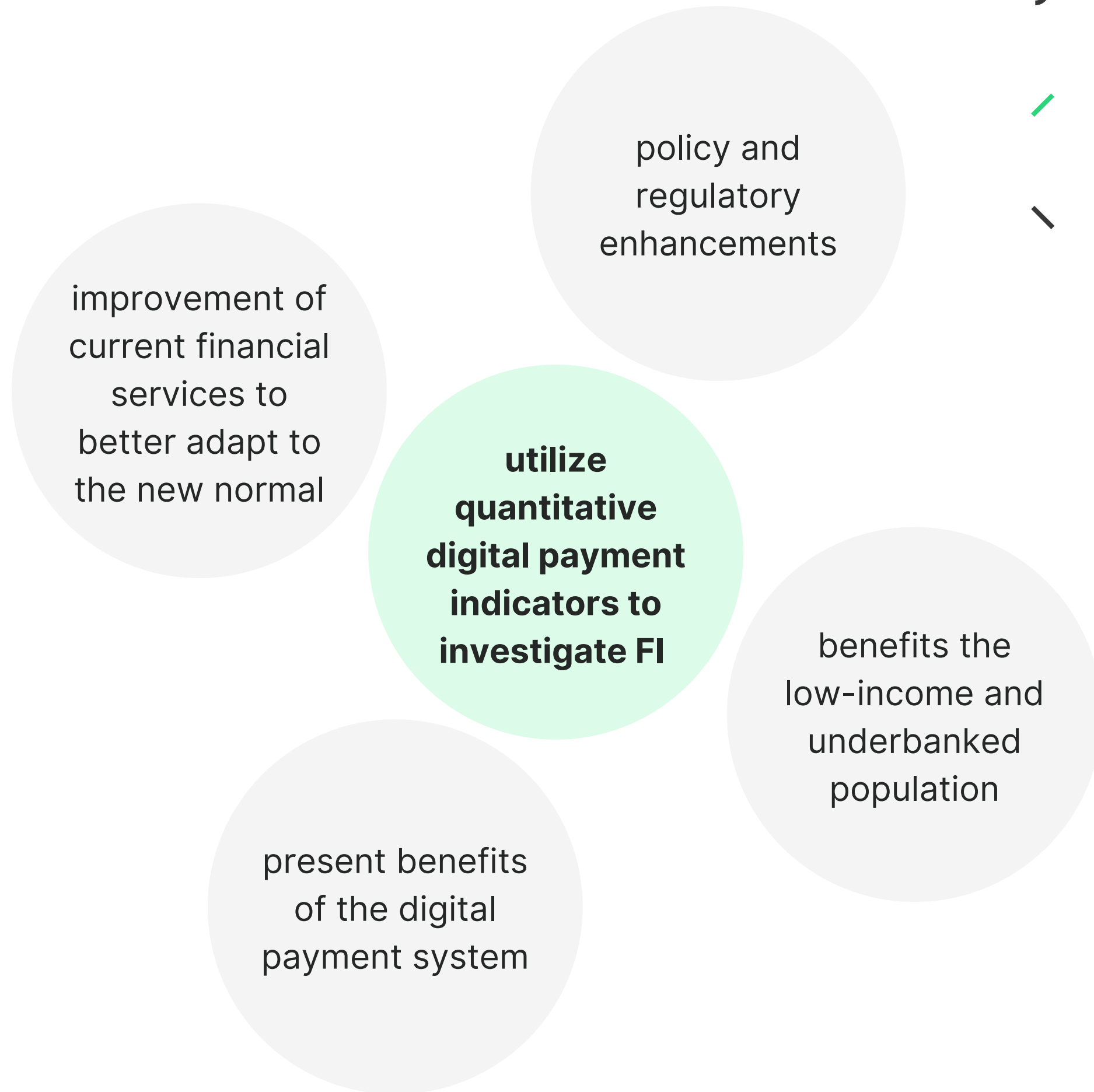
Reveal **areas for improvement** and recommend actions to be taken by public and private stakeholders



OBJECTIVE 4

Utilize **correlation matrix, scree plot and correlation circle** to effectively relay relationships between indicators and FII

Why did we pursue this topic?



Methodology



Collection of
Data



Data Cleaning



Conducting
PCA through
XLSTAT



Interpretation
of Results



Discussion of
Implications

Collection of Data

Main Source: **Bangko Sentral ng Pilipinas**

Validation through **World Bank**

Parameters:

- Number of automated teller machines (ATMs);
- Number of Banks (head office, branches, and other offices);
- Number of Banks per 100,000 adults;
- Number of active mobile money agent outlets;
- Volume of E-money transactions (inflow and outflow);
- Value of E-money transactions (inflow and outflow);
- Deposit accounts per 100,000 adults;
- Number Banks per 100 square kilometer;
- Number of registered mobile money accounts per 100,000 adults;
- Number of active mobile money accounts per 100,000 adults;
- Number of commercial bank branches per 100,000 adults; and
- Number of ATMs per 100,000 adults



Collection of Data

YEAR	ATM	BANK	E-MONEY	VOL-IN	VOL-OUT	VAL-OUT	VAL-IN	REA	AEA	CBB	ATMP	FII
2011	10658	9015	11912	31	127	267	268	13341.49	10903.83	7.657381	16.80462	0.622
2012	12224	9375	15136	39	150	305	308	14335.6	11651.87	7.933654	18.8511	0.624
2013	14528	9884	10620	43	162	346	350	12106.69	8076.88	8.240555	21.92552	0.663
2014	15692	10315	13435	55	218	386	386	16088.12	10211.1	8.616383	23.18432	0.683
2015	17314	10710	19270	60	267	460	456	13524.36	9309.188	8.763675	25.043	0.701
2016	19081	11129	20636	67	299	478	478	16087.42	9929.803	8.837694	27.04162	0.705
2017	20276	11744	40198	73	317	481	482	11873.05	2972.242	8.994506	28.13506	0.711
2018	21278	12316	26455	119	406	544	546	30903.44	6849.656	9.020872	28.89884	0.734
2019	21777	12820	22975	178	449	740	745	54706.03	11680.91	9.071995	28.97211	0.74

Data Cleaning

ATM	BANK	E-MONEY	VOL-IN	VOL-OUT	VAL-OUT	VAL-IN	REA	AEA	CBB	ATMP	FII
- 1.586110 227	- 1.374402 804	- 0.885251 6189	- 0.917451 6583	- 1.2279211 01	- 1.244752 091	- 1.241938 844	- 0.494173 5407	0.660278 8447	- 1.785620 79	- 1.687799 138	- 1.506139 561
- 1.193275 772	- 1.099063 344	- 0.535438 0442	- 0.746320 779	- 1.0249021 97	- 0.979349 8368	- 0.963719 8127	- 0.423873 4995	0.928889 4737	- 1.245509 496	- 1.228040 151	- 1.459796 805
- 0.615312 4342	- 0.709763 9413	- 1.025437 456	- 0.660755 3394	- 0.9189792 902	- 0.692994 7736	- 0.671589 8294	- 0.581494 3512	- 0.354839 0873	- 0.645520 7294	- 0.537345 7753	- 0.556113 0685
- 0.323320 5398	- 0.380121 4211	- 0.720001 5959	- 0.404059 0205	- 0.4246723 935	- 0.413623 9802	- 0.421192 7008	- 0.299941 3108	0.411529 2577	0.089219 71795	- 0.254545 7414	- 0.092685 51142
0.083561 63606	- 0.078012 84699	- 0.086886 76705	- 0.297102 221	0.0078461 41219	0.103211 9876	0.065690 60472	- 0.481241 6031	0.087665 36045	0.377174 2875	0.163022 3925	0.324399 29
0.526817 3726	0.242451 6911	0.061328 28971	- 0.147362 7016	0.2903072 251	0.228928 8446	0.218711 0722	- 0.299990 8124	0.310519 4666	0.521880 784	0.612029 2274	0.417084 8014
0.826585 6835	0.712823 2686	2.183863 385	- 0.019014 54214	0.4491915 848	0.249881 6541	0.246532 9754	- 0.598016 5686	- 2.187842 702	0.828446 8702	0.857679 743	0.556113 0685
1.077939 531	1.150307 077	0.692707 071	0.964988 0137	1.2347864 74	0.689890 6537	0.691683 4262	0.747747 1806	- 0.795517 9422	0.879992 1692	1.029269 36	1.089054 759
1.203114 75	1.535782 321	0.315116 7361	2.227078 248	1.6143435 56	2.058807 541	2.075823 109	2.430984 506	0.939317 3287	0.979937 1863	1.045730 083	1.228083 026

Conducting PCA through XLSTAT

XLSTAT
by Addinsoft

- **XLSTAT** was used for its **Principal Components Analysis (PCA)** function
- **Correlation matrix, eigenvalues and eigenvectors, biplots, and correlation circle** were generated, to name a few

Conducting PCA through XLSTAT

Principal Components Analysis

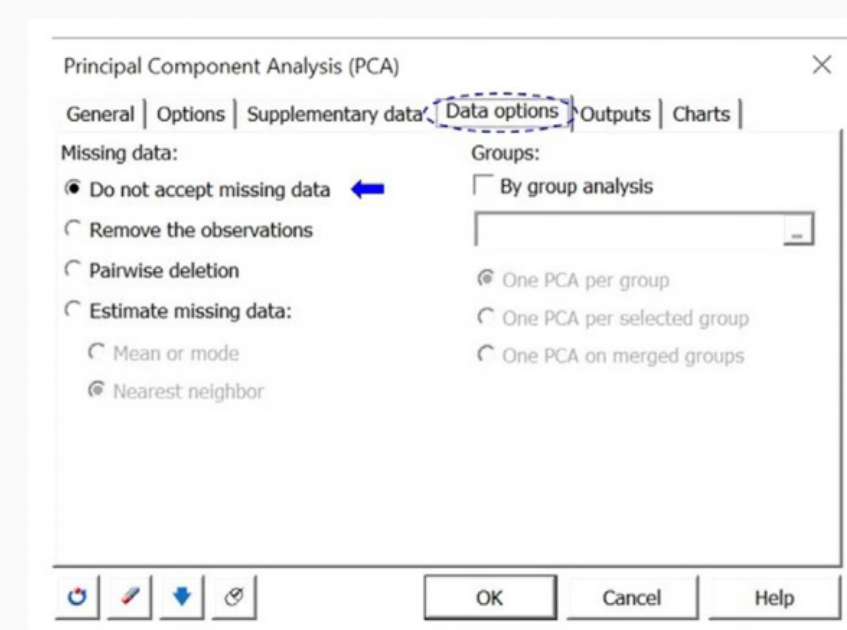
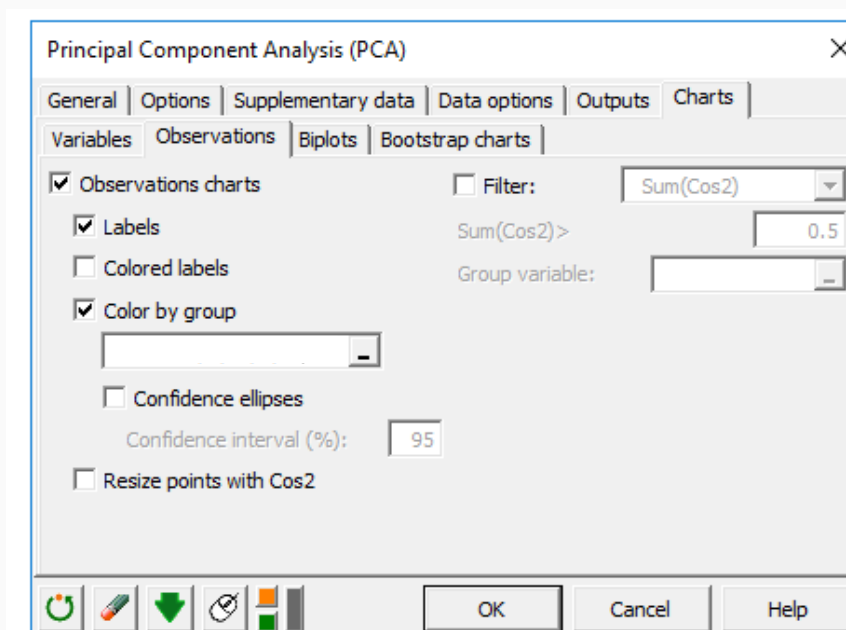
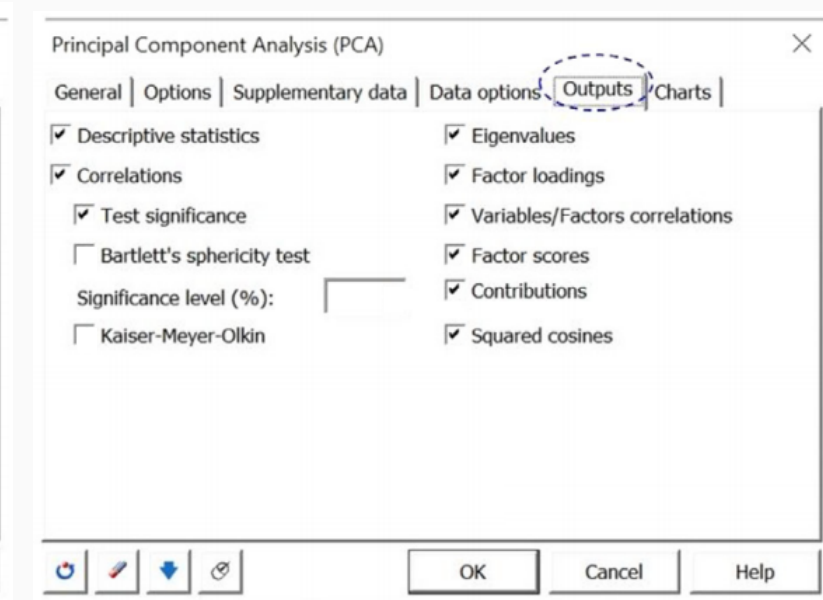
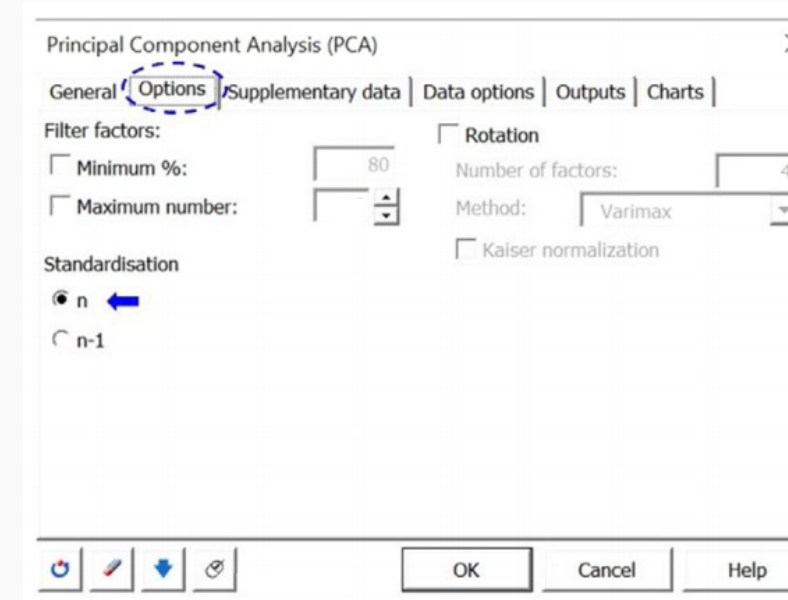
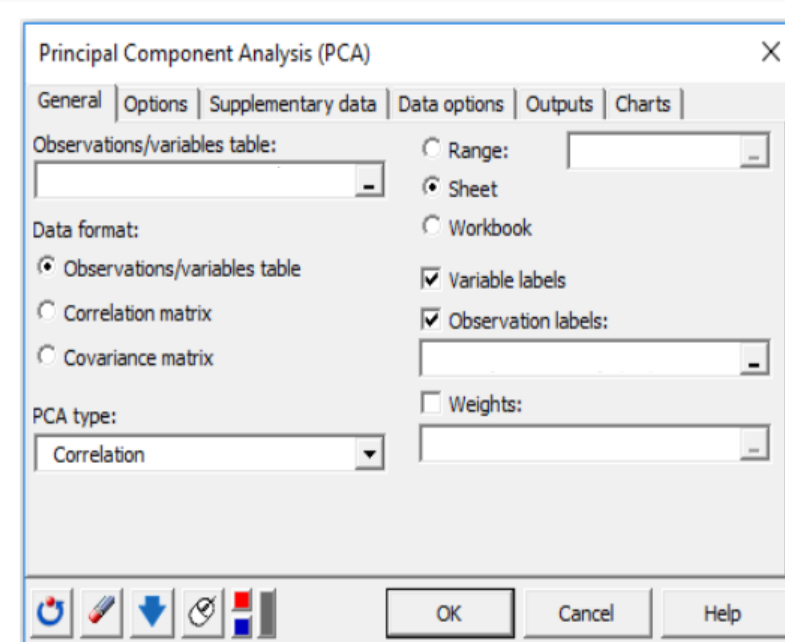
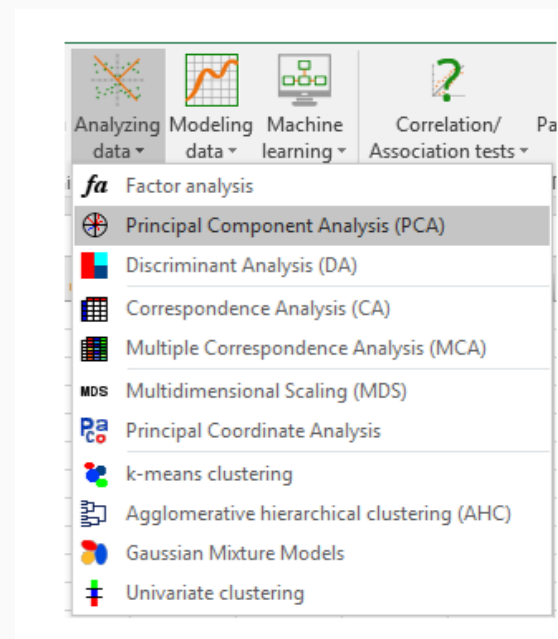
A **dimension reduction** technique

The **first component** has the highest variance followed by second, third and so on.

A principal component is a **normalized linear combination** of the original predictors in a data set.

Normalizing data becomes extremely important when the predictors are measured in **different units**.

Conducting PCA through XLSTAT



Interpretation of Results

- **Correlation matrix, eigenvalues, factor loadings, and the correlation circle** were interpreted



Key Findings

01

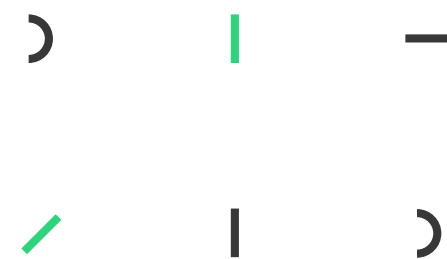
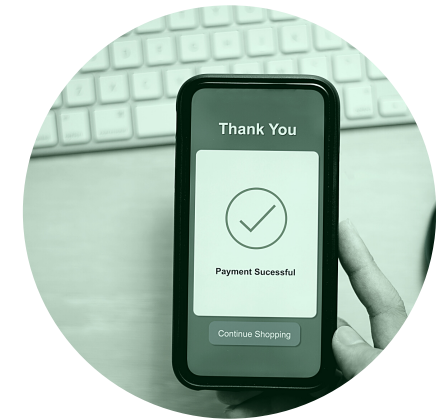
digital finance-related indicators
have an influence on the FII

02

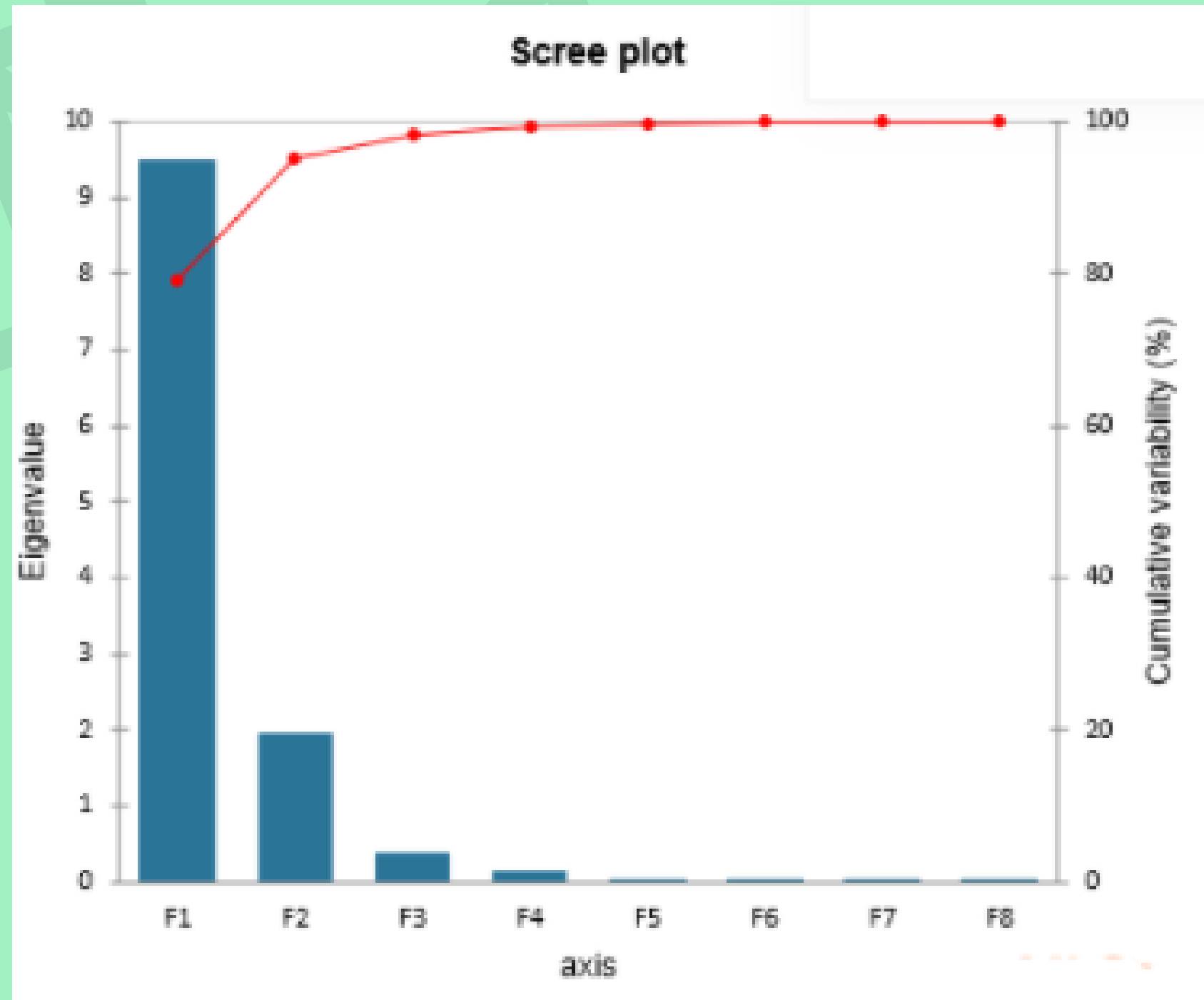
a **low negative correlation** between
FI and number of
active mobile money
accounts

03

financial inclusion is
highly correlated
with **conventional indicators**



Scree Plot



F1, F2, and F3 had a cumulative variability of 98.29%.

This is a **high percentage** of the variance captured, indicating that the maps based on the three factors are **accurate projections** of the initial multi-dimensional table.

Pearson's correlations values between financial inclusion indicators

Variables	ATM	BANK	E-MONEY	VOL-IN	VOL-OUT	VAL-OUT	VAL-IN	REA	AEA	CBB	ATMP	FII
ATM	1	0.981	0.733	0.811	0.959	0.907	0.905	0.598	-0.429	0.976	0.996	0.983
BANK		1	0.708	0.901	0.990	0.952	0.951	0.725	-0.350	0.932	0.961	0.964
E-MONEY			1	0.441	0.656	0.539	0.536	0.185	-0.754	0.697	0.728	0.638
VOL-IN				1	0.925	0.960	0.963	0.951	0.008	0.723	0.761	0.812
VOL-OUT					1	0.962	0.961	0.774	-0.246	0.902	0.932	0.950
VAL-OUT						1	1.000	0.851	-0.092	0.855	0.877	0.909
VAL-IN							1	0.857	-0.090	0.850	0.873	0.905
REA								1	0.278	0.496	0.535	0.613
AEA									1	-0.433	-0.460	-0.370
CBB										1	0.986	0.978
ATMP											1	0.981
FII												1

ATM: Number of Automated Teller Machines (ATMs), **BANK:** No. of Banks (head office, branches, and other offices), **E-MONEY:** Number of active mobile money agent outlets, **VOL-IN:** Volume of E-money transactions (inflow), **VOL-OUT:** Volume of E-money transactions (outflow), **VAL-OUT:** Value of E-money transactions (outflow), **VAL-IN:** Value of E-money transactions (inflow), **REA:** Number of registered mobile money accounts, **AEA:** Number of active mobile money accounts per 100,000 adults, **CBB:** Number of commercial bank branches per 100,000 adults, **ATMP:** Number of ATMs per 100,000 adults, FII: Financial Inclusion Index

NOTE: Values in bold are different from 0 with a significance level $\alpha=0.05$

Pearson's correlations values between financial inclusion indicators

Variables	FII
ATM	0.983
BANK	0.964
E-MONEY	0.638
VOL-IN	0.812
VOL-OUT	0.950
VAL-OUT	0.909
VAL-IN	0.905
REA	0.613
AEA	-0.370
CBB	0.978
ATMP	0.981
FII	1

Size of Correlation Interpretation

.90 to 1.00 (-.90 to -1.00)

Very high positive (negative) correlation

.70 to .90 (-.70 to -.90)

High positive (negative) correlation

.50 to .70 (-.50 to -.70)

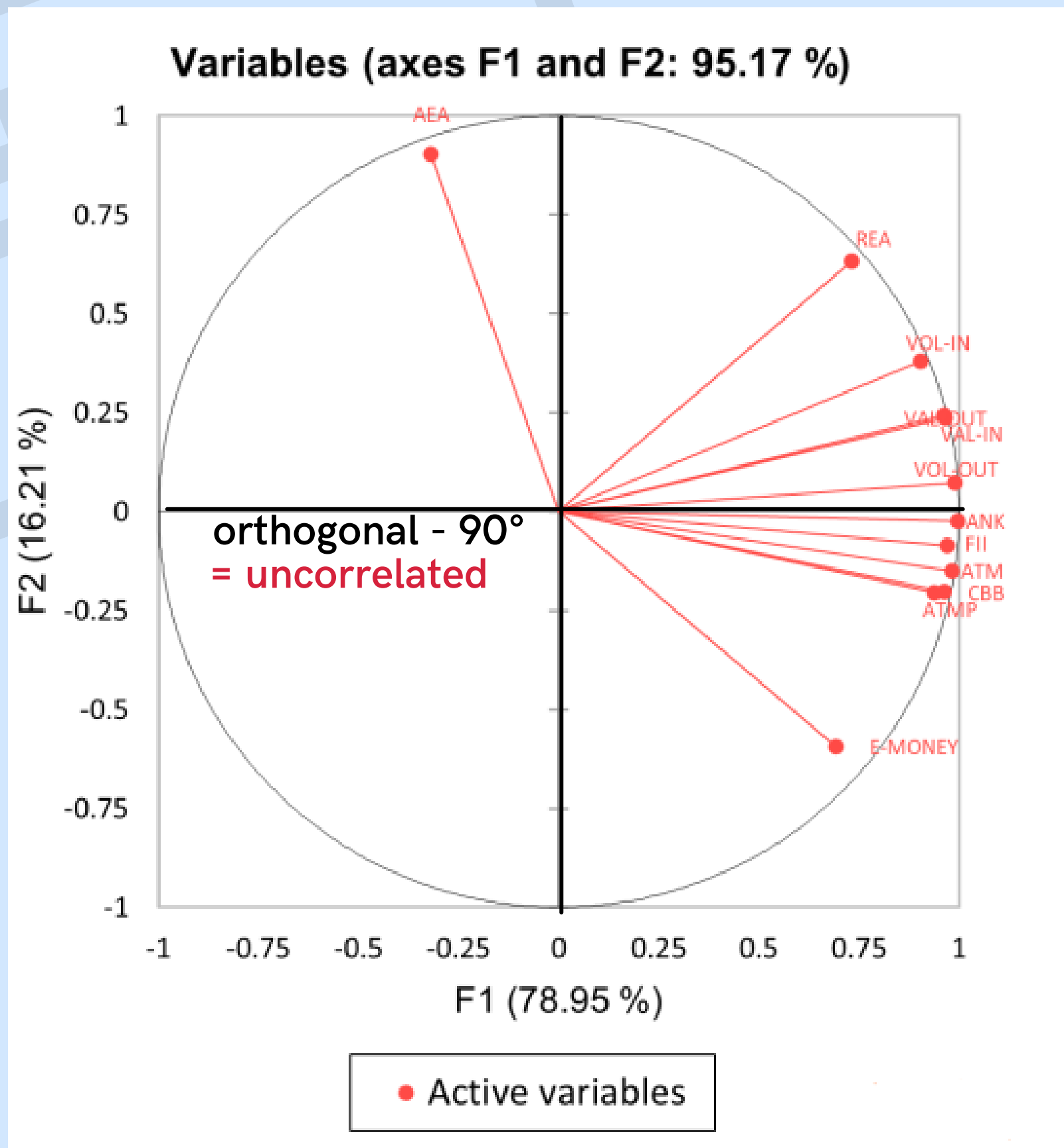
Moderate positive (negative) correlation

.30 to .50 (-.30 to -.50)

Low positive (negative) correlation

.00 to .30 (.00 to -.30)

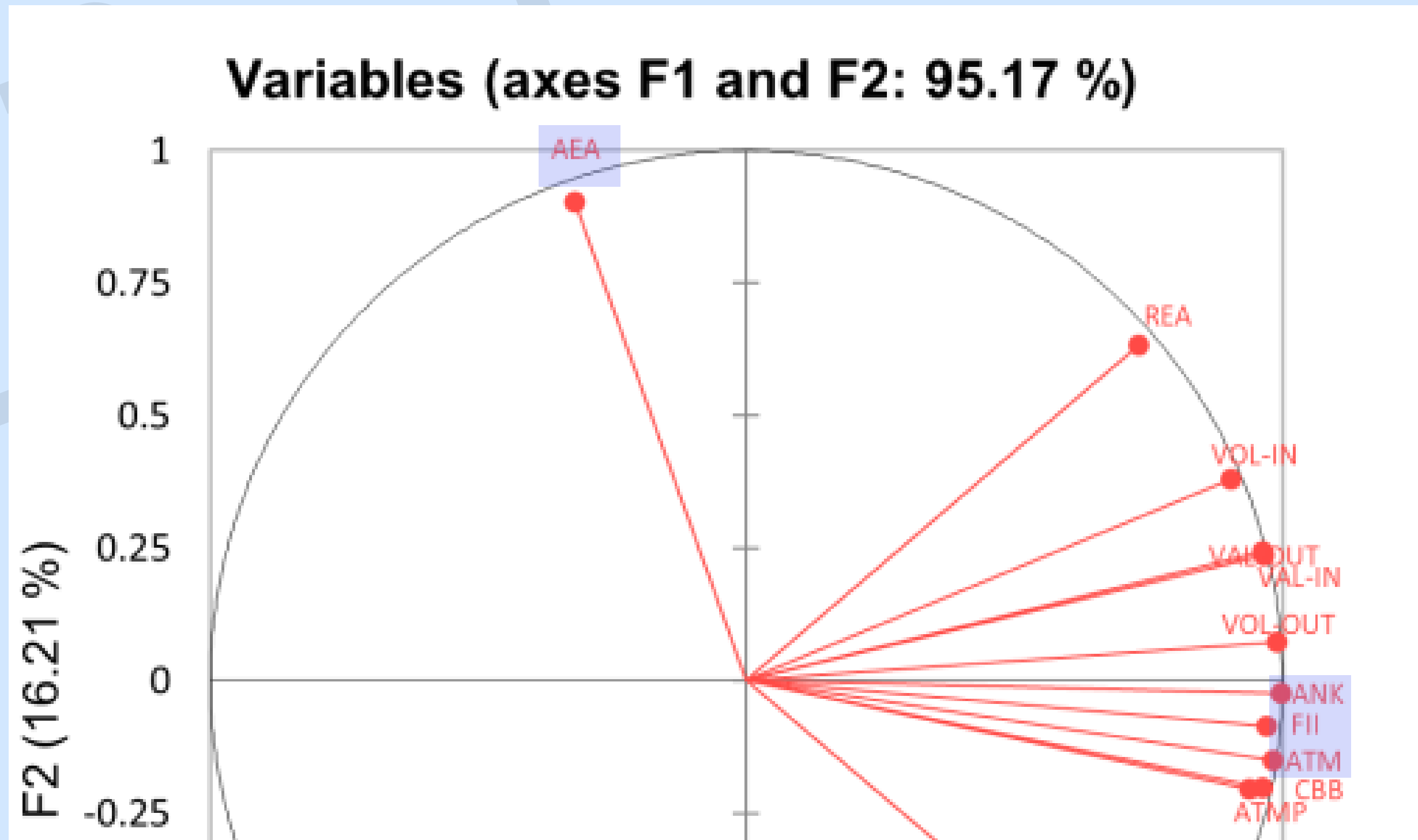
Negligible correlation



Correlation Circle

- Length of the line
- Angle formed
- Positive or Negative side of the axis

Correlation Circle



- FII forms a small angle ($<90^\circ$) with BANK and ATM
- FII forms an angle close to 90° with AEA

Factor loadings:

	F1	F2	F3	F4	F5
ATM	0.981	-0.150	-0.104	0.008	0.026
BANK	0.998	-0.023	0.031	-0.026	0.042
E-MONEY	0.691	-0.595	0.342	0.226	0.005
VOL-IN	0.904	0.381	0.176	-0.080	0.010
VOL-OUT	0.989	0.072	0.029	0.021	0.113
VAL-OUT	0.965	0.236	0.014	0.037	-0.103
VAL-IN	0.963	0.242	0.024	0.030	-0.104
REA	0.731	0.633	0.229	-0.101	0.019
AEA	-0.320	0.902	-0.155	0.244	0.036
CBB	0.939	-0.205	-0.256	0.052	-0.020
ATMP	0.962	-0.202	-0.172	0.011	0.011
FII	0.970	-0.086	-0.207	-0.061	0.015

Digital finance-related indicators have an influence on the FII.

6 of the 11 variables

grouped in F1 are digital payment indicators. Their autocorrelation signifies their influence on the FII.

This suggests that digital payment parameters must also be **considered in computing the FII.**

financial inclusion is highly correlated with conventional indicators

Variables	FII
ATM	0.983
BANK	0.964
CBB	0.978
ATMP	0.981

Indicators

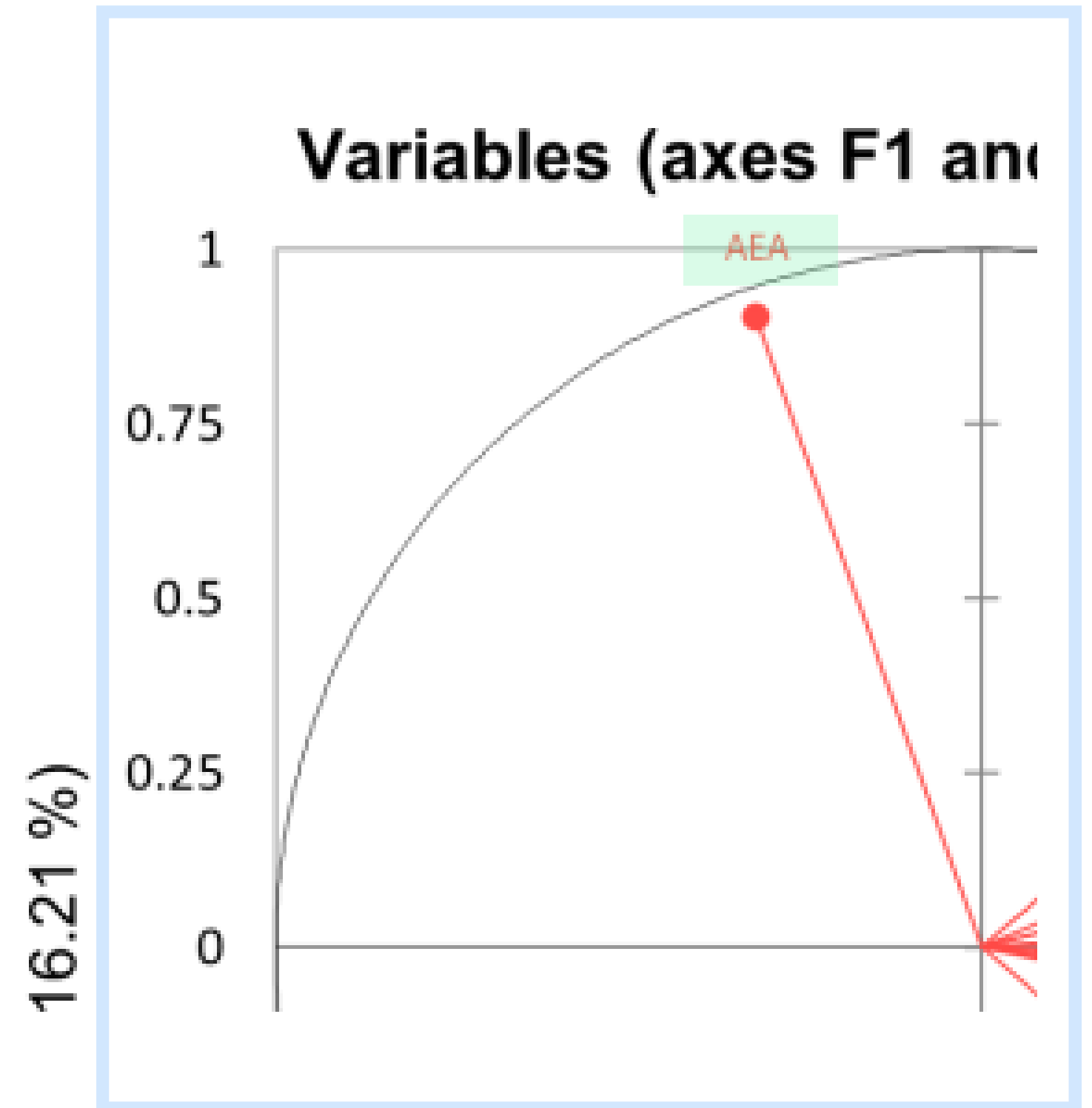
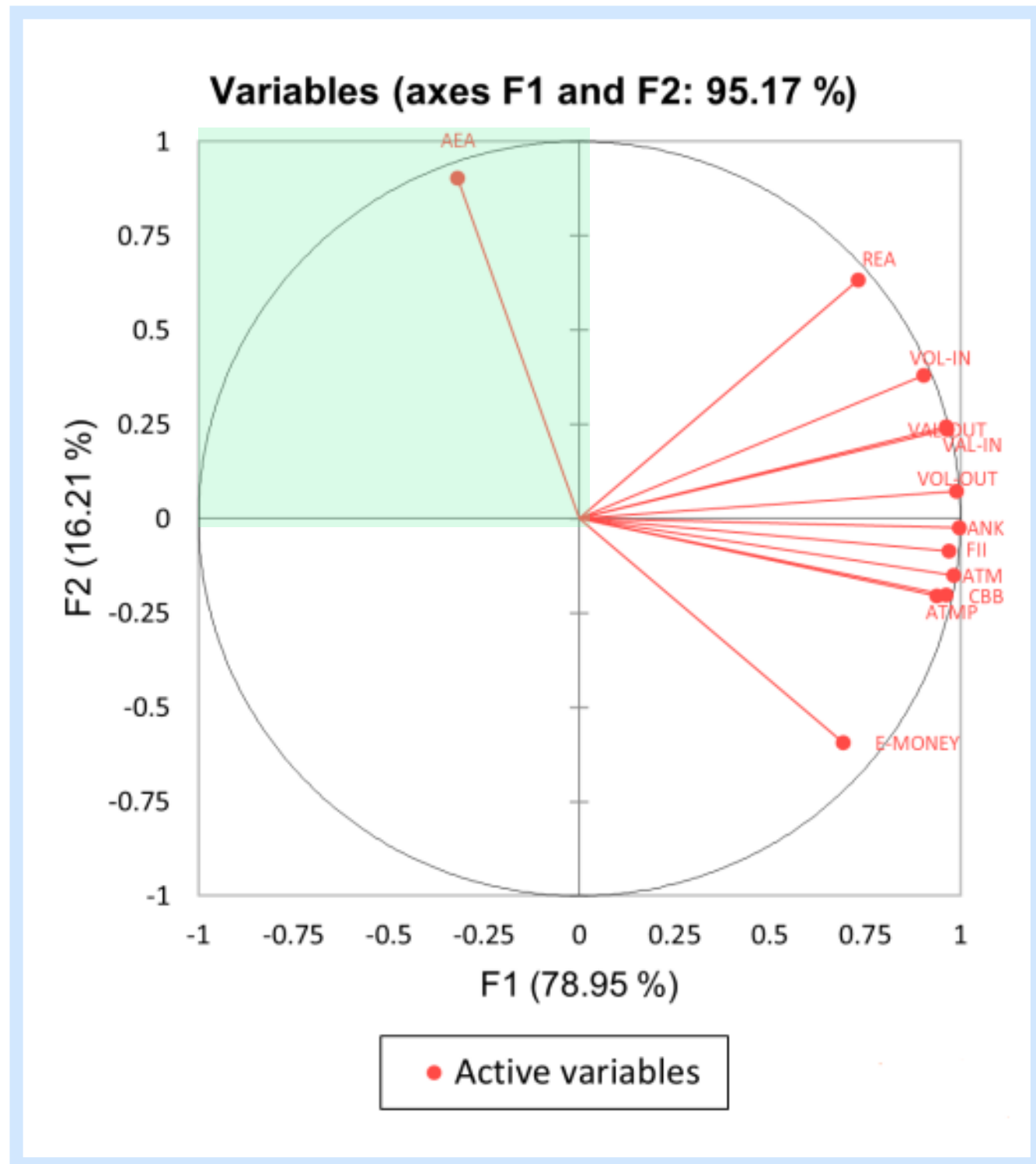
- Number of ATMs
- Number of Banks
- Number of commercial bank branches per 100,000 adults
- Number of ATMs per 100,000 adults

Majority of Filipinos still opt for **physical channels** in making payments or engaging in financial transactions.

Factor loadings:

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FII	0.970	-0.086	-0.207	-0.061	0.015

a **low negative correlation** between FII and number of active mobile money accounts

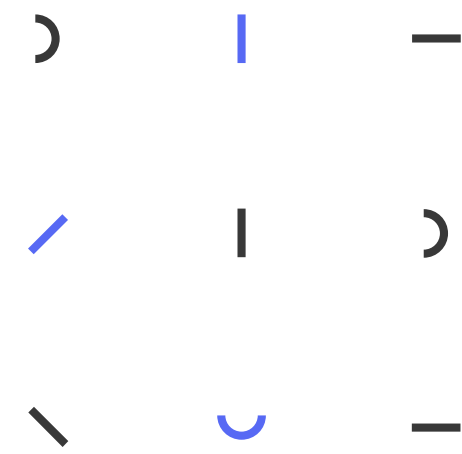
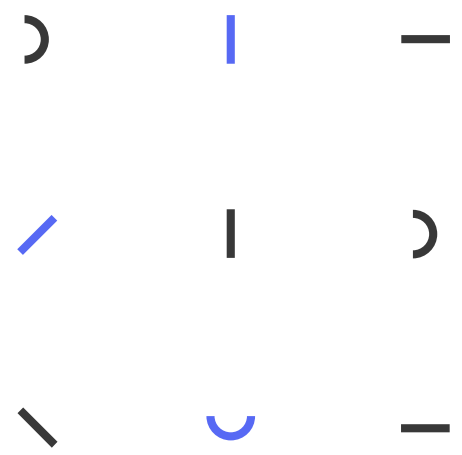


a low negative correlation
between FII and number of active mobile money accounts

Variables	FII
AEA	-0.370

- improper and irregular use of mobile money accounts

- a bad digital infrastructure
- poor mobile connectivity
- lack of financial literacy



Policy Recommendations

number of active mobile money accounts among registered ones negatively correlated with FII



01

Improvement of financial literacy of Filipinos by educating them on the use of digital financial services



02

Use of **simpler or vernacular language** may be more appropriate in promoting the use of digital financial services

Policy Recommendations

number of active mobile money accounts among registered ones negatively correlated with FII



03

Improvements in the [penetration](#) of digital modes of payments by developing the digital infrastructure

individuals comprising these sectors usually engage in informal means of saving, borrowing, or getting loans



04

Policy reforms targeting the [marginalized and informal](#) sectors

Conclusion

The **digital payment system** has the potential to **promote financial inclusion** the Philippines subject to implementation of supportive policies and regulations.

