Applications of Fractional Supersaturated Process and Factor Analysis in the Systemic Risks of Financial Fraud

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Abstract: Fraud is defined as an act committed to deceive people and undermine their trust in financial institutions. The effects of fraud in government financial institutions, the private sector, and at the societal level show that it deeply feeds the economy. **Objective**. This study aims to shed light on the effects of financial fraud, measure its impact, and determine means to control it. **Methods and Materials**. This study considered a survey and a questionnaire was used to collect primary data. The total number of participants included in the questionnaire was 77. Two methods were used to search for the real effects of financial fraud, measure its impact, and determine the means to control it: factor and regression analyses. The data were analyzed using SPSS version 25.0. **Results**. The factor analysis results reveal the factors that contributed to the effects of financial fraud from A1 to A15, excluding factors A12 and A13. The regression analysis revealed the elements that contributed to the effects of financial fraud on A2, A5, and A14. **Conclusion**. Based on the findings of the two methodologies and the similarity in the outcomes of the causal variables, the fundamental and authentic aspects that lead to the effects of financial fraud were identified as A2, A5, and A14.

Keywords: Supersatuated design, financial fraud, factor analysis, survey, regression analysis, data analysis.

1 Introduction

Fraud is defined as any act by which individuals or groups of gain an unfair advantage in a business. This can include theft, corruption, conspiracy, embezzlement, asset misappropriation, money laundering, bribery, and establishing a trust or fiduciary relationship [1]. Internal or external individuals in an organization can commit fraud by preparing a faulty financial statement to entice individuals to invest in the entity [2]. Fraud is defined as an act committed to deceive people and undermine their trust in financial institutions. Such scandals typically involve obtaining money, materials, and concealing payments within an organization [3]. The Association of Certified Fraud Auditors introduced a well-known definition of fraud in the literature: "the use of deception to achieve personal gain for one person while causing loss to another. According to the Association of Certified Fraud Auditors, approximately 6% of the company's $660 billion revenue was lost in 2004 as a result of accounting fraud in the United States. According to the Association of Certified Fraud Auditors' 2008 report on US fraud, US organizations alone lost 7% of annual fraud revenue, amounting to up to $994 billion in losses. Globally, the number of companies reporting financial misrepresentation laundering increased by 133 percent, and corruption and bribery increased by 140%, 133%, and 71% respectively. According to PricewaterhouseCoopers, victims of economic fraud in Malaysia incur financial losses ranging from $100,000 to $5,000,000 annually. The organization also sustained significant collateral damage, including harm to employee morale, brands, reputations, and businesses. Corporate fraud can lead to an organization's death. Many losses have occurred from institutional fraud, in some cases, and have been reported in Asia Pacific, the Americas, Africa, Russia, the Middle East, and Europe [4]. According to the authors of [5], the total value of all reported cases in Africa has increased from $10.8 billion to $11 billion. Employees in collaboration with clients commit fraud against public and private institutions, particularly financial ones. According to Ghana's central bank, the total monetary value involved in all reported fraud cases in corporate financial institutions, both of which were tried during the 2016-2017 fiscal year, was approximately US$244.32 million. According to [6], fraud is primarily an economic complaint of financial institutions and national economies. Fraud and its management have been the primary factors at the bank's problem, and various measures have been taken to reduce the rate to the greatest extent possible. This study classifies bank or financial institution fraud into three types: internal fraud, accounting fraud, and external fraud. The distinction between these groups is based on whether bank fraud is committed inside or outside a financial institution. This classification is based on whether insurance fraud is committed within or outside an insurance company. In their study, [7] argued that internal fraud occurrs within the majority of financial institutions. This refers to employee fraud and fraud committed by organizations themselves.

Through our survey of the scientific papers that discussed financial fraud, these papers did not mention the effects of financial fraud in more detail, and if the effects were mentioned, it was mentioned in general, which loses its essence when

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studying any global phenomenon. Therefore, we read and hear about financial fraud on a large- scale and daily basis only for specialists in the financial field, where there was no disclosure of fraud because its effects are unknown. In this research, we will lead you to study the effects of financial fraud in an accurate and detailed manner, and then determine the most important impact among the effects of financial fraud that countries suffer in repeated forms.

This study significantly contributes to the field of multivariate techniques by introducing two main analyses: factor analysis and regression analysis. All data were analyzed using both methods, and when the same influential factors were found, they were the effects of financial fraud.

The remainder of this paper is organized as follows. Section 2 describes the estimation methods and techniques. Section 3 presents the results of this study to compare the performances of these estimation methods. Section 4 presents the conclusions and major findings of the study.

2. Materials and Methods

2.1 The questionnaire

- A1 - Disrupt economic growth and constitute a major obstacle to market entry.

- A2- Among the effects of financial fraud are the spread of theft, corruption, conspiracies, embezzlement, money laundering, bribery and forgery.

- A3- The effects of financial fraud include the loss of goods from the market, an increase in prices, and a waste of natural resources.

- A4- One of the effects of financial fraud is the existence of a large disparity in the distribution of income and wealth among members of society.

- A5- Fraud makes economic, commercial, investment and social operating environments unhealthy and unstable.

- A6- The fraud undermined investor confidence in the markets, as it slashed the assets of financial institutions.

- A7 - It leads to a decrease in the quality of services provided to consumers and reduces the number of resources available to them.

- A8- Limit voluntary financial participation in many community activities such as charitable works.

- A9- Among the effects of financial fraud is the decline in foreign investments and the reluctance of international companies to invest in those economies, and thus the migration of capital abroad.

- A10- The emergence of these practices leads to instability in society and financial insecurity, which causes a large number of crimes and societal stratification.

A11- Fraud has a significant negative impact on financial performance, and the return on assets of financial institutions, disrupting economic growth.

- A12 - Fraudulent actions lead to a huge loss to government sectors and a decrease in the financing capacity of government institutions by depriving them of tax dues used to support the community's general welfare.

- A13 - Inflation is one of the effects of financial fraud.

- A14- The effects of financial fraud are business depression

- A15 - Some major economic sectors, such as insurance companies and banks, suffer financial losses. Do domestic or international investors lose interest in strategic sectors?

- Y: How many years of experience do businessmen have in the government and private sectors?

2.2: Analysis of the data and testing

Demographic details, such as gender, employment status, age, and frequency of financial fraud, are shown in Table 1. Arabic was the native language of all participants. SPSS software (version 25.0) was used to analyze the data. Quantitative analysis was used to compute the frequency and percentage of demographic data using inference statistics.

Table 1: the demographic information

Variable	Frequency	Percent
Gender		
Male	69	89.60
Female	8	10.40
Gender		
Government Employee	61	79.20
private Sector	15	19.50
Unemployment	1	1.30
Age		
22-32	22	28.60
32-42	32	41.60
42-52	18	23.40
52 and more	5	6.50

2.3 Factor analysis

The social sciences and psychology frequently employ at statistical method known as factor analysis. In fact, this is required in some areas of psychology, especially in those that use tests or questionnaires. Factor analysis and other multivariate methods have been accompanied by the development of powerful computers and terrifying statistical packages. It offers a straightforward explanation of factor analysis and serves as a guide for the technique[8].

2.4 Regression analysis

Regression analysis is one of the most popular statistical methods for identifying relationships between variables. Regression analysis, a statistical technique for examining relationships between variables, offers a comprehensive coverage of traditional statistical analysis techniques. It is intended to give students a comprehension of the purpose of statistical analyses, to enable them to choose, at least in part, the appropriate type of statistical analysis to perform in a particular situation, and to help them develop a basic understanding of what makes for effective experimental designs ([9], [10]).

2.5. The application of the cognitive idea

In this section, the innovative method relies on analyzing the data obtained using the factor analysis method, where the results appear in the presence of factors that affect financial fraud. Then, through the data, the supersaturated design is applied as multiple applications, and those applications are analyzed using a regression analysis method, where results appear in the presence of factors that affect financial fraud. Through the previous two methods, similar factors that appeared in the two methods were determined, therefore, those factors are the effects that result from financial fraud

3. Results

3.1: Factor analysis:

Table 2: Correlation Matrix

		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
Correlation	A1	1.00	.657	.251	.380	.425	.329	.268	.434	.232	.234	.190	.120	.189	.226	.247
	A2	.657	1.00	.438	.288	.451	.267	.204	.519	.332	.270	.261	.118	.176	.113	.134
	A3	.251	.438	1.00	.217	.410	.492	.266	.380	.480	.283	.304	.207	.177	.406	.270

A4	.380	.288	.217	1.00	.419	.345	.395	.474	.451	.559	.427	.248	.119	.114	.354
A5	.425	.451	.410	.419	1.00	.604	.425	.366	.475	.245	.268	.274	.156	.298	.229
A6	.329	.267	.492	.345	.604	1.00	.659	.480	.485	.361	.229	.186	.260	.495	.269
A7	.268	.204	.266	.395	.425	.659	1.00	.556	.472	.276	.326	.125	.310	.417	.415
A8	.434	.519	.380	.474	.366	.480	.556	1.00	.446	.343	.359	.108	.108	.248	.190
A9	.232	.332	.480	.451	.475	.485	.472	.446	1.00	.569	.466	.182	.230	.332	.441
A1	.234	.270	.283	.559	.245	.361	.276	.343	.569	1.00	.332	.054	.318	.284	.451
A11	.190	.261	.304	.427	.268	.229	.326	.359	.466	.332	1.00	.342	.309	.348	.442
A12	.120	.118	.207	.248	.274	.186	.125	.108	.182	.054	.342	1.00	.349	.351	.426
A13	.189	.176	.177	.119	.156	.260	.310	.108	.230	.318	.309	.349	1.00	.648	.391
A14	.226	.113	.406	.114	.298	.495	.417	.248	.332	.284	.348	.351	.648	1.00	.362
A15	.247	.134	.270	.354	.229	.269	.415	.190	.441	.451	.442	.426	.391	.362	1.00

Table 1 shows that 69 male respondents (86.60%) and 8 female respondents (10.40%) made up the target group. There were 1 unemployed person (1.30%), 15 people working in the private sector (19.50%), and 61 government employees (79.20%). The responses for those between the ages of 22 and 23 were 22 with 28.60%, 32 with 41.60%, 42 to 52 with 18 with 32.40%, and 52 and more with 5 with 6.5%. The correlation matrix in Table 2 has 58 out of 105 correlations that are greater than 0.30, which are highlighted in orange. To guarantee that the data were suitable for factor analysis, these requirements were satisfied.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.740
Bartlett's Test of Sphericity	Approx. Chi-Square	525.917
	df	105
	Sig.	.000

In Table 3, the KMO Measure of Sampling, or Kaiser-Meyer-Olkin Adequacy is described as being outstanding above 0.90, meritorious between 0.80 and 0.90, average between 0.70 and 0.60, miserable between 0.50 and 0.50, and undesirable below 0.50 with regard to these variables. For this set of variables, the sampling adequacy KMO value was.740, with 0.740 representing moderate. Table 4 displays the number of eigenvalues greater than 1.0 for the latent root criterion. Given that there are four components or factors in this table, this criterion supports their presence of four of them. We tallied the number of components required to explain ≥ 66.452 percent or more of the variation in the original set of variables for this criterion. With the three components, we were able to achieve a minimum of 65.452 percent minimum in this analysis. The round component matrix of the entire model and that of the model without outliers are presented in Table 5. We conclud that the outliers have no bearing on the solution because the primary pattern of the rotation component matrix is the same for both the models. All cases were included in the subsequent factor-based analysis. We have already generated scores for the four components, which we can use as a file to replace the original 15 variants in subsequent analyses. In component 1, we have 13 affects with a value greater than 0.5, ranging from A1 to A15 excluding factors A12 and A13; however, i in component 2, we have only two affects, A13 and A14.

Table 4: Explanation of Total Variance

Component	First-order eigenvalues			Squared loadings' extraction sums		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.704	38.025	38.025	5.704	38.025	38.025
2	1.724	11.495	49.520	1.724	11.495	49.520
3	1.245	8.300	57.820	1.245	8.300	57.820

4	1.145	7.632	65.452	1.145	7.632	65.452
5	.906	6.039	71.492			
6	.863	5.756	77.247			
7	.723	4.820	82.067			
8	.573	3.817	85.884			
9	.514	3.426	89.310			
10	.423	2.823	92.133			
11	.332	2.211	94.343			
12	.285	1.902	96.246			
13	.251	1.673	97.919			
14	.182	1.212	99.131			
15	.130	.869	100.000			

Table 5: Component Matrix[a]

	Component			
	1	2	3	4
A1	.556	-.405-	.190	.442
A2	.564	-.502-	.186	.463
A3	.612	-.091-	.262	-.037-
A4	.637	-.189-	-.505-	.059
A5	.669	-.248-	.231	-.027-
A6	.725	-.077-	.299	-.435-
A7	.686	.013	.076	-.447-
A8	.671	-.391-	-.015-	-.088-
A9	.737	-.027-	-.253-	-.211-
A10	.615	.031	-.490-	-.098-
A11	.602	.224	-.304-	.193
A12	.405	.465	.080	.434
A13	.485	.587	.228	.161
A14	.600	.502	.401	-.094-
A15	.598	.422	-.294-	.132

3.2: Regression Analysis

The saturated design of the data sample was used so that 15 factors were selected, corresponding to 14 runs. The selected design was then analyzed from the data using a stepwise analysis. The design that shows the results of the descriptive analysis is considered otherwise ignored by the data.

3.2.1: Application 1 of supersatuated design

Table 6: Application 1 of supersatuated design

Run/factor	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	Y
1	4	5	5	3	5	3	5	5	2	1	4	5	3	4	4	17
2	5	5	4	5	4	4	4	4	2	4	5	4	5	1	4	20
3	5	4	3	5	5	4	4	5	4	4	3	4	4	4	1	3
4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	7
5	4	4	3	3	3	3	4	4	4	4	4	3	3	3	3	1
6	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	3
7	5	4	1	3	4	3	1	1	1	4	1	4	4	4	4	5
8	5	5	5	5	5	5	5	4	5	4	4	5	3	3	5	12
9	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	17
10	5	5	5	4	5	4	4	4	4	3	4	5	4	4	5	20
11	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	14
12	5	5	3	4	4	3	4	4	3	4	4	3	4	1	3	20
13	5	5	4	4	5	5	4	4	4	5	5	4	4	4	5	12
14	5	5	4	4	4	3	4	4	3	4	1	5	4	1	5	1

following results were obtained using the stepwise regression analysis method (stepwise) and Table 6: the arithmetic mean was 10.8571 and the standard deviation was 7.36788. Table 7 reveals: there is a single financial fraud effect, A2 (among the effects of financial fraud are the spread of theft, corruption, conspiracy, embezzlement, money laundering, bribery, and forgery), and the analysis equation is Y= -34.400+ 9600 A1+ ε.

Table 7: Descriptive Statistics of Application 1 of supersatuated design

	Mean	Std. Deviation	N
T	10.8571	7.36788	14
A1	4.7857	.42582	14
A2	4.7143	.46881	14
A3	3.9286	1.14114	14
A4	4.1429	.77033	14
A5	4.4286	.64621	14
A6	3.9286	.82874	14
A7	4.0714	.99725	14
A8	4.0714	.99725	14
A9	3.5714	1.22250	14
A10	3.9286	.99725	14
A11	3.7857	1.31140	14
A12	4.2143	.69929	14
A13	3.9286	.61573	14
A14	3.3571	1.39268	14
A15	4.0714	1.14114	14

		B	Sig
1	(Constant)	-34.400-	.066
	A2	9.600	.020

3.2.2: Application 2 of supersatuated design

Table 8: Application 2 of supersatuated design

Run/factor	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	Y
1	4	4	5	4	4	3	4	1	4	4	4	5	4	5	5	10
2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
3	4	5	4	5	5	4	4	3	4	4	4	3	3	4	4	15
4	3	5	5	5	5	3	4	5	5	5	5	4	5	5	3	13
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	25
6	5	5	4	1	3	3	4	3	3	3	4	3	4	4	3	5
7	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	10
8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	7
9	4	4	5	4	5	5	4	4	5	3	4	4	5	5	4	6
10	5	5	5	5	5	5	5	5	5	5	5	5	3	5	4	33
11	5	5	5	4	4	1	1	4	4	4	4	4	1	1	4	3
12	5	5	5	3	5	4	5	5	5	4	5	3	4	4	5	35
13	4	5	5	4	5	4	4	5	4	3	3	4	1	1	3	21
14	5	5	1	5	4	1	4	5	1	5	4	4	3	1	4	13

According to Table 8 and using the stepwise regression analysis method (stepwise), the following results were obtained: the arithmetic mean was 3.7143 and the standard deviation was 1.38278. From Table 9, we find that financial fraud has two effects; A5 (fraud makes the economic, commercial, investment and social operating environment unhealthy and unstable) and A14(the effects of financial fraud are business depression). The equation used for analysis was $Y= 0.258+ 0.026 A1+0.01 A14+ \varepsilon$.

Table 9: Descriptive Statistics of Application 2 of supersatuated design

	Mean	Std. Deviation	N
Y	3.7143	1.38278	14
A1	4.7857	.42582	14
A2	4.7143	.46881	14
A3	3.9286	1.14114	14
A4	4.5000	.65044	14
A5	4.7857	.42582	14
A6	4.5000	1.09193	14
A7	4.2143	1.12171	14
A8	4.5714	.64621	14
A9	3.7143	1.38278	14
A10	4.1429	1.02711	14
A11	4.2143	1.18831	14
A12	4.2143	1.12171	14
A13	4.2143	.80178	14
A14	4.3571	.63332	14
A15	4.1429	.77033	14

		t Sig.
1	(Constant)	.258
	A14	.011
	(Constant)	.241
2	A14	.001
	A5	.026

4.Conclusion

This study investigated and described fractional supersaturated processes and factor analysis in the context of systemic financial fraud risks. To review the literature, we conducted a survey of scientific papers that discussed financial fraud. These studies did not discuss the effects of financial fraud in greater detail, and if the effects were discussed, they were generally mentioned, which loses its significance when studying any global phenomenon. This scholarly article aims to shed light on the effects of financial fraud, measure its impact, and determine the means of controlling it. The questionnaire was delivered to businessmen, and the results were evaluated using precise statistical procedures such as factor analysis and regression analysis. The elements that contribute to the effects of financial fraud from A1 to A15 excluding factors A12 and A13 are shown in the results of the factor analysis. The factors that contribute to the effects of financial fraud on individuals, A2, A5 and A14, were discovered using regression analysis. Based on the findings of the two prior approaches and the similarity of the outcomes of the causal factors, the fundamental and genuine elements that led to the effects of financial fraud were A2, A5 and A14. These are some of the consequences of financial fraud, including theft, corruption, conspiracies, embezzlement, money laundering, bribery, and forgery. Fraud destabilizes the economic, commercial, investment, and social operating environments, and the consequences of financial fraud include business depression. Finally, the federal government should consider these factors and develop mitigation methods. This behavior can be investigated using precise statistical methods [11], [12], [13], [14], and [15].

Data availability.

Data supporting the findings of this study are available upon request from the corresponding author.

Acknowledgments

Conflicts of Interest

The authors declare that there is no conflict of interest.

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