

Principal Components-based Investigative Study of Counter Measures to Financial Crimes

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Abstract

Financial crime is presently a very serious threat to the global, regional and national economies as it manifests itself in several financial institutions and government agencies. One of the reasons for the thriving status of the menace has been lack of globally acknowledged counter measures. Based on this, twenty eight indices that were considered to be related to financial crimes were formulated in this research. A questionnaire was formulated based on the indices and administered on selected financial related agencies and parastatals in States across Nigeria to obtain relevant data which were subjected to Principal Component Analyses (PCA) using SPSS. The analyses showed that effective citizens' control and monitoring, economic and social stability, moral suasion and political security and goodwill are the much desired counter-measures to financial crime. The percentage of relevance of these measures was 64.17%, indicating that the indices of some extraneous counter-measures were not given consideration in the research. Such measures include but not limited to good governance, financial security and moral training. A coefficient score matrix was also generated for the estimation and ranking of the contribution of every respondent to the extracted counter-measures.

Keywords: Principal Component Analysis (PCA), Multivariate Statistical Technique (MST), orthogonal transformation, economic and financial crime

1. Introduction

Financial crime is a non-violent crime committed for monetary, property or any other unlawful or illicit gain from individuals, corporations, government bodies and financial institution (IMF, 2001). Financial crime is also an act or a practice, which is detrimental to the interest, development or well-being of the financial sector of a country (Ladan, 2005). Important characteristics of financial crime include deceit, concealment or violation of trust which are not dependent on the application of threat, physical force or violence. It may be committed individually or collectively in an organized manner thereby violating existing legislation on the economic activities of government and its administration. Economic and financial related crimes remain the bane of Nigerian developmental efforts as her economy is being subverted and the standard of lives going on a fallen trend. The nation is notably known for money laundering, inflated contracts, scam mails, illegal oil bunkering and mining as well as fuel diversion on the roads and seaways. Nigeria is also not spared from narcotic drug trafficking, embezzlements, bribery, looting, illegal arms deal, smuggling, human trafficking and child labor, tax evasion as well as foreign exchange malpractices such as counterfeiting of currency, theft of intellectual property and piracy and open market abuse (Adegbe and Fakile, 2012; Ibrahim *et al.*, 2015; EFCC, 2004; Agus *et al.*, 2010; Gottschalk, 2010; Spencher and Pickett, 2002). The steps being taken to address the problem of financial crimes in Nigeria include the expression of strong political will at the highest level as appropriate legislation was being enacted to criminalize all corrupt conducts including unjust enrichment, provision for interim restraints, forfeiture of tainted property as well as institution of special or designated courts/judges to expeditiously try financial crime cases. There is also the use of technology and establishment of various agencies and commissions such as the Economic and Financial Crimes Commission (EFCC) and Independent Corrupt Practices Commission (ICPC) (Adegbe and Fakile, 2012; Akomaye, 2007; Deloitte, 2014). While technological-based tools give organizations a more holistic view of data, highlight potential areas of risk and allow more focused and targeted combat-efforts, the goals of the agencies and commissions are to prevent and detect

financial crimes through setting up of relevant laws and litigation measures. Several of the existing technology-based tools for combating financial crime rely on the concept of big data, machine and text mining as well as forensic accounting. All these steps and strategies could not work effectively because of various challenges like politicization and blackmail, constitutional immunity as enshrined in the Nigerian constitution, public apathy and doubtful attitudes towards anti-corruption work, and slow justice (Adegbe et al., 2012). Section 2 of this paper presents the PCA model for the investigative study of financial crimes' counter measures. Sections 3 and 4 present the data survey and the results and discussion respectively. The conclusion drawn formed the focus of Section 5.

2. Principal Component Analysis (PCA) Model

A PCA-based model for the investigative study of the counter measures to financial crime based on some formulated indices is used. PCA is a Multivariate Statistical Technique (MST) that is useful in the dimensionality reduction of a large number of interrelated variables while retaining as much vital information as possible (Pearson, 1901; Hotelling, 1933; Jolliffe, 2002; Srinivasulu *et al.*, 2010). The indices formed the vital components of the research instrument (Questionnaire) and are related to one another for the i^{th} respondents as follows (Shehu *et al.*, 2012):

$$Y_j = \sum_{k=1}^p \alpha_{jk} X_k ; j = 1, 2, \dots, p \quad (1)$$

Y_j represents the j^{th} respondent, α_{jk} represents the assessment of the j^{th} indices by k^{th} respondent, X_k represents the k^{th} index and p is the number of indices. PCA is used to generate some clusters of performance indices, where each cluster represents a component with associated percentage contribution. Descriptive statistics, communalities, correlation matrix, Bartlett and Kaiser-Mayer Olkin (KMO) tests, component extraction and eigenvalues formed the focus of the analyses. The descriptive statistics provide the basic features of the data and include the mean, standard deviation, variance and covariance. The communality of the squared factor loadings for component i is its proportion of variation that is explained by the extracted factors and is computed as follows:

$$c_i = \alpha_{i1}^2 + \alpha_{i2}^2 + \dots + \alpha_{ip}^2 = \sum_{i=1}^p \alpha_{ip}^2 \quad (2)$$

p is the number of variables, α_{ip} is the value in Y for row i , column p . The communalities narrate how well the model works for each variable while the correlation matrix describes the correlations between all pairs of dataset. A positive value in the correlation shows a positive relationship while a negative value dictates a negative relationship. The Bartlett's test of sphericity and the Kaiser-Mayer Olkin test give the adequacy measure of the sample from the population. While Bartlett's test examines the null hypothesis that the variables in the population correlation matrix are uncorrelated, KMO test indicates the level of uniqueness and correlations between used and unused variables (Rencher, 2002).

Given a p -dimensional random vector $X = [X_1, X_2, \dots, X_p]$ with correlation matrix ρ and eigenvalues $\lambda_1 \geq \lambda_2 \geq \dots, \lambda_p \geq 0$, the j principal components ($j \in p$) of X are j random variables (Y_1, Y_2, \dots, Y_k) defined for $k=1, 2, \dots, p$ as follows (Martin *et al.*, 2013; Bello *et al.*, 2014):

$$Y_j = \sum_1^p \alpha_{jk} X_k \quad (3)$$

The first principal component is the linear combination with the maximum variance. Although, there is likelihood of p such linear combinations, the first few is always taken to explain the variance in the original data. The existing options for the determination of the number of principal components to retain are the Kaiser option, scree test and the proportion of total variance (Kaiser, 1960; Cattell, 1966). Kaiser criterion states that any principal component with the eigenvalue greater than a calculated threshold must be part of the analysis. Scree test uses the plot of the magnitude of observed individual eigenvalue and the component to determine the appropriate number of components. The components that appear before the break are assumed to be meaningful and retained. The proportion of total variance is a measure of how well the first q principals explain the original variables. The initial extractions are subjected to orthogonal rotation using varimax, equimax, quartimax and promax and the best result is taken for much easier interpretation. Orthogonal transformation is used to obtain meaningful representation of variables and component mapping along the principal axis. Rotation by varimax is based on the assumption that the interpretability of a factor can be measured by the variance of the squares of its factor loadings. Quartimax rotation involves the minimization of the number of factors needed to explain each variable while equamax rotation is a compromise that attempts to simplify both components and variables. Promax is an oblique rotation that allows factors to be correlated and because it is often more easily calculated than any direct oblimin rotation, it is more useful for large datasets. A symmetric, non-singular matrix ρ can be reduced to a diagonal matrix by multiplying with eigenvectors as follows:

$$D = U' \rho U. \quad (4)$$

D is the diagonal matrix of eigenvalues and U is the eigenvector. The variance in the correlation matrix is “repackaged” into p eigenvalues. Each eigenvalue represents the amount of variance that is attributed to each component.

3. Data Survey

The Questionnaire shown in Appendix 1 was designed using the formulated indices for the investigative study of the counter measures to financial crimes. Each of these indices was offered loosed linguistic description and range of values as shown in Table 1.

Table 1. Matrix of weight attached to linguistic value

Linguistic Representation	Excellent	Very Good	Good	Average	Poor
Range of Values	4.01-5.0	3.01-4.0	2.01-3.0	1.01-2.0	0.0-1.0

The first part of the Questionnaire provided vital information about each respondent while the second part presented five columns for the respondent to rank each of the twenty eight indices based on the scale presented in Table 1. The Questionnaire was administered to respondents from several financial institutions, government agencies and individuals in Thirty States across the six geo-political zones and the Federal Capital Territory (FCT) in Nigeria and the summary of the survey is presented in Table 2.

Table 2. Summary of the survey

Serial Number	State	Local Number of Government Surveyed	Total Administered	Total Returned	Total not Returned
1	Abia	5	300	263	37
2	Adamawa	6	425	415	10
3	Akwa-Ibom	8	524	522	2
4	Anambra	5	275	254	21
5	Bauchi	7	589	487	102
6	Benue	7	652	623	29
7	Delta	10	524	451	73
8	Cross River	11	687	671	16
9	Ebonyi	6	165	128	37
10	Edo	8	785	687	98
11	Ekiti	7	570	457	113
12	Enugu	8	622	528	94
13	Imo	7	522	420	102
14	Jigawa	3	420	259	161
15	Kaduna	3	186	181	5
16	Kano	11	894	856	38
17	Kebbi	3	202	202	0
18	Kogi	6	414	401	13
19	Kwara	4	551	510	41
20	Lagos	20	1026	896	130
21	Nasarawa	6	239	239	0
22	Ogun	7	658	452	206
23	Niger	8	659	659	0
24	Ondo	18	1524	1325	199
25	Osun	8	354	258	96
26	Oyo	12	742	468	274
27	Plateau	6	231	197	34
28	Rivers	6	402	401	1
29	Sokoto	3	189	175	14
30	Taraba	5	580	574	6
31	FCT	3	627	587	40
Total		158	16538	14546	1789

A total of Sixteen Thousand Five Hundred and Thirty Eight (16538) copies of the Questionnaire were administered through direct and online contacts. In the direct contact, the researchers visited the surveyed states or engaged the services of third parties while indirect contact involved hosting the Questionnaire on Google forms for online assessment. From the two contact methods, a total of Fourteen Thousand Five Hundred and Forty Six (14546) respondents returned duly completed Questionnaires. Where necessary, the responses were verified and validated through follow-up meetings and personal interviews.

4. Results and Interpretation

The data from the 14546 responses were subjected to PCA using SPSS. The analysis of the respondents' age, computer literacy level, knowledge of financial crime, distribution of occurrences and frequency of financial crimes experienced are presented in Tables 3, 4, 5, 6 and 7 respectively.

Table 3. Respondents' age distribution

Age	Frequency	Percent	Cumulative Percent
11-18	640	4.4	4.4
19-44	13336	91.7	96.1
> 44	570	3.9	100.0
Total	14546	100.0	

Table 4. Computer literacy level of respondents

Values	Frequency	Percent	% Cumulative
Poor	173	1.1	1.1
Average	1954	13.4	14.6
Good	3848	26.5	41.0
Very Good	4713	32.4	73.4
Excellent	3863	26.6	100.0
Total	14546	100.0	

Table 5. Respondents' knowledge of financial crime

Values	Frequency	Percent	% Cumulative
Poor	988	6.8	6.8
Average	3102	21.3	28.1
Good	4803	33.0	61.5
Very Good	3863	26.3	87.7
Excellent	1790	12.3	100.0
Total	14546	100.0	

Table 6. Distribution of range of occurrences

Range	Frequency	Percent	Valid Percent	Cumulative Percent
0	11655	80.1		
1-5	1372	9.4	47.4	47.4
6-10	447	3.1	15.4	62.8
11-15	164	1.1	5.7	68.5
16-20	357	2.5	12.4	80.9
> 20	551	3.3	19.1	100.0
Total	14546	100.0		

Table 7. Distribution of financial crime victims

Classes of Financial Crime	Number of Victims	%
Advance fee fraud	1218	12.72
Forgery (Fake Cheque)	863	9.02
Money Theft Through ATM	879	9.18
Kickbacks and Extortion	755	7.89
Embezzlement	801	8.37
Corruption and Bribery	1048	10.95
Fraud	895	9.34
Money Laundering	554	5.8
Identity theft	478	4.99
Counterfeit Money	724	7.57
Financial Grooming	662	6.92
Insider Trading	385	4.03
Phishing	307	3.22
Total	9568	100

Table 8 presents the means and standard deviation of the rating of the indices by the respondents. The mean and standard deviation of the rating on 'Political Will' are 3.40 (68.0%) and 1.299 respectively while the mean and standard deviation of the rating on 'Industry Contribution' are 3.25 (65.0%) and 1.170 respectively. The mean values reveal that on the average, the respondents gave a 'very good' rating of 'Political Will' and 'Industry Contribution' in combating financial crimes. Similarly, the standard deviations represent the statistical measure of dispersion from the mean for the two variables.

Table 8. Descriptive statistics of variables

Variables	N	Mean	Std. Deviation
Political will	13566	3.40	1.299
Industry Contribution	13535	3.25	1.170
Funding of Research on Financial Security	13535	3.19	1.235
Societal Campaign	13490	3.25	1.177
Employment generation	13597	3.20	1.381
Economic and Political stability	13520	3.25	1.315
Moral upbringing	13551	3.31	1.232
Social equality and Fairness	13643	3.16	1.264
Pro-Active (Preventive) Measures	13459	3.24	1.244
Re-Active (Curative) Measures	13535	3.14	1.187
National orientation	13581	3.21	1.204
Religious campaign	13459	3.20	1.211
Public/Private Agency Collaboration	13367	3.15	1.188
Ruggedness of Financial System's Design	13382	3.11	1.196
Physical Security at Financial Institution	13367	3.21	1.206
Implementation of Appropriate Legislative Framework	13382	3.18	1.162
Implementation of Effective Investigative Framework	13444	3.23	1.249
Reward for Integrity, excellence and honesty	13367	3.20	1.275
Scalability of Hardware at Financial Installations	13474	3.22	1.206
Effectiveness of Financial Criminal Tracking Software	13505	3.20	1.241
Availability of Forensic Experts (Forensic Accounting)	13398	3.19	1.263
Execution of Regular Auditing in Financial Institutions	13474	3.24	1.190
Regular Staff Training on Financial Crime	13306	3.23	1.187
Internal Control System, Policies, Laws and Operations	13444	3.21	1.204
Adherence to Due Process	13398	3.18	1.222
Data Analytics and Visualization	13382	3.22	1.203
Effective Predictive Modelling and Strong Warning System	13398	3.22	1.236
Effective Financial Data Management	13459	3.24	1.257

The extracted communalities presented in Table 9 shows 0.801 for 'Political will'. This implies that 80.1% of the variance for 'Political will' can be explained by the extracted factors while the remaining 19.9% is attributed to some extraneous factors. Similarly, the extracted communality of 0.795 for 'Industry Contribution' implies that 79.5% and 20.5% of its variance are attributed to the extracted and extraneous factors respectively.

Table 9. Communalities of variables

Variables	Initial	Extraction
Political will	1.000	0.801
Industry Contribution	1.000	0.795
Funding of Research on Financial Security	1.000	0.738
Societal Campaign	1.000	0.700
Employment generation	1.000	0.785
Economic Stability and Political stability	1.000	0.768
Moral upbringing	1.000	0.677
Social equality and Fairness	1.000	0.674
Pro-Active (Preventive) Measures	1.000	0.769
Re-Active (Curative) Measures	1.000	0.772
National orientation	1.000	0.689
Religious campaign	1.000	0.663
Public/Private Agency Collaboration	1.000	0.699
Ruggedness of Financial System's Design	1.000	0.662
Physical Security at Financial Institution	1.000	0.729
Implementation of Appropriate Legislative Framework	1.000	0.696
Implementation of Effective Investigative Framework	1.000	0.711
Reward for Integrity, excellence and honesty	1.000	0.681
Scalability of Hardware at Financial Installations	1.000	0.656
Effectiveness of Financial Transactions Tracking Software	1.000	0.676
Availability of Forensic Experts (Forensic Accounting)	1.000	0.731
Execution of Regular Auditing in Financial Institutions	1.000	0.754
Regular Staff Training on Financial Crime	1.000	0.761
Internal Control System, Policies, Laws and Operations	1.000	0.700
Adherence to Due Process	1.000	0.679
Data Analytics and Visualization	1.000	0.767
Effective Predictive Modelling and Strong Warning System	1.000	0.757
Effective Financial Data Management	1.000	0.700

The analysis of correlation matrix presented in Appendix 2 shows a highest correlation of 0.716 exists between 'Economic and Political Stability' and 'Employment Generation'. The next highest correlation of 0.692 exists between 'Effectiveness of Financial Criminal Tracking Software' and 'Availability of Forensic Experts (Forensic Accounting)'. The implication of the former is that 'Economic and Political Stability' is most likely to share the same factor with 'Employment Generation'. Similarly, in the later, 'Effectiveness of Financial Criminal Tracking Software' will likely share same factor with 'Availability of Forensic Experts (Forensic Accounting)'. The Least correlation of 0.319 exists between 'Religious Campaign' and 'Availability of Forensic Experts (Forensic Accounting)'. This means that 'Religious campaign' and 'Availability of Forensic Experts (Forensic Accounting)' are not likely to share the same factor. The Barlett test of sphericity produced a χ^2 of 14377.321 with significance level of 0.000 which indicates that the sample population is adequate. In addition, Kaiser-Mayer Olkin (KMO) test produced a measure of 0.966 to further confirm the adequacy of the sample population. The application of Kaiser Criterion and Interpretability test on the initial components led to the initial extractions presented in Table 10.

Table 10. Extracted components matrix

Variables	Component			
	1	2	3	4
Reward for Integrity, excellence and honesty	0.758			
Data Analytics and Visualization	0.757			
Pro-Active (Preventive) Measures	0.749			
Availability of Forensic Experts (Forensic Accounting)	0.747			
Employment generation	0.741			
Funding of Research on Financial Security	0.735	0.332		
Regular Staff Training on Financial Crime	0.734			
Adherence to Due Process	0.734			
Effectiveness of Financial Transactions Tracking Software	0.732			
Social equality and Fairness	0.730			
Economic and Political stability	0.727		-0.302	
Effective Predictive Modelling and Strong Warning System	0.726			
Moral upbringing	0.721			
Scalability of Hardware at Financial Installations	0.715			
Effective Financial Data Management	0.714			
Implementation of Effective Investigative Framework	0.711			
Internal Control System, Policies, Laws and Operations	0.708	-0.349		
Societal Campaign	0.704			
National orientation	0.701			
Implementation of Appropriate Legislative Framework	0.700			
Execution of Regular Auditing in Financial Institutions	0.694	-0.333		
Ruggedness of Financial System's Design	0.681		0.344	
Public/Private Agency Collaboration	0.677		0.451	
Re-Active (Curative) Measures	0.668			
Industry Contribution	0.663	0.348		0.375
Physical Security at Financial Institution	0.654		0.345	
Political will	0.610	0.356		0.439
Religious campaign	0.605		0.468	

The extracted components were rotated using orthogonal transformation techniques. Rotation by Varimax produced the best result and it is presented in Table 11 showing four factors with their corresponding loadings.

Table 11. Rotated extracted component matrix

Variables	Component			
	1	2	3	4
Availability of Forensic Experts (Forensic Accounting)	0.709			
Execution of Regular Auditing in Financial Institutions	0.703			
Internal Control System, Policies, Laws and Operations	0.702			
Effectiveness of Financial Transactions Tracking Software	0.690			
Regular Staff Training on Financial Crime	0.679			
Adherence to Due Process	0.678			
Data Analytics and Visualization	0.641			
Scalability of Hardware at Financial Installations	0.620			
Reward for Integrity, excellence and honesty	0.590			
Effective Predictive Modelling and Strong warning System	0.567			
Effective Financial Data Management	0.536			
Implementation of Effective Investigative Framework	0.515			0.441

Implementation of Appropriate Legislative Framework	0.495	0.420
Economic and Political stability	0.710	
Employment generation	0.694	
Social equality and Fairness	0.667	
Moral upbringing	0.659	
Pro-Active (Preventive) Measures	0.625	
Societal Campaign	0.570	0.427
Re-Active (Curative) Measures	0.516	
Religious campaign		0.733
Public/Private Agency Collaboration		0.715
National orientation		0.614
Ruggedness of Financial System's Design		0.609
Physical Security at Financial Institution	0.411	0.560
Political will		0.748
Industry Contribution		0.744
Funding of Research on Financial Security	0.448	0.607

Table 11 reveals four clusters with each presenting a set of variables that align to form a counter measure to financial crime. Cluster 1 (Control and Monitoring) loads on Availability of Forensic Experts (Forensic Accounting), Execution of Regular Auditing in Financial Institutions, Internal Control System, Policies, Laws and Operations, Effectiveness of Financial Transactions Tracking Software, Regular Staff Training on Financial Crime and Adherence to Due Process. It also loads on Data Analytics and Visualization, Reward for Integrity, Excellence and Honesty, Effective Predictive Modeling and Strong Warning System, Effective Financial Data Management, Implementation of Effective Investigative Framework and Implementation of Appropriate Legislative Framework. Cluster 2 (Economic and Social stability) loads on Economic and Political stability, Employment Generation and Social Equality and Fairness. It also loads on Moral Upbringing, Pro-Active (Preventive) Measures, Re-Active (Curative) Measures and Societal Campaign. Cluster 3 (Moral Suasion and Partnership) loads on Religious Campaign, Public/Private Agency Collaboration, National Orientation, Re-Active (Curative) Measures and Ruggedness of Financial System Design. Cluster 4 (Political stability and goodwill) loads on Political Will, Industry Contribution and Funding of Research on Financial Security. The eigenvalues of the extracted factors is presented in Figure 1.

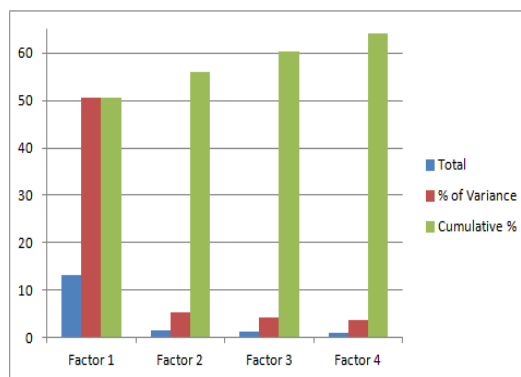


Figure 1. Eigen values of factors

The four clusters contributed 64.17% of the extracted counter measures with Cluster 1 emerging as the most significant with 50.59% contributions. This result established that very enduring control and monitoring strategies are much desired to effectively combat financial crime. This corroborated the views of the authors in (Mohammed, 2012; Sofia de Oliveira *et al.*, 2016) that sanctions, stringent financial control and monitoring policies as well as compliances with regulations must be held in high esteem at every strata of the economy of a nation if all forms of financial crimes are to be curbed. Clusters 2, 3 and 4 showed the percentage contributions of 5.33%, 4.44% and 3.82% respectively. These results also established economic and social stability, moral suasion and partnership as well as political stability and goodwill on the part of leaders as essential requirements for government at all levels if

financial crime is to be effectively checked. This view has been the opinion of the author in (Nakajima, 2007; Kasum, 2009; Nwosumba, 2016; Thomson, 2012; Sofia de Oliveira *et al.*, 2016) who stated that increased peoples' awareness, public and private sectors partnership and continuous research and training are the panacea to the scourge of financial crime. The obtained coefficient matrix is shown in Table 12. The matrix is obtained by forming a linear equation of the weighted standard scores of each respondent on the variables. Given that the standard scores by the b^{th} respondent in the twenty-eight variables under consideration are $W_{b,1}, W_{b,2}, W_{b,3} \dots, W_{b,28}$, then the view of each respondent on control and monitoring, economic and social stability, moral suasion and partnership and political stability and goodwill is denoted by M_1, M_2, M_3 , and M_4 respectively and modeled as follows:

$$M_1 = -0.109W_{b,1} - 0.099W_{b,2} + \dots + 0.087W_{b,28} \tag{5}$$

$$M_2 = -0.130W_{b,1} - 0.049W_{b,2} + \dots + 0.050W_{b,26} \tag{6}$$

$$M_3 = -0.005W_{b,1} - 0.081W_{b,2} + \dots + 0.067W_{b,26} \tag{7}$$

$$M_4 = +0.468W_{b,1} - 0.081W_{b,2} + \dots - 0.154W_{b,26} \tag{8}$$

Table 12. Component score coefficient matrix

Variables	Component			
	1	2	3	4
Political will	-.109	-.130	-.005	.468
Industry Contribution	-.099	-.049	-.081	.442
Funding of Research on Financial Security	-.112	.058	-.039	.288
Societal Campaign	-.079	.193	-.108	.132
Employment generation	-.047	.303	-.134	-.027
Economic and Political stability	-.061	.321	-.139	-.024
Moral upbringing	-.067	.287	-.030	-.099
Social equality and Fairness	-.066	.291	-.021	-.114
Pro-Active (Preventive) Measures	-.097	.243	.053	-.083
Re-Active (Curative) Measures	-.128	.185	.183	-.123
National orientation	-.105	.032	.267	-.050
Religious campaign	-.155	-.053	.394	-.023
Public/Private Agency Collaboration	-.063	-.081	.360	-.084
Ruggedness of Financial System's Design	-.026	-.103	.271	-.010
Physical Security at Financial Institution	.031	-.253	.238	.125
Implementation of Appropriate Legislative Framework	.076	-.167	.043	.173
Implementation of Effective Investigative Framework	.087	-.079	-.078	.183
Reward for Integrity, excellence and honesty	.118	-.014	-.110	.092
Scalability of Hardware at Financial Installations	.158	-.125	-.045	.090
Effectiveness of Financial Criminal Tracking Software	.199	-.042	-.153	.042
Availability of Forensic Experts (Forensic Accounting)	.207	-.029	-.157	.020
Execution of Regular Auditing in Financial Institutions	.222	-.106	-.063	-.022
Regular Staff Training on Financial Crime	.186	-.036	-.042	-.073
Internal Control System, Policies, Laws and Operations	.210	-.036	-.016	-.147
Adherence to Due Process	.185	-.054	-.005	-.090
Data Analytics and Visualization	.146	-.002	.045	-.149
Effective Predictive Modelling and Strong warning System	.105	.015	.071	-.139
Effective Financial Data Management	.087	.050	.067	-.154

Based on Table 1, the standard scores by ten randomly selected respondents for each of the twenty-eight variables under consideration are presented in Table 13. Figure 2 shows the calculated percentage contributions of each of the ten sampled respondents to each of the four clusters.

Table 13. Standard score of 10 respondents

Respondents	PLW/I	IdCon	FundR	SoCam	EmpGn	EcsSb	MorUp	SocEq	Proms	RcIMs	NatOr	RgCap
Res1	2	3	3	3	2	2	2	3	2	4	3	3
Res2	5	4	5	5	4	5	5	4	5	4	5	5
Res3	2	5	2	2	2	1	2	2	3	2	2	1
Res4	2	1	2	1	1	1	1	2	1	1	1	2
Res5	4	4	2	3	3	3	3	2	2	3	3	3
Res6	3	4	3	4	2	2	3	4	3	3	2	2
Res7	4	4	5	3	3	5	5	1	5	5	5	5
Res8	2	3	3	2	2	2	2	1	2	3	1	2
Res9	3	3	2	3	3	3	1	2	2	3	3	3
Res10	3	3	2	3	2	2	3	2	3	3	3	4

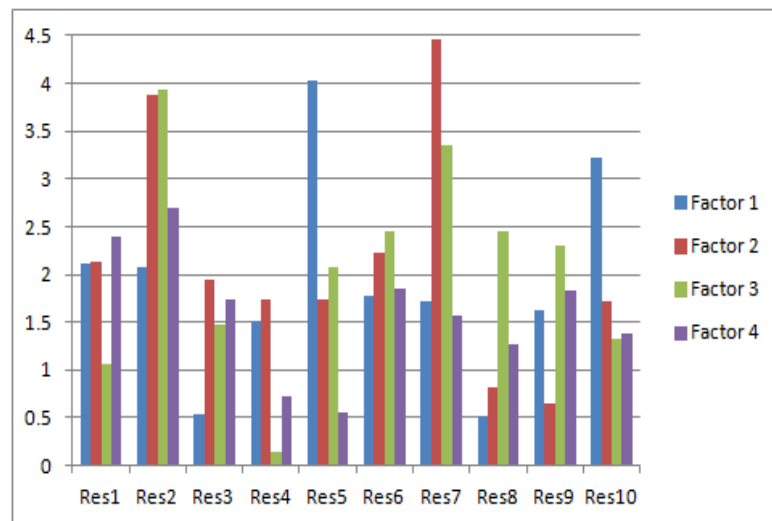


Figure 2. Aggregate factor scores with percentage contributions for a subset of respondents

5. Conclusion

Nigerians have continued to suffer different degree of losses arising from financial crime. It has also come to the knowledge of government, groups and individuals that something urgent must be done to curb the activities of financial criminals. In view of this, a PCA-based investigative study of the counter-measures to financial crimes was carried out. The study led to the generation of a component matrix which was subjected to orthogonal transformation with a view to discover reasonable factorization of the indices. The transformation established four counter measures with each of them loading on some related indices (variables). A counter-measure score coefficient matrix was also generated to serve as basis for determining the contribution of each respondent. The obtained eigenvalue of each extracted counter-measure formed the basis of the evaluation of its percentage contribution. The aggregate percentage contribution of the four extracted counter-measures was less than 100 signalling that the related indices of some extraneous (latent) counter-measures were left out in the research instrument. The results of the study placed high premium on control and monitoring, economic and social stability, moral suasion and partnership, political stability and goodwill as veritable tools for combating financial crime. This corroborated the views of the authors in (Mohammed, 2012; Sofia de Oliveira *et al.*, 2016) that sanctions, stringent financial control and monitoring policies as well as compliances with regulations must be held in high esteem at every strata of the economy of a nation if all forms of financial crimes are to be curbed. These results also agreed with the opinion of the author in (Nakajima, 2007; Kasum, 2009; Nwosumba, 2016; Thomson, 2012; Sofia de Oliveira *et al.*, 2016) who stated that

increased peoples' awareness, public and private sectors partnership and continuous research and training are the panacea to the scourge of financial crime.

In view of the very high emphasis on economic and social stability, it can be deduced that illiteracy, high population density, unemployment and poverty contributed immensely to financial crime. It is therefore required that government at all levels should double its efforts to reduce the levels of illiteracy, unemployment and poverty through better funding education, actualization of small, medium and large scale industries and massive investment in Agriculture. It is also required that government employs more security personnel for better monitoring, control, prevention and management of financial crime.

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Appendix 1: Questionnaire on Analysis of Counter Measures to Financial Crime in the Scenery of Nigeria

The purpose of this Questionnaire is to conduct investigative study on counter measures to financial crimes in Nigerian with a view to developing a pro-active solution. Confidentiality of personal information is guaranteed. We would therefore appreciate your sincere contributions to the research by giving a very accurate and honest response to this Questionnaire.

Section A: Profile of Respondents

1. AGE (Please Tick as appropriate)

<u>5-10</u>	<u>11-18</u>	<u>19-44</u>	<u>45 and above</u>
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2. SEX (Please Tick as appropriate)

<u>Male</u>	<u>Female</u>
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3. HIGHEST ACADEMIC QUALIFICATION (Please Tick as appropriate)

<u>Primary Schl. Cert.</u>
<u>O. Level</u>
<u>A. Level</u>
<u>B. Sc./B. Tech.</u>
<u>M. Sc./M. Tech.</u>
<u>PhD/D. Sc./D. Tech</u>
<u>Others</u>

4. OCCUPATION

5. ORGANIZATION

6. LOCATION (local Government and State)

7. COMPUTER LITERACY LEVEL (Pls. Tick (√) as appropriate)

<u>Excellent</u>
<u>Very Good</u>
<u>Good</u>
<u>Average</u>
<u>Poor</u>

8. UNDERSTANDING OF THE INTERNET (Pls. Tick (√) as appropriate)

- Excellent**
- Very Good**
- Good**
- Average**
- Poor**

9. UNDERSTANDING OF FINANCIAL/COMPUTER CRIME (Pls. Tick (√) as appropriate)

- Excellent**
- Very Good**
- Good**
- Average**
- Poor**

10. HAVE YOU BEEN A VICTIM OF COMPUTER CRIME (Please Tick (√) as appropriate)

- Yes**
- No**

IF YES:

a. TICK (√) AS APPROPRIATE, THE RANGE OF OCCURRENCES

- 1-5**
- 6-10**
- 11-15**
- 16-20**
- Above 20**

b. TICK (√) AS MANY AS POSSIBLE MODE OF OCCURRENCES

- Advance fee fraud** (“Yahoo Yahoo”)
- Forgery** (Fake Office Documents, Certificates, etc.)
- ATM** (Money Theft Through ATM)
- Piracy** (Pirated Software, Video/Audio CDs, etc.).
- Phreaking** (Making Fraudulent free calls)
- Spamming** (Unsolicited emails)
- Embezzlement** (Executive Theft, Salami Shaving. etc.).
- Computer Virus and/or Denial of Service**
- Pornography/Financial Grooming**
- Others**(Specify):

13. Financial Crime Gender Incidence

<i>Index</i>	Very High	High	Medium	Low
Male				
Female				

14. Financial Criminals' Age Range

<i>Index</i>	Very High	High	Medium	Low
2-11				
12-17				
18-25				
26-45				
Above 45				

Section B: Assessment of Financial Crime Counter Measures

SNo.	<i>Index</i>	Excellent	Very Good	Good	Average	Poor
1	Political will					
2	Industry Contribution					
3	Funding of Research on Financial Security					
4	Societal Campaign					
5	Employment generation					
6	Economic Stability and Political stability					
7	Moral upbringing					
8	Social equality and Fairness					
9	Pro-Active (Preventive) Measures					
10	Re-Active (Curative) Measures					
11	National orientation					
12	Religious campaign					
13	Public/Private Agency Collaboration					
14	Ruggedness of Financial System's Design					
15	Physical Security at Financial Institution					
16	Implementation of Appropriate Legislative Framework					
17	Implementation of Effective Investigative Framework					
18	Reward for Integrity, excellence and honesty					
19	Scalability of Hardware at Financial Installations					
20	Effectiveness of Financial Criminal Tracking Software					
21	Availability of Forensic Experts (Forensic Accounting)					
22	Execution of Regular Auditing in Financial Institutions					
23	Regular Staff Training on Financial Crime					
24	Internal Control System, Policies, Laws and Operations					
25	Adherence to Due Process					
26	Data Analytics and Visualization					
27	Effective Predictive Modelling and Strong warning System					
28	Effective Financial Data Management					

Appendix 2: Correlation Matrix

	PW	IC	FR	SC	EG	EPM	MU	SEF	PAM	RAM	NO	RC	PPC	RFS	PSF	IAL	IIF	RIE	SHF	ETS	AFE	ERA	RST	ICS	ADP	DAV	EPM	EFD
PW	1.00	.670	.597	.476	.375	.399	.374	.400	.447	.405	.439	.402	.384	.367	.375	.412	.432	.429	.403	.377	.403	.362	.386	.349	.392	.401	.391	.359
IC	.670	1.00	.674	.521	.469	.483	.444	.469	.481	.418	.436	.375	.380	.414	.379	.467	.474	.458	.446	.421	.434	.403	.413	.384	.434	.426	.424	.407
FR	.597	.674	1.00	.618	.574	.555	.510	.509	.576	.486	.490	.436	.472	.481	.452	.453	.476	.548	.454	.483	.497	.433	.478	.432	.461	.483	.485	.463
SC	.476	.521	.618	1.00	.664	.598	.505	.542	.478	.425	.460	.395	.426	.448	.404	.437	.446	.508	.444	.489	.509	.388	.482	.421	.441	.470	.455	.483
EG	.375	.469	.574	.664	1.00	.716	.607	.574	.573	.468	.466	.364	.443	.472	.413	.507	.495	.555	.454	.521	.528	.444	.521	.475	.466	.478	.497	.489
EPM	.399	.483	.555	.598	.716	1.00	.653	.579	.565	.431	.478	.386	.405	.442	.390	.471	.510	.533	.439	.481	.521	.422	.513	.460	.468	.498	.452	.489
MU	.374	.444	.510	.505	.607	.653	1.00	.622	.590	.456	.517	.414	.446	.432	.443	.453	.514	.538	.479	.483	.454	.434	.496	.437	.463	.496	.480	.507
SEF	.400	.469	.509	.542	.574	.579	.622	1.00	.629	.549	.518	.403	.462	.459	.373	.444	.489	.519	.479	.505	.519	.449	.468	.471	.498	.497	.503	.497
PAM	.447	.481	.576	.478	.573	.565	.590	.629	1.00	.681	.549	.461	.489	.449	.411	.455	.512	.541	.477	.509	.515	.474	.457	.471	.504	.534	.485	.494
RAM	.405	.418	.486	.425	.468	.431	.456	.549	.681	1.00	.560	.482	.448	.451	.362	.396	.446	.447	.441	.403	.431	.410	.397	.417	.446	.495	.475	.436
NO	.439	.436	.490	.460	.466	.478	.517	.518	.549	.560	1.00	.547	.555	.488	.512	.473	.448	.411	.449	.406	.468	.470	.514	.457	.443	.481	.464	.436
RC	.402	.375	.436	.395	.364	.386	.414	.403	.461	.482	.547	1.00	.580	.474	.459	.390	.342	.432	.410	.355	.319	.349	.399	.344	.363	.430	.416	.392
PPC	.384	.380	.472	.426	.443	.405	.446	.462	.489	.448	.555	.580	1.00	.609	.512	.452	.391	.436	.458	.423	.446	.428	.450	.459	.469	.474	.472	.510
RFS	.367	.414	.481	.448	.472	.442	.432	.459	.449	.451	.488	.474	.609	1.00	.565	.508	.446	.481	.407	.444	.440	.422	.463	.468	.472	.481	.469	.489
PSF	.375	.379	.452	.404	.413	.390	.443	.373	.411	.362	.512	.459	.512	.565	1.00	.572	.525	.442	.493	.441	.438	.431	.444	.407	.446	.461	.447	.436
IAL	.412	.467	.453	.437	.507	.471	.453	.444	.455	.396	.473	.390	.452	.508	.572	1.00	.617	.553	.498	.500	.489	.449	.469	.441	.513	.490	.483	.478
IIF	.432	.474	.476	.446	.495	.510	.514	.489	.512	.446	.448	.342	.391	.446	.525	.617	1.00	.615	.532	.530	.518	.488	.478	.465	.493	.457	.479	.452
RIE	.429	.458	.548	.508	.555	.533	.538	.519	.541	.447	.411	.432	.436	.481	.442	.553	.615	1.00	.624	.625	.572	.515	.515	.522	.555	.569	.524	.493
SHF	.403	.446	.454	.444	.454	.439	.473	.479	.477	.441	.449	.410	.458	.407	.493	.498	.532	.624	1.00	.628	.581	.526	.510	.497	.523	.533	.458	.501
ETS	.377	.421	.483	.489	.521	.481	.483	.505	.509	.403	.406	.355	.423	.444	.441	.500	.530	.625	.628	1.00	.692	.561	.533	.500	.536	.561	.522	.500
AFE	.403	.434	.497	.509	.528	.521	.454	.519	.515	.431	.468	.319	.446	.440	.438	.489	.518	.572	.581	.692	1.00	.665	.601	.559	.548	.564	.489	.519
ERA	.362	.403	.433	.388	.444	.422	.434	.449	.474	.410	.470	.349	.428	.422	.431	.449	.488	.515	.526	.561	.665	1.00	.650	.580	.503	.523	.472	.463
RST	.386	.413	.478	.482	.521	.513	.496	.468	.457	.397	.514	.399	.450	.463	.444	.469	.478	.515	.510	.533	.601	.650	1.00	.662	.604	.558	.548	.478
ICS	.349	.384	.432	.421	.475	.460	.437	.471	.471	.417	.457	.344	.459	.468	.407	.441	.465	.522	.497	.500	.559	.580	.662	1.00	.651	.589	.537	.520
ADP	.392	.434	.461	.441	.466	.468	.463	.498	.504	.446	.443	.363	.469	.472	.446	.513	.493	.555	.523	.536	.548	.503	.604	.651	1.00	.672	.585	.528
DAV	.401	.426	.483	.470	.478	.498	.496	.497	.534	.495	.481	.430	.474	.481	.461	.490	.457	.569	.533	.561	.564	.523	.558	.589	.672	1.00	.687	.631
EPM	.391	.424	.485	.455	.497	.452	.480	.503	.485	.475	.464	.416	.472	.469	.447	.483	.479	.524	.458	.522	.489	.472	.548	.537	.585	.687	1.00	.652
EFD	.359	.407	.463	.483	.489	.489	.507	.497	.494	.436	.436	.392	.510	.489	.436	.478	.452	.493	.501	.500	.519	.463	.478	.520	.528	.631	.652	1.00