



# Assessment of sustainable green financial environment: the underlying structure of monetary seismic aftershocks of the COVID-19 pandemic

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## Abstract

The study aims to assess a sustainable green financial environment by exploring the underlying structure of monetary seismic aftershocks of the COVID-19 pandemic. This study is qualitative and uses a review of literature, primary data collection methods, and qualitative analysis techniques as the study's overall design. The data is collected by one-to-one interview using a matrix style questionnaire from a panel of experts based on the purposive sampling technique. Interpretive structural modeling (ISM) combined with Matrices' Impacts Cruise's Multiplication Appliquée a UN Classement (MICMAC) is used for assessment, modeling, and analysis of data. The monetary aftershocks, namely, "more cash in hand required," "decreased travel costs," "shift to more certain or fixed revenue streams," "lower rent costs," "more zealous monitoring of cash collection cycle," and "decreased entertainment costs," occupy *level I* (top of the model being least critical shocks), and "tedious regulations" occupy *level VIII* (bottom of the model being the most vital). Other aftershocks form the middle of the model being moderate critical. Analysis of MICMAC shows that monetary seismic aftershocks high fees for assistance regarding SOPs, tedious regulations, and more downtime due to pandemic alerts are independent. This study addresses the core issue from within the aftermath of the COVID-19 pandemic. It provides new important information regarding the structure of a sustainable green financial environment that is useful for economists, financial analysts, commercial and central bankers, accountants and finance managers from the organization's public/and private sectors, local and international community, and researchers of the domain. It provides an informative structural model and classification of critical aftershocks. There are specific data/methodological/resource-related limitations of the study. The study's data are collected from a focus group; the study's methodology is qualitative and indicates relations among variables that do not quantify the associations. The study is a typical initiative of academic researchers with limited financial/physical resources; therefore, the generalizability of the study results is accordingly limited. The study is based on original, essential data and innovatively and creatively approaches the problem. It provides a unique model of an unprecedented phenomenon for reverberating the sustainable green financial environment.

**Keywords** Sustainable green financial environment · Monetary · Seismic · Aftershocks of the COVID-19 pandemic · ISM · MICMAC

## Introduction

Financial sustainability and stability are vital indicators of a country's robust economic environment. It supports the economies to absorb the tremors of global economic, financial, or pandemic crises. The recent years have seen tremendous distress in global economies due to the COVID-19 pandemic. Rarely, any country in the world can claim to be safe from the economic aftershocks of this pandemic. The

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emerging economies have been hit harder by this pandemic. In addition to the suspension of local economic activities, the decrease in international demand and travel has put a lot of pressure on the economies (Usman and Balsalobre-Lorente 2022; Yang et al. 2021; Narayan et al., 2021). It has become imperative to have a well-structured financial policy that can help in minimizing these adversities (Usman and Makhdom 2021; Denysov et al., 2021). The present study aims to develop an underlying structure focusing on reverberating the sustainable green financial environment. A green financial environment envisages the allocation of financial resources and capital to industries emitting lesser pollution and concentrating on green financial products. Hence, it can achieve economic benefits and environmental sustainability (He et al., 2019; Wang and Zhi, 2016; Usman et al. 2022; Abbass et al. 2021a; Ramzan et al. 2022; Yang et al. 2022; Zhu et al., 2018). While different countries worldwide take measures to revive their economies, Pakistan is no exception.

In 2019, Pakistan's GDP was 3.3%, with positive improvements till the start of 2020, but the outburst of COVID-19 shook its economy adversely. The lockdowns in provinces, halt of economic activities and international travel, and closing of educational institutions worsened the condition (Asghar et al., 2020; Narayan et al., 2021). The spillover effects of shaking the global economy also contribute to slow economic progression in Pakistan (Shahzad et al., 2021). A loss of approximately 1.3\$ trillion to the economy is estimated, which may arise into an exceptional figure later on (Asghar et al., 2020). Though the lockdown in Pakistan was relatively shorter than in other countries, the pandemic has hit its economy very hard (Ashfaq and Bashir, 2020). The government of Pakistan is taking extensive measures to revive the economy by introducing the Ehsaas Program, green stimulus project, and different fiscal policies by the central bank of Pakistan (Abbass et al. 2022a, b; Monetary Policy Statement, 2020; Ashfaq and Bashir, 2020). But the magnitude of the loss faced by the economy is so large that all these measures are considered inefficient in the wake of this pandemic. To counter these effects, it is inevitable to assess a financial environment to stop economic tumbling. Therefore, this study explores the factors that can help out a sustainable green financial environment in Pakistan during the turbulent period. The research objectives of this study are to (i) explore monetary seismic aftershocks post-COVID-19 scenario to improve the green financial environment, (ii) to develop a hierarchy of these factors, (iii) to classify them based on their driving and dependence, (iv) to develop an underlying structure of factors of monetary seismic aftershocks, and (v) to discuss the structure qua reality. This study attempts to answer questions relating to the factors that need to be given importance to having a sustainable financial environment and establishing

a contextual relationship among these factors. To achieve these research objectives, various methodological techniques (Huang et al. 2022; Balsalobre-Lorente 2022; Ali et al. 2022; Rashid et al., 2021) and interpretive structural modeling (ISM) combined with Matrices' Impacts Cruise's Multiplication Appliquée a UN Classement (MICMAC) are the most suitable for this study. These techniques are helpful in the qualitative analysis of complex interdependent relations using limited data. ISM is used to analyze these complex relations and represent them in structured models with well-defined graphical presentations (Li et al. 2019; Mureshed et al. 2021; Begum et al. 2022; Abbass et al. 2022c, d; Warfield, 1973). It can convert mental models to binary and later to graphical ones. ISM with MICMAC is often used in various researches because it is simple and outperforms statistical and other mathematical techniques. MICMAC verifies the results of ISM and provides a classification diagram based on their driving dependence using scale-/data-centric approaches. The remaining paper is structured in four sections: Literature review; Research design; Analysis, results and discussion; and conclusion.

## Literature review

Reviewing the heap of the available literature is not out of context to establish the research background and avoid reinventing the wheel. Extensive literature is checked, and the most relevant studies are reported here. Many scholars have explored the sustainability of a green financial environment in the recent past. But since the focus of this study is on the monetary seismic aftershocks of the COVID-19 pandemic, we are focused on referring to appropriate, very recent studies only. The literature is searched using Google as a search engine while exploring various databases like ScienceDirect, Taylor & Francis, JSTOR, Emerald, EBSCOhost, and Wiley-Blackwell. Keeping in view the context of the study, we focused on studies published after June 2020 to January 2022 on the subject of financial management, viz., financial development, remittance, and poverty reduction, in Sub-Saharan Africa, post-COVID-19 macroeconomic policies (Acheampong et al., 2021), comparison of the G20 countries' stock market in the pre-COVID-19 and post-COVID-19 pandemic (Alqahtani et al., 2021), and examining the determinants of financial well-being and general well-being during COVID-19 pandemic; the case of Sweden (Barrafrem et al., 2021), role of environmental, social, and governance (ESG) during the COVID-19 pandemic time of financial crises in China (Ahmad et al. 2021; Broadstock et al., 2021), financial distress among Spanish hospitality firms during the COVID-19 disaster (Crespí-Cladera et al., 2021), and financial fragility in COVID-19 outbreak; in the case of investment funds in the USA (Falato et al., 2021), examine the financial health of

Latin American (Giordano et al., 2021), use of IT systems in financial services during the COVID-19 pandemic in Poland (Halina & Magdalena, 2021), and impact of the COVID-19 pandemic on the connectedness of Hong Kong financial market (So et al., 2021), and loss of financial well-being, survey carried to 1,222 Brazilians (Vieira et al., 2021). It is impossible to delineate every study available on the topic. However, the most relevant ones are reported here.

Akhtaruzzaman et al. (2021) analyzed financial contagion between China and G7 countries during the COVID-19 outbreak and listed firms (both financial and non-financial) across these countries. They bolstered that optimal hedge ratios significantly increase in most cases. They experience a substantial upsurge in a conditional correlation between their stock returns. Chhatwani and Mishra (2021) investigated the linkage between financial fragility and financial optimism during COVID-19. They affirmed that financial fragility harms financial optimism that could be minimized through financial literacy (playing the moderator). Feyen et al. (2021) analyzed the determinants of responsiveness of policymakers in developing economies and emerging markets during the COVID-19 pandemic across 155 jurisdictions and introduced a policy classification framework and a new global database. Rao et al. (2021) carried out a comprehensive study to document eighteen empirical studies on COVID-19 and financial markets to examining pandemics' contagious effect. Singh et al. (2021) examined the response of stock market returns and the policy interventions of China and Russia during the COVID-19 pandemic. They found that policy interventions were effective in China but failed in Russia. Wei and Han (2021) gathered data from 37 countries facing severe pandemics to estimate

the effect of the COVID-19 pandemic on the transmission of monetary policy to financial markets (such as stock, government bonds, credit default swaps, and exchange rates). The results asserted that the COVID-19 pandemic significantly weakened the financial market transmission policy. Wolfe and Patel (2021) collected data from 4,806 participants of the UK population directly affected by COVID-19. They examined the relationship between financial worries and well-being among self-employed during the COVID-19 pandemic. They revealed that a fall in income (higher than expectation) mediates the association between happiness and self-employment. Abuzayed et al. (2021) and Wang, Li, and Huang et al. (2020) critically investigated the volatility spillovers and their time–frequency dynamics among major international financial markets during the COVID-19 pandemic. Zaremba et al. (2021) examined the 67 equity markets worldwide during the COVID-19 pandemic to determine a country's financial immunity. They further argued that the stock market in countries having conservative investment policies, low unemployment rates, and low valuations (relative to expected profit) tends to be more immune to crises. The extensive literature review has helped authors state the absence of studies available to address the issue of having a sustainable green financial environment in a post-COVID-19 scenario. It has also helped in identifying a list of factors of monetary seismic aftershocks that can be used to regain a sustainable green financial environment (Table 1).

The aftershocks extracted from the literature (Table 1) were presented to a panel of experts for verification using the majority approval method. The same was verified and approved as important, relevant, and representative of reverberating green financial management.

**Table 1** List of monetary seismic aftershocks of COVID-19

Sr	Aftershocks	References
1	More cash in hand required	Zhu, Lin, Deng, Chen, & Chevallier (2021)
2	Higher costs of health/cleanliness/safety	Clark et al. (2021)
3	Costs of changed office use/design	Shibata (2021)
4	High fees for assistance regarding SOPs	Suggested by experts
5	More office space required	Halina & Magdalena (2021)
6	Increase in cost of wellness programs	Wolfe and Patel (2021)
7	Increased technology costs	Bogdan et al. (2021); Wang et al. (2021)
8	Decreased travel costs	Stone et al. (2021)
9	Increased insurance premiums	Maiti et al. (2021)
10	Higher levels of inventories required	Suggested by experts
11	Shift to more certain or fixed revenue streams	Li, Li, Wei, Bai, Wei, & Liang (2021)
12	Lower rent costs	Shibata (2021)
13	More zealous monitoring of cash collection cycle	Bhar & Malliaris (2021)
14	Increased taxes	Zhang et al. (2021)
15	Tedious regulations	Bhar & Malliaris (2021); Kaneda et al. (2021)
16	More downtime due to pandemic alerts	Guo et al. (2021); Talwar et al. (2021)
17	Decreased entertainment costs	Yost et al. (2021)

## Research design

The research philosophy used here is interpretivism with an inductive research approach. The study is qualitative and is built upon primary data. The study population is folks of stakeholders (i.e., economists, financial analysts, banks and bankers, central banks, accountants and finance managers from the organizations of public/private sectors, local and international community at large, and researchers of the domain). The sample is chosen based on non-probability purposive sampling, while the piece's size depends on the standards of a homogenous/heterogeneous panel of experts available for qualitative studies (Li et al. 2019; Shaukat et al., 2021). The panel is heterogeneous, consisting of fifteen experts from academia and industry (Li et al. 2019; Shaukat et al., 2021). A matrix type questionnaire (VAXO) is used to elicit data from the experts on the panel using  $\frac{n(n-1)}{2}$  matrix (Shaukat et al., 2021). Various methods like Delphi, questionnaire, brainstorming, problem-solving group session, in-depth discussion, one-to-one, face-to-face, approval voting on alternatives/elect alternatives, triadic sorting task approach, and idea generation exercise are commonly used to extract data (Abbass et al. 2021b; Basit et al., 2021). This study uses face-to-face in-depth interviews to collect data on a questionnaire that uses VAXO symbols for every pair of relations. There is also a multitude of different methods for identifying the factors relating to a system under study, like literature review (Ali et al., 2018); case study (Li et al. 2019); expert opinion (Niazi et al., 2019); E.F.A. (Li & Yang, 2014); Delphi method (Bhosale & Kant, 2016); presumed by authors (Lohaus & Habermann, 2019); and idea engineering workshop and brainstorming session (Kumar et al., 2013). The exploration of literature review and experts' opinions is used to identify factors in this study (Abbass et al., 2021c). In a nutshell, the study uses a review of literature techniques to identify monetary seismic aftershocks of COVID-19, the ISM method for hierarchizing and structuring the relations, and MICMAC analysis for classification. The study is built on basic concepts of Boolean algebra, set theory, and directed graph theory; therefore, it does not require a prior approach; instead, it is theory-building research.

## Panel of experts

It is common to use a panel of experts if data regarding the issue under study is nonexistent, limited, unreliable, or expensive. The data relating to this study, particularly how experts consider a sustainable financial environment can regain post-COVID-19 shocks, is not readily available.

This highlights the importance of using the opinion of experts from within the stakeholders of the financial sector. The quality and reliability of data provided by experts are more valuable, valid, and meaningful than that of statistical (Voinea et al. 2020; Niazi et al., 2019). As per Warfield (1974), a panel of fifteen to twenty-five can give optimum results. The size of the panel varies with the nature of the study. For qualitative studies, the panel of experts may range from 5 to 25 experts, i.e., for homogenous 15–25 and heterogeneous 5–12 experts (Li et al. 2019; Shaukat et al., 2021). This study uses a panel comprising fifteen experts that suffice to provide reliable results. The experts on the panel are recruited based on their theoretical knowledge and relevant finance-related practical experience of at least 10 years (Annexure II). The panel consists of seven PhDs in finance from public sector universities of Pakistan, one financial management consultant, one group head finance, one senior auditor, two directors of finance, one chartered accountant, one head of corporate finance, and one manager of accounts & finance. The experience of experts ranges from 13 to 30 years of practical experience, giving them more credibility in providing the answers relevant to the study. The experts approached three times during the period of the study. Firstly, they came to them to develop rapport and briefing about the nature and purpose of the study and approval voting on the inclusion of factors in the final questionnaire. Secondly, they were reached in a field setting for one-to-one interviews to elicit data. Thirdly, they contacted experts for review and theoretical, logical, and conceptual verification of the model. This whole exercise took approximately 3 months. Each expert provided data separately on paired relations of factors on  $\frac{n(n-1)}{2}$  matrix ( $ij$  part of the questionnaire). For data extraction, VAXO symbols are used. The questionnaire (Annexure I) contained the instructions to fill in the questionnaire. The responses for each factor were accumulated using mode.

## Analysis, results, and discussion

### Interpretive structural modeling

For structural modeling, the classical procedure of ISM, as developed by Warfield (1973), is followed. The expert data is aggregated in structural self-interaction matrix (SSIM) (Table 2).

The standard rules devised by Warfield (1973) and used by Niazi et al. (2020) are employed to transform SSIM into a binary matrix (Table 3).

All 0s in the direct reachability matrix are checked for transitivity on a scientific basis using MS Excel. Transitive relations are incorporated into the reachability matrix

**Table 2** Structural self-interaction matrix (SSIM)

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		A	A	A	O	A	A	O	A	A	O	O	X	A	O	A	O
2			O	O	O	O	O	O	X	O	O	O	O	O	X	O	O
3				O	X	O	X	O	O	O	O	O	O	O	O	O	O
4					O	X	O	O	O	O	O	O	O	O	A	V	O
5						O	O	O	O	O	O	O	O	O	O	O	O
6							O	O	V	O	O	O	O	O	O	O	O
7								V	O	O	O	O	O	V	O	A	O
8									O	O	O	O	O	O	O	A	O
9										V	O	O	O	O	A	O	O
10											V	O	V	V	O	A	O
11												O	O	O	O	O	O
12													O	O	O	O	O
13														O	O	O	O
14															O	O	O
15																V	O
16																	V
17																	

and obtained into a transitive binary matrix (Table 4). The transitive relations are distinguished by 1\*.

The transitive binary matrix is apportioned using the iteration method (Warfield, 1973). The permutation method developed by Warfield (1973) is used to prepare a conical matrix Table 5. The gray cells on diagonals specify the extraction of the ISM model.

Abridged representation of ISM is reported here (Table 6) for conciseness.

An ISM model, i.e., directed graph (Fig. 1), is built using level partitioning achieved due to iterations.

The ISM model shows that the monetary aftershocks coded as 1, 8, 11, 12, 13, and 17 occupy *level I*. Accordingly, 5 and 14 occupy *level II*; 3, 7, and 10 occupy *level III*; 9 and 16 occupy *level IV*; 4 occupy *level V*; 2 occupy *level VII*; 6 occupy *level VII*; and 15 occupy *level VIII*. Apart from the inherited level-to-level relationships, there are at-level relations, i.e., two-way relations between 3 and 7 at *level III* and two-way relations between 1 and 13 at *level I*. However, there are no other at-level relationships among the factors.

## MICMAC analysis

Using the MICMAC procedure developed by Godet (1986), the transitive binary matrix (Table 4) is used to construct a driving-dependence diagram (Fig. 2) by applying a scale-centric approach.

The results of MICMAC, as represented in Fig. 2, show that monetary seismic aftershocks coded as 4, 15, and 16 are categorized as *independent*. Monetary seismic aftershocks coded as 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, and 17 are categorized as *autonomous*. No monetary seismic aftershock is categorized as *linkage*. Monetary seismic aftershocks coded as 1 and 13 are categorized as *dependent*.

## Results

Like all other pseudo-natural systems, the financial systems are also shaken by the COVID-19 pandemic. It has become the day's call to reverberate the financial systems and assess the same as an aftershock of the COVID-19 pandemic. We applied literature discourse to recognize the importance and



**Table 3** Binary matrix (direct reachability)

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
3	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
4	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0
5	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0
7	1	0	1	0	0	0	1	1	0	0	0	0	0	1	0	0	0
8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
10	1	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0
11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
13	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
14	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
15	0	1	0	1	0	0	0	0	1	0	0	0	0	0	1	1	0
16	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	1
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

intend to evaluate reverberating the sustainable green financial environment by exploring the underlying structure of monetary seismic aftershocks of COVID-19 ISM and MICMAC. Results of literature discourse revealed that there are seventeen critical monetary seismic aftershocks of COVID-19. Results of ISM show that the monetary aftershocks, namely, “more cash in hand required (1),” “decreased travel costs (8),” “shift to more certain or fixed revenue streams (11),” “lower rent costs (12),” “more zealous monitoring of cash collection cycle (13),” and “decreased entertainment costs (17)” occupy *level I*. Accordingly, “more office space required (5)” and “increased taxes (14)” occupy *level II*; “costs of changed office use/design (3),” “increased technology costs (7),” and “higher levels of inventories required (10)” occupy *level III*; “increased insurance premiums (9)” and “more downtime due to pandemic alerts (16)” occupy *level IV*; “high fees for assistance regarding SOPs (4)” occupy *level V*; “higher costs of health/cleanliness/safety (2)” occupy *level VI*; “increase in the cost of

wellness programs (6)” occupies *level VII*; and “tedious regulations (15)” occupy *level VIII*. Analysis of MICMAC shows that monetary seismic aftershocks high fees for assistance regarding SOPs (4), tedious regulations (15), and more downtime due to pandemic alerts (16) are categorized as *independent*. Monetary seismic aftershocks “higher costs of health/cleanliness/safety (2),” “costs of changed office use/design (3),” “more office space required (5),” “increase in cost of wellness programs (6),” “increased technology costs (7),” “decreased travel costs (8),” “increased insurance premiums (9),” “higher levels of inventories required (10),” “shift to more certain or fixed revenue streams (11),” “lower rent costs (12),” “increased taxes (14),” and “decreased entertainment costs (17)” are categorized as *autonomous*. No monetary seismic aftershock is categorized as *linkage*. Monetary seismic aftershocks more cash in hand required (1) and more zealous monitoring of cash collection cycle (13) are categorized as *dependent*. The results of both ISM and MICMAC are summarized in Table 7.

**Table 4** Transitive binary matrix

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Driving
1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
2	1	1	0	1*	0	0	0	0	1	1*	0	0	1*	0	1	1*	0	8
3	1	0	1	0	1	0	1	1*	0	0	0	0	1*	1*	0	0	0	7
4	1	0	0	1	0	1	1*	1*	1*	1*	0	0	1*	0	0	1	1*	10
5	1*	0	1	0	1	0	1*	0	0	0	0	0	0	0	0	0	0	4
6	1	1*	0	1	0	1	0	0	1	1*	0	0	1*	0	0	1*	0	8
7	1	0	1	0	1*	0	1	1	0	0	0	0	1*	1	0	0	0	7
8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
9	1	1	0	0	0	0	0	0	1	1	1*	0	1*	1*	1*	0	0	8
10	1	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	5
11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
13	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
14	1	0	0	0	0	0	0	0	0	0	0	0	1*	1	0	0	0	3
15	1*	1	0	1	0	1*	1*	1*	1	1*	0	0	0	0	1	1	1*	11
16	1	0	1*	0	0	0	1	1	0	1	1*	0	1*	1*	0	1	1	10
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
<b>Dependence</b>	<b>13</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>7</b>	<b>4</b>	<b>1</b>	<b>11</b>	<b>6</b>	<b>3</b>	<b>5</b>	<b>4</b>	

Table 7 shows factor 15, namely, tedious regulations, as a critical factor requiring utmost consideration by policymakers and authorities.

**Discussion**

With the main objective of analyzing the underlying structure of monetary seismic aftershocks of COVID-19 and applying ISM and MICMAC to the collected data, it is important to discuss the results in reality. Discussion is divided into five parts: discussion on results of the study, discussion on contrasting the study with contemporary literature, debate on implications of the study, discussion on limitations of the research, and discussion on recommendations for future research to overcome limitations of the current study.

i) *Discussion on results of the study:* the discussion on results is also sub-divided into three parts, i.e., discussion of results of literature, discussion on impacts of

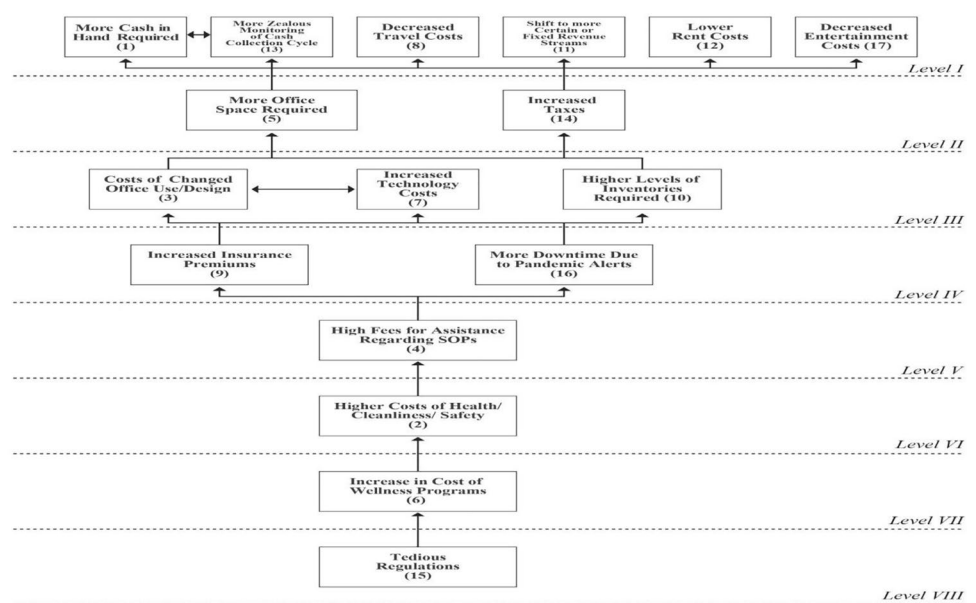
ISM, and discussion on impacts of MICMAC. Results of literature discourse revealed that there are seventeen critical monetary seismic aftershocks of COVID-19. Before embarking on the results of ISM, it is essential to understand the scheme of ISM modeling. ISM modeling follows bottom-to-top approach, according to which the binary matrices partitioned as a result of exploiting set theory are arranged according to different levels. The bottom tier is the factors appearing closer to the bottom level which are considered the most critical mainly while to be dealt with as a matter of policy. The factors that occupy the middle of the model and or moderators/mediators are less crucial relative to the bottom but more critical close to the top. The top of the model is considered to be the least critical.

ii) While building a model, transitive relations are ignored. Level-to-level relations are determined by level partitioning. In contrast, the relations among the factors at the level are determined by inspecting relevant sub-matrix appearing on a diagonal (marked as gray) in the

**Table 5** Conical matrix

Code	1	8	11	12	13	17	5	14	3	7	10	9	16	4	2	6	15
1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
5	1*	0	0	0	0	0	1	0	1	1*	0	0	0	0	0	0	0
14	1	0	0	0	1*	0	0	1	0	0	0	0	0	0	0	0	0
3	1	1*	0	0	1*	0	1	1*	1	1	0	0	0	0	0	0	0
7	1	1	0	0	1*	0	1*	1	1	1	0	0	0	0	0	0	0
10	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0
9	1	0	1*	0	1*	0	0	1*	0	0	1	1	0	0	1	0	1*
16	1	1	1*	0	1*	1	0	1*	1*	1	1	0	1	0	0	0	0
4	1	1*	0	0	1*	1*	0	0	0	1*	1*	1*	1	1	0	1	0
2	1	0	0	0	1*	0	0	0	0	0	1*	1	1*	1*	1	0	1
6	1	0	0	0	1*	0	0	0	0	0	1*	1	1*	1	1*	1	0
15	1*	1*	0	0	0	1*	0	0	0	1*	1*	1	1	1	1	1*	1

**Fig. 1** ISM model. Source: author’s constructed





**Table 6** Condensed representation of ISM

		Level	Code	1	8	11	12	13	17	5	14	3	7	10	9	16	4	2	6	15			
<b>Antecedent Sets</b>	<b>I</b>		<b>1</b>	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>2</b>	
			<b>8</b>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>1</b>
		<b>Level</b>	<b>11</b>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>1</b>
			<b>12</b>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>1</b>
			<b>13</b>	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>2</b>
		<b>17</b>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	<b>1</b>	
		<b>Level</b>	<b>5</b>	1*	0	0	0	0	0	1	0	1	1*	0	0	0	0	0	0	0	0	0	<b>4</b>
		<b>II</b>	<b>14</b>	1	0	0	0	1*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	<b>3</b>
			<b>3</b>	1	1*	0	0	1*	0	1	1*	1	1	0	0	0	0	0	0	0	0	0	<b>7</b>
		<b>Level</b>	<b>7</b>	1	1	0	0	1*	0	1*	1	1	1	0	0	0	0	0	0	0	0	0	<b>7</b>
		<b>III</b>	<b>10</b>	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	<b>5</b>
		<b>Level</b>	<b>9</b>	1	0	1*	0	1*	0	0	1*	0	0	1	1	0	0	1	0	1*	0	0	<b>8</b>
		<b>IV</b>	<b>16</b>	1	1	1*	0	1*	1	0	1*	1*	1	1	0	1	0	0	0	0	0	0	<b>10</b>
		<b>Level</b>	<b>4</b>	1	1*	0	0	1*	1*	0	0	0	1*	1*	1*	1	1	0	1	0	0	0	<b>10</b>
		<b>V</b>	<b>2</b>	1	0	0	0	1*	0	0	0	0	0	1*	1	1*	1*	1	0	1	0	1	<b>8</b>
		<b>Level</b>	<b>6</b>	1	0	0	0	1*	0	0	0	0	0	1*	1	1*	1	1*	1	1*	1	0	<b>8</b>
	<b>VI</b>	<b>15</b>	1*	1*	0	0	0	1*	0	0	0	1*	1*	1	1	1	1	1	1*	1	1	<b>11</b>	
	<b>Level</b>	<b>13</b>	<b>6</b>	<b>4</b>	<b>1</b>	<b>11</b>	<b>4</b>	<b>3</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>7</b>	<b>5</b>	<b>5</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>3</b>				

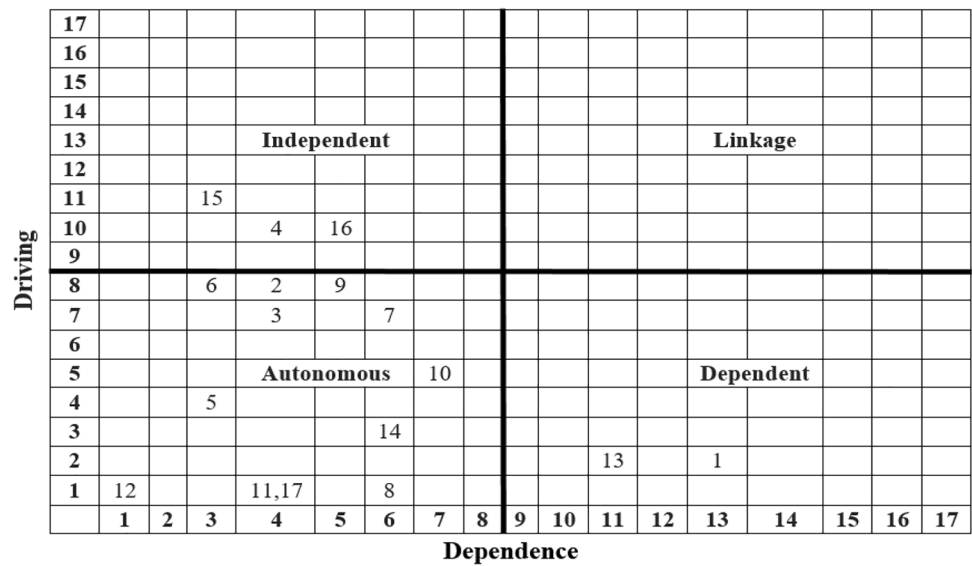
conical matrix. MICMAC is a structural analysis of elements of any system using the multiplicative properties of Boolean algebra; it classifies the elements into four important clusters. The most crucial cluster is called independent, and the factors that fall in this cluster have high driving power but less dependence power. They can drive the other factors and hence are considered critical factors to the system. The second cluster is called the dependent cluster.

- iii) The factors that fall in this cluster have high dependence power but low driving power; hence, they are driven by the other factors and considered less critical for the system. Instead, they are considered to be the outcome of the system. The third cluster is linkage. The characteristics that fall in the linkage cluster have high driving power

and, at the same time, high dependence power. They are ambivalent, agile, unbalanced, or unsettled. Any action on them may affect them, other factors, and intern as a loop. Therefore, more care is required to deal with these types of elements. The fourth cluster is autonomous. The characteristics that fall in autonomous groups have low driving and low dependence power and are considered disconnected from the system and should ideally be eliminated from the analysis. Still, their presence is evidence of their few but strong links with the system.

Therefore, the results of ISM and the effects of MICMAC should be interpreted and understood in light of the discussion mentioned above. The results of MICMAC corroborate the results of ISM.

**Fig. 2** Driving-dependence diagram. Source: author’s constructed



**Table 7** Results juxtaposed

Result of literature review	Results of MICMAC analysis	Results of ISM	Comments
Code	Issue	Driving Dependence Effectiveness Cluster Level	
1	More cash in hand Required	2 13 -11 Dependent I	
2	Higher costs of health/cleanliness/safety	8 4 4 Autonomous VI	
3	Costs of changed office use/design	7 4 3 Autonomous III	
4	Increased fees for assistance regarding SOPs	10 4 6 Independent V	
5	More office space required	4 3 1 Autonomous II	
6	Increase in cost of wellness programs	8 3 5 Autonomous VII	
7	Increased technology costs	7 6 1 Autonomous III	
8	Decreased travel costs	1 6 -5 Autonomous I	
9	Increased insurance premiums	8 5 3 Autonomous IV	
10	Higher levels of inventories required	5 7 -2 Autonomous III	
11	Shift to more certain or fixed revenue streams	1 4 -3 Autonomous I	
12	Lower rent costs	1 1 0 Autonomous I	
13	More zealous monitoring of cash collection cycle	2 11 -9 Dependent I	
14	Increased taxes	3 6 -3 Autonomous II	
15	Tedious regulations	11 3 8 Independent VIII	Key factor
16	More downtime due to pandemic alerts	10 5 5 Independent IV	
17	Decreased entertainment costs	1 4 -3 Autonomous I	

iv) *Discussion on contrasting the study with contemporary literature:* from the literature review, there is a shortage of studies addressing this phenomenon, particularly in the post-COVID-19 scenario. Many researchers have neither identified nor analyzed many variables, even though it is one of the fundamental problems. Therefore, this study is different in terms of variables, methodology of the modeling, and analysis technique. However,

the results can generally be contrasted with some of the studies, viz., Table 8.

Chhatwani and Mishra (2021) analyzed the linkage between financial fragility and financial optimism during COVID-19 using regression. They found that financial fragility harms financial optimism that could be minimized through financial literacy (playing the role of a moderator).

**Table 8** Comparison of the present study with prior studies

Sr	Studies	Focus	Variables	Methodology	Results
1	Current	A structural model of monetary seismic aftershocks of COVID-19: reverberating the financial management	17	ISM and MICMAC	Tedious regulations are the most critical factor
2	Chhatwani and Mishra (2021)	Investigated the linkage between financial fragility and financial optimism during COVID-19	4	Regression	Financial fragility harms financial optimism that could be minimized through financial literacy (playing the role of a moderator)
3	Feyen et al. (2021)	Analyzed the determinants of responsiveness of policymakers in developing economies and emerging markets during the COVID-19 pandemic	18	Kaplan–Meier (KM) survival curve estimates and Cox proportional hazards regression	The study proposed a policy classification framework & a new global database for developing economies across 155 jurisdictions
4	Singh et al. (2021)	Examined the response of stock market returns and the policy interventions of China and Russia during the COVID-19 pandemic period		Event study methodology alongside DCC-GARCH and Markov regime switching (MR.) models	The study concluded that policy interventions were effective in China but failed in Russia
5	Wolfe and Patel (2021)	Assessed the relationship between financial worries and well-being among self-employed during the COVID-19 pandemic	12	The survey, ordinary least squares	The study found that a fall in income (higher than expectation) mediates the association between happiness and self-employment

Feyen et al. (2021) investigated the determinants of responsiveness of policymakers in developing economies and emerging markets during the COVID-19 pandemic using Kaplan–Meier (KM) survival curve estimates and Cox proportional hazards regression. They concluded that the study proposed a policy classification framework and a new global database for developing economies across 155 jurisdictions. Singh et al. (2021) examined the response of stock market returns and the policy interventions of China and Russia during the COVID-19 pandemic period using event study methodology alongside DCC-GARCH and Markov regime switching (MRS) models, and the study concluded that policy interventions were effective in China but failed in Russia. Wolfe and Patel (2021) analyzed the relationship between financial worries and well-being among self-employed during the COVID-19 pandemic using survey and ordinary least squares, and the study results found a fall in income (higher than expectation) mediates the association between happiness and self-employment. Though these studies are relevant to the issue of the study, none of them approached the matter comprehensively and more straightforwardly as the current research approached it. Therefore, it is only fair to claim that the investigation is different from the contemporary literature and adds some new valuable information.

- v) *Discussion on implications of the study*: it is also divided into two parts, i.e., practical implication and theoretical. Practical implications of the study are discussed stakeholder-wise. The study provides insights, new information, and a framework for analysis for financial analysts. It also sets priorities for policymakers and bankers. It extends practical frontiers of knowledge for economists and the local/international community. The study also shares many information and priorities in decision-making for financial managers and accountants. Lastly, the study has developed a new framework for researchers for building future research. Theoretical implications of the study include a structural model of relations indicative of independent, dependent, and mediating or moderating variables in the first- and second-order proper for theorists/empiricists.
- vi) *Discussion on limitations of the study*: limitations of the study may be discussed from three different angles, i.e., methodological limitations, data limitations, and resources constraints. As for methodology is concerned, firstly, it is a qualitative methodology used with an inductive approach that uses elementary concepts of Boolean algebra, set theory, and directed graph theory;

therefore, analytical strength is accordingly limited. Secondly, the ISM method answers the question what is related to what and does not quantify the relations, does not tell the cause, and does not tell the pole of the relationship. Thirdly, while constructing the ISM model, transitive links are removed and ignored for simplification. Fourthly, the responses are aggregated using the majority rule (statistically saying mode value) instead of consensus. As far as data limitations are concerned, firstly, the data is collected from a medium-sized panel of experts from Pakistan only. Secondly, the matrix type questionnaire used for data collection contains quite some pairs, a complicated questionnaire with the chance of stereotyping. Thirdly, a list of barriers is generated from a review of a limited number of studies which is not claimed as exhaustive, and there may be some other barriers that would have been included. Fourthly, the data have been collected using bi-valence (0, 1) that ignores fuzzy values. Fifthly, the data have been collected from Pakistani experts; therefore, the generalization of results is accordingly limited. As for as limitations of resources are concerned, firstly, it is contained in minimal time by the researcher professors by profession having a lot of job commitments. Secondly, this is an independent research and a non-funded study; therefore, it was constrained accordingly.

- vii) *Discussion on recommendations for future research to overcome limitations of the current study*: this section formulates recommendations for future researchers to overcome the limits above and enhance the frontiers of findings of the study. It is recommended that future studies should use advanced quantitative methodologies like SEM, GMM, and wavelet analysis to overcome the limitation of qualitative methods. T-ISM, modified T-ISM, polarized T-ISM, etc. can also overcome the limitations of quantification, cause, pole, etc. Future studies can also use T-ISM, modified T-ISM, and polarized T-ISM and include some essential transitive links to overcome the limitation of removing transitive relations. Delphi method or some other method should be used to create a consensus to overcome the limitations of majority rule. Upcoming studies should constitute the optimum size of a panel consisting of highly expert persons from some educationally and technologically advanced country to justify the limitation of panel size, expertise of the experts on board, and context of the study. The logic-knowledge-based questionnaire can be used to overcome the limits of the matrix questionnaire. Future researchers can prepare an exhaustive list of barriers through a relatively thorough literature review to include all possible obstacles and design the studies using fuzzy-ISM/fuzzy-T-ISM/fuzzy-MICMAC etc. to construct a rather refined model and design-funded research study of international

level envisaged over a reasonable period and with the support of global institutions because it is an issue of international concern.

The study contributed to literature (i) a verified/refined list of barriers to address cyber security challenges, (ii) ISM model, (iii) MICMAC diagram, (iv) information on the driving/dependence power of each barrier (i.e., intra-model relationships), and (v) discussion on model/analysis qua reality contrasting with contemporary literature.

## Conclusion

This study attempts to answer questions relating to the factors that need to be given importance to having a sustainable financial environment and establishing a contextual relationship among these factors. The study aims to reverberate the sustainable green financial environment by exploring the underlying structure of monetary seismic aftershocks of COVID-19. The study reviews literature techniques to identify monetary seismic aftershocks of COVID-19, the ISM method for hierarchizing and structuring the relations, and MICMAC analysis for classification. Results of literature discourse revealed that there are seventeen critical monetary seismic aftershocks of COVID-19. The monetary aftershocks coded as 1, 8, 11, 12, 13, and 17 occupy *level I*. Accordingly, 5 and 14 occupy *level II*; 3, 7, and 10 occupy *level III*; 9 and 16 occupy *level IV*; 4 occupy *level V*; 2 occupy *level VII*; 6 occupy *level VII*; and 15 occupy *level VIII*. Monetary seismic aftershocks coded as 4, 15, and 16 are *independent*. Monetary seismic aftershock codes as 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, and 17 are *autonomous*. No monetary seismic aftershock is categorized as *linkage*. Monetary seismic aftershocks coded as 1 and 13 are classified as *dependent*. In *N* nutshell, monetary aftershocks, namely, “more cash in hand required,” “decreased travel costs,” “shift to more certain or fixed revenue streams,” “lower rent costs,” “more zealous monitoring of cash collection cycle,” and “decreased entertainment costs,” occupy *level I* (top of the model being least critical shocks), and “tedious regulations” occupy *level VIII* (bottom of the model being the most critical). Other aftershocks form the middle of the model being moderate critical. Analysis of MICMAC shows that monetary seismic aftershocks high fees for assistance regarding SOPs, tedious regulations, and more downtime due to pandemic alerts are independent.

**Author contribution** The idea of the original draft belongs to Weiqiong Fu and Hanxiao Zhang. Dr. Abdul Basit and Dr. Tehmina Fiaz Qazi write the Introduction, Literature review, and Empirical outcomes

sections. Dr. Weiqiong Fu and Dr. Tehmina Fiaz Qazi helped collect and visualize data of the observed variables. Dr. Kashif Abbass and Dr. Abdul Aziz Khan Niazi constructed the methodology section in the study. All the authors read and approved the final manuscript.

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**Data availability** Available upon request.

## Declarations

**Ethics approval and consent to participate** We confirmed that this manuscript has not been published elsewhere and is not under consideration by another journal. Ethical approval and informed consent are not applicable for this study.

**Consent for publication** Not applicable.

**Competing interests** The authors declare no competing interests.

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