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Modeling the Impact of Citizens' Social Responsibility on Sustainable Development Based on the Modifying Role of the COVID-19 Pandemic

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Abstract: In light of the coronavirus disease 2019 (COVID-19) pandemic, there is a strong correlation between citizens' social responsibility (SR) and sustainable development (SD). Accordingly, the present study aimed to model the impact of citizens' SR on SD concerning the modifying role of the COVID-19 pandemic. To this end, the data were collected from two target groups, namely, elites (viz. experts and professionals) (n=15) and the citizens of Tehran, Iran (n=384), through a questionnaire. The research model was also designed based on expert opinions, using the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), type-II fuzzy logic, and ELECTRE III, and then modified. The given model was subsequently examined by the partial least squares regression (PLS regression). Results showed that if citizens' SR is elevated by about one-unit, social justice, sustainable economy, and stable environment would be augmented by 0.693, 0.735, and 0.583 units, respectively. SD would also grow by 0.485, 0.948, and 0.743 units if social justice, sustainable economy, and sustainable environment increased by one unit. Consequently, the results of the present study confirm the mechanism of the impact of citizens' SR on SD.

1. Introduction

Achieving sustainable development (SD) is often possible without regard to environmental issues. In this sense, SD will only be accomplished by providing education, building culture, and changing citizens' attitudes and behaviors. At the same time, special attention to environmental protection is one of the SD characteristics and responsibilities assumed by citizens. In both cultural teachings and laws (Tayci and Uysal, 2012; Yarrington et al., 2018). Environmental protection is considered a public duty to support social life and growth in a society; therefore, recognizing environmental principles and avoiding destruction are among citizenship's most obvious responsibilities (Alkhathlan and Javid, 2013).

Citizens' social responsibility (SR) has been further defined as the social rules and regulations meeting society's expectations of individuals (Umberson and Montez, 2010). In this way, human relationships with oneself, fellows, and nature are balanced through taking responsibility (Mohammadzade and Soleimanpouromran, 2021). Citizens' SR also has a voluntary basis and includes observing human rights issues such as environmental considerations, energy management, and saving (Gebert et al., 2014).

In this respect, the coronavirus disease 2019 (COVID-19) has attracted much attention as a disease for which humans have not yet been able to find a definitive cure. Public laws, as the regulators of public relations, also state that all individuals have equal

rights based on their citizenship status. Citizens' cooperation with the government in implementing orders, laws, and protocols is thus considered to fulfill their civic duties. The government itself has some responsibilities through the laws and citizenship rights. One of the severe challenges facing underdeveloped countries is the low level of familiarity with the duties among citizens (Samad et al., 2017). In this regard, only a few attempts have been made to model the impact of citizens' SR on SD based on the modifying role of the COVID-19 pandemic, to the author's knowledge. Being socially responsible means that individuals and organizations must be ethical and sensitive to socio-cultural and environmental issues. Striving for SR also helps individuals, organizations, and governments to contribute positively to SD accomplishment. Unfortunately, the advent of the COVID-19 pandemic in recent years along with double pressures exerted on human societies through psychological and socioeconomic channels has reduced the impact and consequently attention to citizens' SR on SD. In other words, this pandemic has modified the positive relationship between citizens' SR and SD in human societies.

In line with Carroll (1979), (Samad et al., 2017) there are different dimensions of SR (Gilligan, 1982), including economic, legal, moral, and social. Caroll's model of SR (1973) (9) accordingly developed in 1991 when he proposed the pyramid of common social responsibility (CSR) (Choi et al., 2008). One way to avoid damaging the environment and prevent its destruction was thus proposed, that is, to change human behavior toward a naturalistic view.

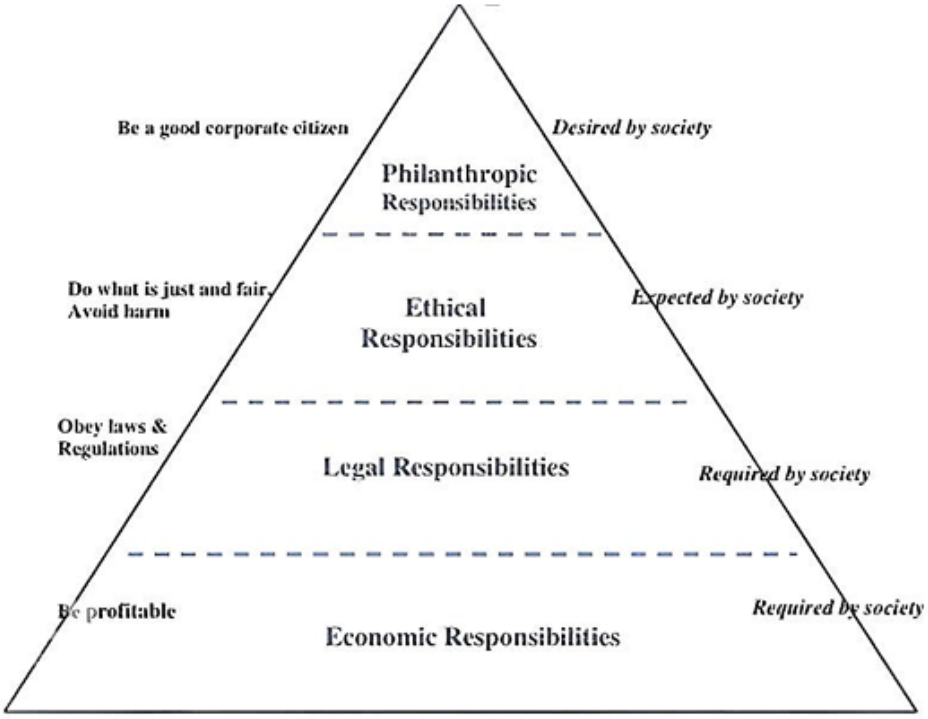

Figure 1. Carroll's Pyramid of Social Responsibility (Carroll, 1991)

Researchers tried to study the effective parameters on development around the world. Alvarado et al., (2021) studied ecological footprint, economic complexity and natural resources rents in Latin America. Dagar et al., (2021) investigated variations in technical efficiency of farmers with distinct land size across agro-climatic zones based on evidence from India. Tang et al., (2022) studied the role of business regulations in testing the resource-curse hypothesis in ASEAN countries. Zhang et al., (2022) studied environmental impact of information and communication technology by investigating the role of education in developing countries. Xin et al., (2023) studied SMEs' sustainable performance in the digital era by Evidence from Pakistan.

Also, Irfan et al., (2022) used AHP and G-TOPSIS approaches for Prioritizing and overcoming biomass energy barriers. Xie et al., (2023) by evidence from frequency domain causality approach for global data studied forest and mineral volatility and economic performance.

Today, the world is being affected by the COVID-19 pandemic. Many religious people have also called the disease "human sin" (Elvis and Ronda, 2021). Some even believe that "humans are viruses" (i.e. the decrease in human population has positive effects on the environment) and point to some of the positive environmental effects of this condition because the economy has been suspended. Others have further added that (Fornes et al., 2020), "the planet is better now," using the images of animals returning to the cities, although many of these claims remain still unconfirmed (Watts et al., 2021).

Despite different views toward COVID-19 (Barca et al., 2020), the relevance of the ethic of care has been renewed, highlighting the conditions for effective communication among human beings. Although the virus has facilitated the understanding of common vulnerabilities as mortals, the actual health effects of the virus have been highly discriminatory with a different effect on one race or gender or individuals with an underlying disease (Hanna et al., 2020). Accordingly, cities and local governments must actively pursue the prerequisites of communal members falling out of the existing system gaps (Jon, 2020).

Acting responsibly as part of the world also means considering the chaotic phenomena inherent in the world's life and reacting to the possibilities that may contribute to prosperity. These approaches can include respecting the main routes rather than trying to control them or the connection between man and nature through a more sustainable urban configuration(Ma et al., 2021). In fact, at the moment declaring a "war on the virus" with thousands of relatives helplessly defeated by COVID-19, it may be overly early to think beyond the fate of various species. However, humans can easily succumb to these microscopic creatures, effectively keeping them from the power of any "creature" that proves its presence through shapeless actions. While there has been encouraging debate about bearing in mind this global health crisis as a foundation for more attention to the global climate crisis(Italia et al., 2020), the attitude toward SR has not changed so far since 2007.

Citizens still believe that the government is in charge of addressing social needs and increasing confidence in solidarity (Erikson, 2020; Schneider et al., 2011). At the same time, new developments and the government's demands for responsibility are the main solutions to social problems, (Allain-Dupré, 2018). However, there is a growing trend in citizens' awareness of their civic duties and the need for participation (Othman, 2021). However, there is also a widening gap in the understanding of responsibility, which is generally evident in specific attitudes (Abbas, 2021). As a result, it is expected that SR in these conditions can lead to more SD. An important part of SR is the citizens' active involvement in voluntary social activities, which will become even more significant in critical circumstances. This includes participating in meetings where community issues are discussed (e.g., in municipalities, local neighborhood units, tenant councils, etc.), contributing voluntarily to community activities (such as cleaning streets and other public areas), or helping other people for free.

The present study is thus organized as follows. After the introduction, the theoretical debates and research background are explained in Section 2, and the research method is delineated in Section 3. The model estimation and the analysis of the results are also provided in Section 4, and lastly, in Section 5, summaries and policy recommendations are presented.

2. Materials and Methods

The present research used interviews, library studies, and a questionnaire to collect the data. Accordingly, the questionnaire was designed and distributed among the statistical samples. The open-ended questionnaire was thus employed for elites (viz.

experts and professionals), and the closed-type one was utilized for citizens. As modeling was the main objective of this study, first, the final questionnaire was developed using expert opinions, and then, it was established based on citizens' views. The questionnaires for elites and citizens were 1-9 and 1-5 points on a Likert-type scale, respectively. The difference in such points was the elites' power of thinking and knowledge compared to ordinary citizens in distinguishing the responses (Moradi et al., 2021). The present study was also conducted in 2021-2022 with a statistical population of elites working in COVID-19 and SR, citizenship, and SD. The statistical sample included 16 elites from the target community selected using the snowball sampling method. As the elites formulated the final items, the questionnaire was distributed among the citizens, and the model of the impact of citizens' SR was estimated once with all the initial items and once with the selected items to confirm the adequacy of the statistical justification of the number of elites entering into the modeling process. The research process is presented in Figure 2.

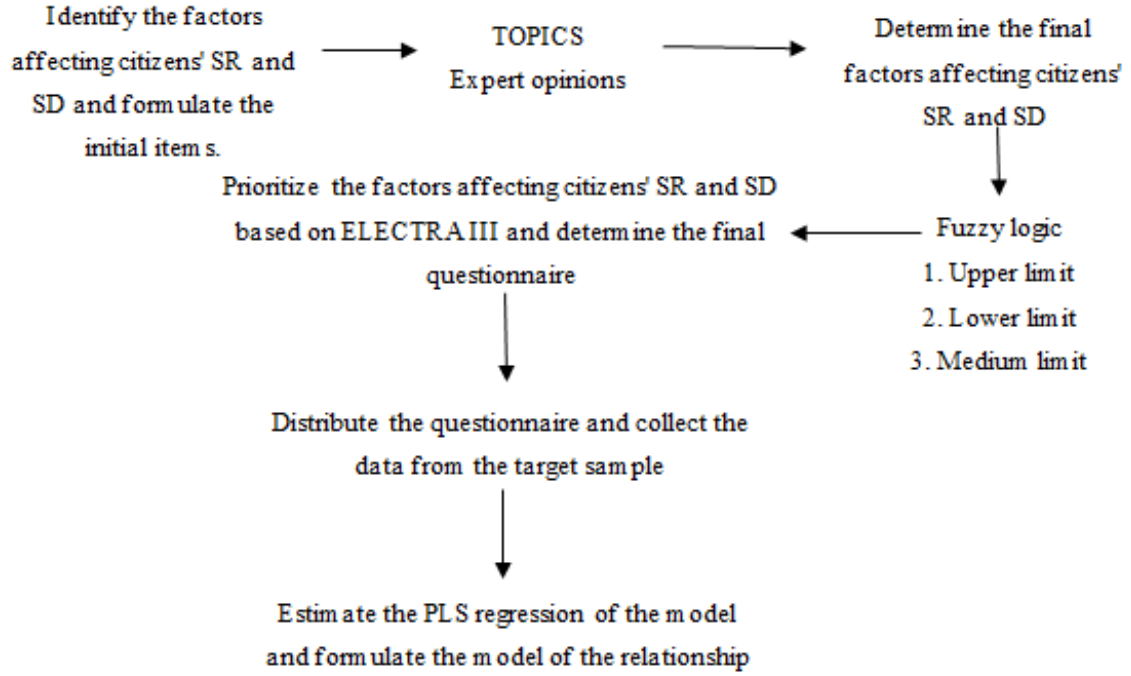

Figure 2. Research process

Figure 2 shows four models used to meet the research objectives. Using the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), the non-trivial items that did not have a sufficient mean value to be present in the final model were removed. Employing type-II fuzzy logic and ELECTRE III, the items made by the elites during their scoring or pairing comparisons were removed. Ultimately, the final model was determined using the partial least squares regression (PLS regression).

3. Model Estimation

This section consisted of two main parts. In the first part, the Delphi method outputs were presented: removing unimportant indicators based on expert opinions. In the second part, the type-II fuzzy logic and ELECTRE III results were illustrated, prioritizing the most important indicators affecting citizens' SR and SD. Before using the model, it was also necessary to introduce the research questionnaires.

In the following, the unimportant research variables were removed using the TOPSIS. Based on the above fuzzy numbers and verbal expressions, the mean fuzzy scores of expert opinions about the options available in this research are shown in Table 2.

Table 1. Primary questionnaire questions

Row	variable	question	Number of items
1	Economical	1-5	5
2	Social	6-10	5
3	Ethical	11-15	5
4	Legal	16-20	5
5	Environmental	21-25	5
6	Social responsibility	26-30	5
7	Social justice	31-35	5
8	Sustainable economy	36-40	5
9	Stable environment	41-45	5
10	Sustainable Development	46-50	5
11	Covid-19 virus	51-55	5

The fuzzy numbers were converted into verbal expressions as follows:

Table 2. Average fuzzy scores of each of the social responsibility options

	Mean fuzzy scores of each of the studied options		
Evident 1	4.76	6.68	8.68
Evident 2	4.546667	6.546667	8.546667
Evident 3	4.64	6.613333	8.613333
Evident 4	4.613333	6.586667	8.586667
Evident 5	4.56	6.533333	8.533333

The distance between the fuzzy numbers corresponding to the options and each verbal expression is described in Table 3.

Table 3. The verbal expressions corresponding to the mean fuzzy scores of the research options

	Verbal expressions corresponding to the mean fuzzy scores of research options						
	Option distance to verbal phrase						
	Very weak	weak	medium	good	Very good	Minimum distance	Verbal phrase
Evident 1	5.12	3.71	1.71	0.3	2.29	0.3	good
Evident 2	4.97	3.55	1.55	0.45	2.45	0.45	good
Evident 3	5.04	3.62	1.62	0.38	2.38	0.38	good
Evident 4	5.02	3.6	1.6	0.4	2.4	0.4	good
Evident 5	4.96	3.54	1.54	0.46	2.46	0.46	good

The following findings of the fuzzy TOPSIS technique were discussed to prioritize the options examined.

Step 1: Form a decision-making matrix to evaluate the options. This matrix is provided in Table 4.

Table 4. Fuzzy options evaluation options (decision matrix)

Evident 1	**5**	**7**	**9**	**5**	**7**	**9**	**1**	**3**	**5**
Evident 2	7	9	11	5	7	9	5	7	9
Evident 3	5	7	9	5	7	9	1	3	5
Evident 4	5	7	9	7	9	11	1	3	5
Evident 5	7	9	11	7	9	11	1	3	5

Step 2: Scale the decision-making matrix, whose results are illustrated in Table 5.

Table 5. Fuzzy-scale matrix

Evident 1	**0.4545**	**0.6363**	**0.8181**	**0.4545**	**0.6363**	**0.8181**	**0.1**	**0.3**	**0.5**
Evident 2	0.6363	0.8181	1	0.4545	0.6363	0.8181	0.5	0.6	0.8
Evident 3	0.4545	0.6363	0.8181	0.4545	0.6363	0.8181	0.1	0.3	0.5
Evident 4	0.4545	0.6363	0.8181	0.6363	0.8181	1	0.1	0.3	0.5
Evident 5	0.6363	0.8181	1	0.6363	0.8181	1	0.1	0.3	0.5

Step 3: Create a fuzzy weightless scale ($\tilde{V}$) matrix, as the expert opinions weight is considered the same. The fuzzy weightless scale matrix is given in Table 6.

Table 6. Fuzzy weightless scale ($\tilde{V}$) matrix

Evident 1	**0.0025**	**0.0035**	**0.0045**	**0.0025**	**0.0035**	**0.0045**	**0**	**0**	**0**
Evident 2	0.0035	0.0045	0.0055	0.0025	0.0035	0.0045	0	0	0
Evident 3	0.0025	0.0035	0.0045	0.0025	0.0035	0.0045	0	0	0
Evident 4	0.0025	0.0035	0.0045	0.0035	0.0045	0.0055	0	0	0
Evident 5	0.0035	0.0045	0.0055	0.0035	0.0045	0.0055	0	0	0

Step 4: Calculate the sum of the distances of each option from the fuzzy positive and negative ideals, whose results are listed in Tables 7 and 8, respectively.

Table 7. The sum of the distances of each of the options from the fuzzy positive ideal

Evident 1	**0.996465**	**0.996465**	**0.998485**
Evident 2	0.995455	0.996465	0.996465
Evident 3	0.996465	0.996465	0.998485
Evident 4	0.996465	0.995455	0.998485
Evident 5	0.995455	0.995455	0.998485

Table 8. The sum of the distances of each of the options from the fuzzy negative ideal

Evident 1	**0.00363**	**0.00363**	**0.001725**
Evident 2	0.00462	0.00363	0.00363
Evident 3	0.00363	0.00363	0.001725
Evident 4	0.00363	0.00462	0.001725
Evident 5	0.00462	0.00462	0.001725

Step 5: Compute the relative proximity of option i from the ideal solution and rank the options whose results are presented in Table 9.

Table 9. Ranking Options

Options	**The distance to the positive ideal**	**The distance to the negative ideal**	**Weight**	**Rank**
Evident 1	149.3305	0.673253	0.003488	5
Evident 2	149.3263	0.677466	0.004716	1
Evident 3	149.3347	0.669048	0.00456	3
Evident 4	149.3358	0.668189	0.004654	2
Evident 5	149.3482	0.655993	0.004493	4

Ranking the options with the fuzzy TOPSIS technique indicated that the "evident 2" option had a higher priority than the others. Options with a mean value below four were also removed from the non-hidden ones of the collaboration index between colleagues. Overall, 24 indicators were omitted from the model due to the lack of minimum mean value required to enter the model. In the following, using the type-II fuzzy and ELECTRE III, there were attempts to remove the variables due to the elites' inability to compare the pairs between the options. The results of the table of the items of the final questionnaire are provided below.

3.1. Fuzzy Method

Based on expert opinions, this section identified the criteria for measuring the indicators affecting SD and citizens' SR. In the fuzzy method, xj represents these indicators.

3.2. Computability

An indicator must be computable in addition to being functional. Accordingly, an indicator is effective even if it is based on theoretical foundations, but it will only be so in practice with the ability to calculate. Ability and Ease of Access to Data Required for Calculation An indicator will only be desirable if it can calculate, but it is only possible to collect data to calculate it. In this criterion, the goal is the applicability of the data in the activity, referring to the amount of the data transferred. An indicator needs more accuracy in forecasting to be helpful in practice and even misleads decision-makers.

3.3. Comprehensibility

An indicator must be comprehensible, causing decision-makers to know when and where to use each and for what purposes. In addition, an expert should have common perceptions of an indicator and refrain from personal perceptions.

3.4. Data Collection Cost-Effectiveness

This criterion refers to the financial cost and the opportunity to measure an indicator; in other words, how can an indicator help transmit information about the impact of citizens' SR on SD under COVID-19 conditions?

3.5. Information Value

An indicator must have information value, so obtaining information from it can create a new perspective on the situation.

3.6. Ability to Analyze

An indicator must be able to analyze, which means that increasing or decreasing the indicator can analyze the future situation.

3.7. Applicability

The applicability of an indicator refers to the degree to which it is relevant to achieve the desired goals. In other words, the indicator's ability in the applicability of the information transmitted should be high and not only denote the volume of the information transmitted.

Based on the results in Table 10, the criteria below and equal to the mean value of 5 are removed. Accordingly, computability, information value, comprehensibility, accuracy in predicting SD and CSR, and applicability are the main criteria for prioritizing the indicators examined. Accordingly, the factors affecting SD and CSR are prioritized. The following table is based on the information from 16 questionnaires selected from the active elites discussing SD and CSR. In this table, expert opinions are considered the

input data of type-II fuzzy logic using Buckley's approach to fuzzy estimation. The upper and lower limits for each criterion are determined based on expert opinions and the criteria set using the fuzzy model.

Table 10. Factors affecting the sustainable index and social responsibility

Row	Factor	Number of experts
1	Computability	15
2	Ability and ease of access to the data required for calculation	15
3	Accuracy of a criterion	15
4	Comprehensibility	14
5	Cost-effectiveness of collecting the required data	8
6	Information value	7
7	Ability to analyze	6

Table 11. Secondary questionnaire questions

Row	variable	question	Number of items
1	Economical	1-3	3
2	social	4-5	2
3	Ethical	6-8	3
4	Legal	9-11	3
5	environmental	12-14	3
6	social responsibility	15-18	4
7	social justice	19-21	3
8	Sustainable economy	22-24	3
9	Stable environment	25-26	2
10	Sustainable Development	27-28	2
11	Covid-19 virus	29-31	3

Then, using the concepts of fuzzy logic to non-fuzzify the decision matrix, the primary method of region two is used with the following relation because it does not require the personal judgment of the analyst. As the lower or upper limits have been so far examined in some studies and their values have been introduced as the criterion of the researchers' decision-making, personal judgment is practically removed from the model via the following formula:

$$\text{Fuzzy triangle center area number} = \text{CA} = \left(\frac{(\beta-\alpha)+(\text{m}-\alpha)}{3}\right) + \alpha \quad (1)$$

In the above relation, α represents the lower limit, β shows the upper limit, and M represents the mean of the fuzzy numbers. Upon calculating the decision matrix and the non-fuzzy one, the results are entered using ELECTRE III. Given the large dimensions of the expressed matrices, the results are refused.

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Table 12. Fuzzy matrix results

factor	Ability to calculate			Ability and ease of access to the required calculation data			Comprehensibility			Accuracy of a criterion			Applicability of the index		
limit	upper limit	Lower limit	mean	upper limit	Lower limit	mean	upper limit	Lower limit	mean	upper limit	Lower limit	Mean	upper limit	Lower limit	mean
x1	0.39	0.38	0.385	0.09	0.06	0.075	0.32	0.45	0.385	0.52	0.29	0.405	0.24	0.22	0.23
x2	0.25	0.07	0.16	0.46	0.15	0.305	0.41	0.55	0.48	0.04	0.03	0.035	0.25	0.24	0.245
x3	0.07	0.03	0.05	0.1	0.05	0.075	0.4	0.58	0.49	0.43	0.53	0.48	0.39	0.35	0.37
x4	0.06	0.11	0.085	0.3	0.17	0.235	0.15	0.09	0.12	0.54	0.53	0.535	0.43	0.54	0.485
x5	0.3	0.06	0.18	0.05	0.17	0.11	0.29	0.35	0.32	0.3	0.27	0.285	0.6	0.27	0.435
x6	0.42	0.1	0.26	0.01	0	0.005	0.43	0.42	0.425	0.21	0.3	0.255	0.52	0.55	0.535
x8	0.19	0.02	0.105	0.42	0.07	0.245	0.17	0.31	0.24	0.34	0.15	0.245	0.13	0.33	0.23
x10	0.19	0.12	0.155	0.04	0.24	0.14	0.3	0.25	0.275	0.63	0.51	0.57	0.24	0.19	0.215
x11	0.45	0.19	0.32	0.35	0.51	0.43	0.19	0.26	0.225	0.07	0	0.035	0.25	0.03	0.14
x12	0.17	0.01	0.09	0.39	0.54	0.465	0.29	0.25	0.27	0.15	0.17	0.16	0.08	0.05	0.065
x15	0.16	0.31	0.48	0.04	0.25	0.17	0.04	0.16	0.31	0.48	0.04	0.25	0.17	0.04	0.13
x16	0.05	0.08	0.49	0.48	0.37	0.20	0.32	0.05	0.08	0.49	0.48	0.37	0.20	0.32	0.08
x17	0.09	0.24	0.12	0.54	0.49	0.18	0.18	0.09	0.24	0.12	0.54	0.49	0.18	0.18	0.19
x18	0.18	0.11	0.32	0.29	0.44	0.19	0.08	0.18	0.11	0.32	0.29	0.44	0.19	0.08	0.38
x19	0.26	0.01	0.43	0.26	0.54	0.06	0.10	0.26	0.01	0.43	0.26	0.54	0.06	0.10	0.28
x20	0.11	0.25	0.24	0.25	0.23	0.38	0.08	0.11	0.25	0.24	0.25	0.23	0.38	0.08	0.19
x21	0.16	0.14	0.28	0.57	0.22	0.07	0.12	0.16	0.14	0.28	0.57	0.22	0.07	0.12	0.18
x22	0.32	0.43	0.23	0.04	0.14	0.49	0.05	0.32	0.43	0.23	0.04	0.14	0.49	0.05	0.45
x23	0.02	0.02	0.08	0.32	0.05	0.00	0.01	0.02	0.02	0.08	0.32	0.05	0.00	0.01	0.08
x24	0.41	0.39	0.40	0.13	0.07	0.10	0.35	0.49	0.42	0.52	0.29	0.41	0.26	0.24	0.25
x25	0.26	0.07	0.16	0.47	0.15	0.31	0.44	0.59	0.52	0.07	0.07	0.07	0.28	0.27	0.27
x26	0.07	0.04	0.06	0.12	0.06	0.09	0.41	0.59	0.50	0.47	0.57	0.52	0.42	0.39	0.41
x27	0.08	0.11	0.10	0.30	0.18	0.24	0.17	0.12	0.14	0.56	0.55	0.56	0.48	0.56	0.52
x29	0.33	0.07	0.20	0.05	0.17	0.11	0.32	0.38	0.35	0.32	0.29	0.30	0.64	0.31	0.48
x30	0.43	0.10	0.27	0.04	0.01	0.02	0.44	0.44	0.44	0.24	0.31	0.27	0.53	0.58	0.55
x31	0.20	0.03	0.12	0.42	0.09	0.26	0.19	0.33	0.26	0.39	0.19	0.29	0.15	0.34	0.25

4. ELECTRE III Results

To this point, the evaluation score of each variable has been obtained based on each indicator. According to other ELECTRE III inputs, it is necessary to determine the importance or the weight of the indicators and their threshold values. Clarifying the importance or the weight of the indicators in ELECTRE III is sometimes critical and sensitive. Determining the superiority of the options over each other is somewhat tricky. When there are multiple decision-makers, the situation becomes much more complex due to the individuals' different and even conflicting preferences. For this purpose, external techniques should be exercised to convert the preferences into the weight value of the indicators. This study completed 16 questionnaires from 16 elites active in the SD and CSR field. Assuming that the elites were homogeneous, expert opinions were converted into a single number using the simple average method. Based on the expert opinions, this table introduced a pair of matrices between the criteria for measuring the indicators affecting SD and CSR. To calculate the pairing matrix in the present study, first:

- Each element is doubled.
- The sum of the squares of each column is obtained.
- The square root of the sum of the squares of each column is computed.
- Then, each element in the even matrix is divided by the square root of the sum of the squares of each column to normalize the even matrix.

Table 13. Scores of various indicators based on expert opinion

Factors	CMT*	AEARDC*	CMPH*	AAC*	APPINX*
Computability	1	2	1	4	5
Ability and ease of access to the required data calculation	0.50	1	2	5	6
Comprehensibility	1.00	0.50	1	6	7
Accuracy of a criterion	0.25	0.20	0.17	1	4
Applicability of the index	0.20	0.17	0.14	0.25	1

CMT – Computability; AEARDC - Ability and ease of access to the required data calculation; CMPH – Comprehensibility; AAC - Accuracy of a criterion; APPINX - Applicability of the index

Normalization or scaling is also an underlying concept in multi-criteria decision-making (MCDM) techniques, which means scaling and making it possible to compare the data with different measurement criteria. To normalize here means to scale. A simple method for normalizing a clock's number is called particular vector calculation. In this method, dividing each number in a set by the sum of its elements is sufficient. In this case, the sum of all elements after normalization is one. Table 14 summarizes these results.

Table 14. Normalized matrix

factors	CMT*	AEARDC*	CMPH*	AAC*	APPINX*
Computability	0.65	0.87	0.41	0.45	0.44
Ability and ease of access to the required data calculation	0.33	0.43	0.81	0.57	0.53
Comprehensibility	0.65	0.22	0.41	0.68	0.62
Accuracy of a criterion	0.16	0.09	0.07	0.11	0.35

Applicability of the index	0.13	0.07	0.06	0.03	0.09
Computability	0.208	0.181	0.189	0.199	0.221

CMT – Computability; AEARDC - Ability and ease of access to the required data calculation; CMPH – Comprehensibility; AAC - Accuracy of a criterion; APPINX - Applicability of the index

According to the above matrix, the highest weight is allocated to applicability. Next, a definite matrix is obtained by multiplying each factor's weight by the mean importance of each factor (a questionnaire is designed for this matrix).

Table 15. Definitive matrix

factors	**CMT***	**AEARDC***	**CMPH***	**AAC***	**APPINX***
Symbol	1	2	3	4	5
x1	0.54	1.42	0.49	0.48	0.95
x2	1.31	0.58	0.40	0.94	0.88
x3	0.44	1.47	0.38	0.42	0.60
x4	1.02	0.76	1.58	0.38	0.44
x5	1.17	0.94	0.59	0.68	0.51
x6	0.79	1.36	0.44	0.76	0.42
x8	1.50	0.73	0.80	0.80	0.95
x10	1.31	1.29	0.68	0.36	0.99
x11	0.65	0.42	0.82	1.18	1.57
x12	1.42	0.38	0.70	1.26	1.57
x15	0.65	1.22	1.12	0.76	1.83
x16	1.00	0.53	1.27	0.44	1.11
x17	1.40	0.45	1.12	0.52	1.24
x18	1.04	0.58	1.58	0.58	0.99
x19	0.90	0.62	1.58	0.48	1.48
x20	1.04	0.62	1.27	0.84	0.99
x21	1.10	0.62	1.35	0.56	1.83
x22	0.62	0.82	0.70	1.41	0.66
x23	1.17	1.51	1.35	1.33	0.99
x24	0.52	1.30	0.46	0.49	0.92
x25	1.27	0.54	0.38	0.94	0.83
x26	0.44	1.36	0.39	0.39	0.56
x27	1.02	0.69	1.35	0.36	0.44
x29	1.04	0.86	0.56	0.66	0.48
x30	0.78	1.25	0.44	0.73	0.41
x31	1.50	0.65	0.75	0.69	0.93

CMT – Computability; AEARDC - Ability and ease of access to the required data calculation; CMPH – Comprehensibility; AAC - Accuracy of a criterion; APPINX - Applicability of the index

The indicators, including the indifference threshold (q), the veto threshold (v), and the superiority threshold (p), are directly determined by the elites as described in the table (the questionnaire is designed for this matrix).

Table 16. Threshold values of superiority, indifference, and veto of decision indicators

	CMT*	**AEARDC***	**CMPH***	**AAC***	**APPINX***
Threshold q	1	0.5	0.5	1	0.5
Superiority threshold p	1.5	1.5	2	3	3
Veto threshold limit v	7	6	5	5	6
The nature of the index	positive	positive	positive	positive	positive

CMT – Computability; AEARDC - Ability and ease of access to the required data calculation; CMPH – Comprehensibility; AAC - Accuracy of a criterion; APPINX - Applicability of the index

Next, the definite decision matrix is softened, and the weights obtained in the definite matrix are multiplied. Given that all the criteria examined are positive, the table of coordinated and uncoordinated matrices is calculated, which is refused to provide due to the long computational volume. Based on this, the coordination matrix is determined as follows:

$$I_{KI} = \sum W_j \ , j \in Ski \quad (2)$$

To "form a coordinated matrix," the coordinated sets are utilized. The threshold limit of the synchronized matrix will be thus calculated as follows:

$$\bar{I} = \left(\frac{\text{Matrix of synchronized sum values}}{\text{number of coordinated matrix values}}\right) \quad (3)$$

Given that the sum of the numbers inside the coordinate matrix is 711.36 and the number of elements in the matrix is 1482, the threshold in this matrix will be 48%. Using this threshold, the numbers above it are one, and the rest is zero to achieve an effective coordinate matrix. Afterward, the uncoordinated matrix threshold is calculated. In a coordinated and uncoordinated matrix, the numbers zero and one must be calculated and divided by the total number of elements in the matrix to calculate the veto threshold. As a result, the number is correct.

$$\overline{NI} = \left(\frac{\text{Matrix of uncoordinated sum values}}{\text{number of uncoordinated matrix values}}\right) \quad (4)$$

We have prioritized the factors affecting addiction based on the sum of the numbers in each row (Table 17). Given that the sum of the numbers inside the uncoordinated matrix is 1318.98 and the number of elements in the matrix is 1482, the threshold in this matrix is 89%. Using this threshold, the numbers above it are set as one, and the rest is zero, to obtain an effective uncoordinated matrix. Finally, the validity matrix will be calculated. The product of the effective coordinate matrix and the validity matrix can be accordingly obtained.

Table 17. Validity matrix

variable	mean	variable	mean
x1	9	x18	1
x2	11	x19	4
x3	10	x20	5
x4	20	x21	19
x5	21	x22	13
x6	26	x23	14
x8	22	x24	18
x10	23	x25	16
x11	25	x26	15
x12	24	x27	17
x15	12	x29	8
x16	3	x30	7
x17	2	x31	6

If a criterion weighs more than half, the factor will be influential in the final decision-making; otherwise, the factor will be removed. In most MCDM models, the number half is the decision criterion. In ELECTRE III models, this value will be half different due to the indifference threshold index (q), the veto threshold (v), and the superiority threshold (p). According to statistics, in ELECTRE III, one-third, in addition to one of the prioritized

indicators affecting the role of CSR on sustainable development, is removed. Accordingly, ten other ineffective indicators will be removed from the primary model, including x4, x5, x6, x8, x10, x11, x12, x21, x24, and x25.

In this section, it is obligatory to develop an optimal model. Therefore, it is essential to draw the initial model and develop the final one based on the Delphi method's results, the type-II fuzzy model, and ELECTRE III. Some questionnaires are further used to ensure validity, and Cronbach alpha coefficient and composite reliability are employed to assess the reliability of the questionnaires (Table 18).

Table 18. Validity and reliability index

Index	Cronbach alpha	Factor load
Economical	0.907	0.926
Social	0.825	0.909
Ethical	0.857	0.886
Legal	0.898	0.812
environmental	0.855	0.833
social responsibility	0.878	0.809
social justice	0.925	0.954
Sustainable economy	0.887	0.903
Stable environment	0.890	0.873
Sustainable Development	0.901	0.885
Covid-19	0.957	0.924

The research indicators have high validity and reliability because Cronbach alpha coefficients are above 0.7, and the factor loading is above 0.3. After checking the questionnaire's validity and reliability, the model's path analysis is estimated. Because there is no specific model in the research, the model is estimated in four separate cases.

One of the main goals of using structural equation modeling (SEM) is to know the consistency between experimental data and conceptual and theoretical models. To identify the degree of consistency of the experimental data and conceptual model, some indicators and criteria are used, which are called goodness-of-fit indices (GFIs). In the SEM, different indicators are also used to ensure the GFI of the model. In Table 19, the most critical GFIs of various models are presented.

Table 19. Model goodness indicators of model fit

Index	Level	result	model
GFI	0.976	good	Absence of all variables (Delete variables based on Delphi, fuzzy type 2, and electrotype three methods)
RMS	0.022	good	
GFI	0.684	Not good	Presence of all variables (No deletion of variables based on Delphi, fuzzy type 2, and electrotype three methods)
RMS	0.115	Not good	

Considering the GFIs of the model indicators, the estimated model has a good level (GFI above 70% and the root mean square error of approximation (RMSEA) below 8%). As a result, the research outputs are highly reliable. Based on the results, the first model has higher accuracy, so if the hypotheses are presented, and the research results are developed in future research, the first model can be used. Moreover, the model

estimation results in the case that all variables without prioritization are included in the model reduce the model's accuracy; thus, eliminating unimportant variables and prioritizing variables affecting the role of citizens' SR on SD can augment the accuracy and efficiency of the model. Therefore, it is argued that omitting more unrelated variables and prioritizing some other variables in the present study are statistically justified.

In order to estimate the relationships between the research variables based on the PLS regression, it is first necessary to formulate the relationship between the variables about the theoretical foundations presented in the research. Before estimating the final model, it is assessed without making a connection between the research questions, shown in two ways in the following diagram. However, it was observed that the model error rate was about 9%. Therefore, the final estimation of the model was performed using the ARM Feature provided by the Smart-PLS software. Considering that the error of the estimation model reached below 5%, these results were obtained. Applying a new correlation also improved the results. Based on the given results, all the variables entered into the model had a suitable factor loading, so their presence in the model was statistically justified.

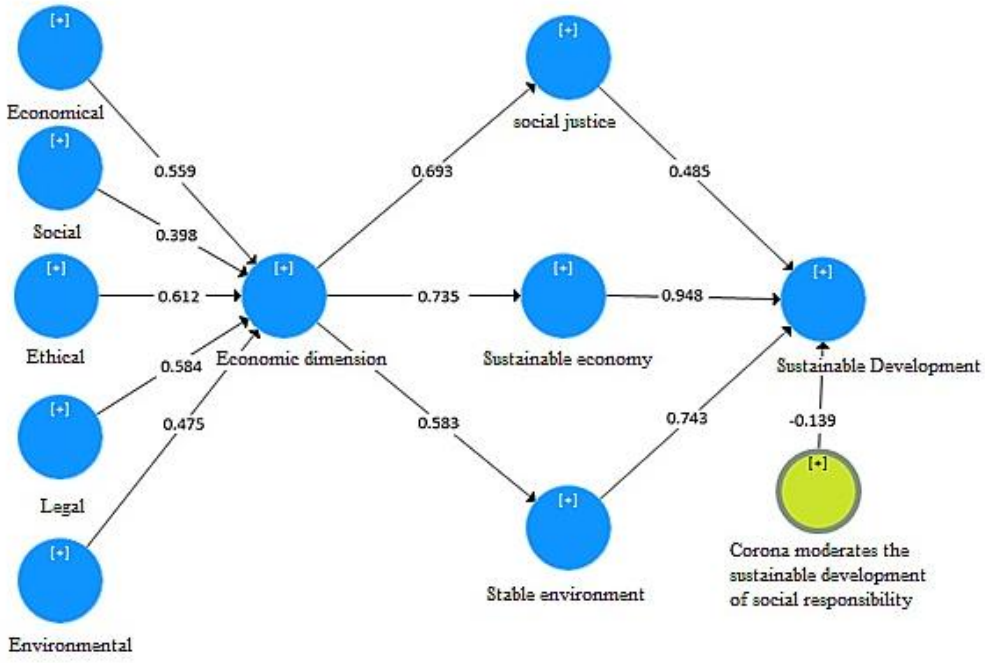

Figure 3. Standardized question coefficients

If the SR of a unit increases, it boosts social justice, a sustainable economy, and a stable environment by 0.693, 0.735, and 0.583, respectively. If a unit's social justice, sustainable economy, and sustainable environment grow, SD rises by 0.485, 0.948, and 0.743 units, respectively. Based on the COVID-19 results, the relationship between citizens' SR and SD of -0.139 units is affected and adjusted. Based on this, the research hypothesis of the correlation between citizens' SR and SD under the influence of COVID-19 was confirmed with reference to the results of the GFIs of the model, as presented in Table 20.

Table 20. Good fit indicators of the model

Index	Explanation coefficient	Modified explanation coefficient
Index SRMR	0.022	0.021
GFI	0.976	0.981

As the GFI above 70% and the RMSEA less than 8% are located, the model is at the desired level in terms of GFIs.

5. Discussion and Conclusions

Similar studies have generally examined the extent of the impact of citizens' SR on SD. Although the primary purpose of the present study was to explain the optimal model of this relationship and then measure how SR and SD are related, the secondary objective was to reflect on the severity and effectiveness of the modifying role of the COVID-19 pandemic in the relationship between citizens' SR and SD.

Based on the Delphi method, the variables of x7, x9, x13, x14, and x28, and according to ELECTRE III, the variables of x4, x5, x6, x8, x10, x11, x12, x21, x24, and x25 were removed. Considering the results, it was observed that modeling and eliminating unimportant variables increased the model accuracy from 0.684 to 0.976.

The following conclusions were obtained based on the COVID-19 results:

- The relationship between citizens' SR and SD is affected by -0.139 units. Based on this, the research hypothesis concerning the modifying role of COVID-19 in the relationship between citizens' SR and SD under the influence of COVID-19 was confirmed. In light of the research results, it can be stated that these results were consistent with the findings reported in (Hanna et al., 2020) and in line with the negative impact of COVID-19 on the relationship between citizens' SR and SD. As a result, the increase in the model's accuracy and the consistency of the research results with other studies approved conformity with reality and theoretical foundations.
- The relationship between citizens' SR and SD of -0.139 units is affected and adjusted. Based on this, the research hypothesis concerning the correlation between citizens' SR and SD under the influence of COVID-19 was confirmed.

The results indicated that planned citizenship education for all sections of society could affect all aspects of their knowledge, skills, and attitudes. The output of the models also illustrated that a lack of social skills could lead to behavioral problems, low self-esteem, isolation and depression, delinquency, spouse dissatisfaction, emotional problems, aggression, and poor self-concept. Social skills training could be required as a holistic approach to empower people to get to know themselves, others, and the environment. Of note, learning skills was not just about learning but could affect attitudes and values. In addition to applying social skills in real-world situations, people could learn some facts about different situations. Such training could help people adapt to life-changing conditions such as urbanization, family structure change, and the natural evolution of cultures, and even deal with everyday situations in ways acceptable to family and society. The findings of the evaluated models similarly demonstrated that the low-quality environment could negatively affect people's lives, and if citizenship education was not in line with the growth and development of the urban population and the spirit of SR toward the environment were not strengthened, environmental pollution, as expected, could be experienced in the coming years. Therefore, citizens' SR could play an important role in solving the mentioned problems. Accordingly, it is assumed that the institutionalization of civic education leads to unity and social solidarity and strengthens the sense of brotherhood, diversity, commitment, and responsibility. The role of these teachings in society could lead to high SR in citizens. Finally, the following conclusions were obtained from the results of current research:

- If a unit's social justice, sustainable economy, and sustainable environment rise, SD is elevated.
- If the SR of a unit increases, it boosts social justice, a sustainable economy, and a stable environment.
- According to the results of the final model, if the environmental, economic, and social dimensions increase by one unit, SD grows.

- By comparing the research results with the impact of citizens' SR on SD, it can be seen that economic, social, and environmental factors have a significantly positive effect on SD in terms of citizenship. Consequently, the results of the present study confirm the mechanism of the impact of citizens' SR on SD.

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