International Journal of Applied Economics, Finance and Accounting
ISSN 2577-767X
Vol. 18, No. 2, pp. 351-360
2024
DOI: 10.33094/ijaefa.v18i2.1400

The mediating effect of the COVID-19 pandemic on heuristic techniques and cognitive biases on investment decision-making

Williams Kwasi Peprah[1*]
Christopher Ampadu Kwakwah-Oppong[2]
Francis Osei-Kuffour[3]
Lenny Leorina Evinita[4]

[1,2]*Department of Accounting, Economics and Finance, Andrews University, Berrien Spring, Michigan State, USA.*
[1]*Email: peprah@andrews.edu*
[2]*Email: ampadukwakw@andrews.edu*
[3]*School of Business, Valley View University, Ghana.*
[3]*Email: fkuffour@vvu.edu.gh*
[4]*Faculty of Economics, Universitas Negeri Manado, Indonesia.*
[4]*Email: lennyevinita@unima.ac.id*

Keywords:
Behavioral finance
Cognitive biases
COVID-19 pandemic
Heuristics techniques
Investment decision-making.

JEL Classification:
E44; E71; G11; G41.

Received: *14 November 2023*
Revised: *19 January 2024*
Accepted: *12 February 2024*
Published: *23 February 2024*
(Corresponding Author)*

Abstract

US investors' behavioral finance and investment decision-making approach became a concern during the COVID-19 pandemic era as the capital market crashed. The study used mediation analysis to explain how or why the COVID-19 pandemic intervened in the causal association of behavioral finance concepts of heuristic techniques and cognitive biases on their investment decision-making. This causal research design study was based on 500 snowball-sampled US investors who answered self-constructed, validated, and reliability-tested Likert-scale quantitative variables measured through a first-party data collection approach. The results showed that the COVID-19 pandemic was a specific moderate to partial significant mediator on the low positive significant relationships between heuristic techniques and investment decision-making, and the COVID-19 pandemic was a specific moderate to full significant mediator on the low positive not significant relationships between cognitive biases and investment decision-making among US investors. From the point of view of behavioral finance, the COVID-19 pandemic situation clearly and significantly demonstrated how US investors used 75.6% heuristics techniques (calculated guesses based on prior knowledge) and 87.5% cognitive biases (unintentional errors in their worldview) to cause the crash of the capital market. These findings confirm the rational expectations theory.

Funding: This research is supported by the Office of Research and Creative Scholarship, Andrews University, Berrien Springs, Michigan, USA (Grant number: 11-2011-9430-75-201147).
Institutional Review Board Statement: The Ethical Committee of the Andrews University, Berrien Springs, Michigan, USA has granted approval for this study 7 December 2022 (Ref. No. 22-153).
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Data Availability Statement: The corresponding author may provide study data upon reasonable request.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Study conceptualization, designed the study, writing original draft, methodology, data curation, performed analysis, funding acquisition, W.K.P.; data collection, A.K.O.; methodology, writing- review and editing, F.O.K, and L.L.E. All authors have read and agreed to the published version of the manuscript.

1. Introduction

The uncertainty of the global economy due to the COVID-19 pandemic heightened the risk of investment (Haq, 2020; Viscusi, 2020). As a result, investors' decision-making is important to study in line with heuristic techniques and cognitive biases. The COVID-19 pandemic situation has led to further discussion on behavioral finance, which looks at individual investor behavior to shed light on why people do not often make the best financial decisions, suffer unfavorable outcomes from their choices, and perform poorly as investors. Could it

be that investors' psychological reactions to COVID-19 pandemic have had an impact on the capital market and revealed information about what motivates speculative tendencies, market anomalies, and extreme market crash scenarios? The social environment in which investors operate also shapes their sentiments, feelings, optimism, and pessimism regarding future stock prices (Goodell, Kumar, Rao, & Verma, 2023).

During the COVID-19 period, the stock markets experienced rapid volatility in response to investors' unpredictable emotions (Jan, Jain, Li, Sattar, & Tongkachok, 2022). Due to this situation, this paper explores the knowledge gap and seeks an explanation of how or why the COVID-19 pandemic influenced investors' investment decision-making as correlated to the existing heuristic techniques and cognitive biases.

Bisati, Ganai, and Gulzar (2021) posited that investors typically use behavioral heuristics to resolve their decision-making processes, which can result in solid investment decisions without utility maximization and systematic errors in judgment. Investment decisions matter. Some investment decisions are simple, while others are challenging and need a multi-step process. Instead of gathering data that might enable investors to make better decisions, they are said to base their decisions on their past experiences and intuition.

Furthermore, cognitive biases are systematic discrepancies between the right responses to a judgment task. It frequently bases decisions on just one trait or piece of information. Cognitive biases affect decision-making, and they are entrenched personal beliefs that help people make difficult decisions (Shah, Ahmad, & Mahmood, 2018; Zhang, Bij, & Song, 2020). Decision-makers use their mental shortcuts to act swiftly in difficult and complex circumstances. Bellé, Cantarelli, and Belardinelli (2018) claim that cognitive biases cause systemic errors to arise, which then lead to adverse outcomes.

Again, this study fills a methodological gap by adopting the mediation approach to enhance statistical understanding and application in investment behavioral research. The COVID-19 pandemic as a mediator explains the causal relationships between the independent variables (heuristic techniques and cognitive biases) and the dependent variable (investment decision-making). Mediation analysis has been popularized by psychological research by Abu-Bader and Jones (2021), like this research.

A correlational study by Jan et al. (2022) in China showed that availability bias had a negative and significant adverse consequence on investment decisions during the post-COVID-19 pandemic, whereas overconfidence, representational bias, and anchoring bias had significant and positive influences. The correlational results satisfy Baron and Kenny (1986) rule of thumb, which requires the association of the variables to be established before conducting a mediation analysis. It must be noted that the study by Jan et al. (2022) only focused on relationships and Chinese investors, and this study used investors in the United States of America to determine the mediating role of the COVID-19 pandemic on the association between heuristic techniques and cognitive biases on investment decision-making.

This study looked at how the COVID-19 pandemic explained the decision-making of investors when it comes to their heuristic and cognitive biases. The research questions for the study are stated below:

1. Does the COVID-19 pandemic mediate the relationship between heuristic techniques and investment decision-making?
2. Does the COVID-19 pandemic mediate the relationship between cognitive biases and investment decision-making?

The hull hypothesis:

1. *The COVID-19 pandemic does not mediate the relationship between heuristic techniques and investment decision-making.*
2. *The COVID-19 pandemic does not mediate the relationship between cognitive biases and investment decision-making.*

This research is anchored on behavioural finance, which is a school of thought that investigates how psychology affects the actions of investors and how this changes the stock market from a technical analysis and valuation point of view. Technical Analysis is based on price trends and patterns of charts to determine future price movements (Edwards, Magee, & Bassetti, 2018). Behavioral finance requires investors to act logically when given certain constraints, especially during the COVID-19 pandemic. Tversky and Kahneman (1974) introduced behavioral finance. They demonstrated how a person makes judgments about the likelihood of events depending on how quickly pertinent examples come to mind using cognitive biases and heuristics techniques. It frequently leads to systematic biases.

The study considered representativeness, anchoring, and availability as the heuristic techniques (Ayaa, Peprah, Mensah, Owusu-Sekyere, & Daniel, 2022). Heuristic technique is a method of problem-solving or self-discovery that makes a calculated guess based on prior knowledge (Zhang & Zhang, 2014). The use of heuristics reduces the cognitive strain involved in decision-making. Heuristic techniques mainly address generalizations and departures from logical calculation. Heuristic procedures have consequently come to be associated with irrationality and the inevitability of cognitive illusions.

Representativeness is comparing past events to the current situation (Dumm, Eckles, Nyce, & Volkman-Wise, 2020). It assumes the event will happen, even though it may not. Representativeness is an important heuristic strategy since it can produce more accurate results. Based on probabilities of situational resemblance, investors guess that the stock market may behave as an event in the past, and this affects their investment decision-making.

An anchoring heuristic is when an investor uses their initial point of reference to guide their actions (Madaan & Singh, 2019). By looking at a primary value or initial position and changing it until it fits the final decision. According to Owusu (2020), anchoring describes an irrational inclination towards a benchmark figure. This benchmark skews market participants' investment decisions. The concept of anchoring explains why, when selling or valuing equities on the stock market, investors give the initial purchase price such a high priority.

Yamashiro and Roediger III (2021) asserted that the availability heuristic deals with making investment decisions based on easily accessible facts or the influence of the most memorable or intense experiences on decision-making. A decision-maker decides based on existing information, not alternatives. Investors base their decisions on readily available information; hence, information pointing to uncommon events is given less weight. Richardson (2017) postulates that how recently and profoundly something has affected an individual will determine how easy it is for the individual to recall. This implies that current events are easier to consider while making decisions than ideas that are difficult to recall.

Cognitive bias is an unintentional error in thinking that affects how people view the world and make decisions (Shah et al., 2018). The perception of the world now is that the COVID-19 pandemic is affecting how investors are making their decisions. This study considers two common biases that influence investors' decision-making. These are overconfidence bias and the disposition effect presented by Ayaa et al. (2022).

Overconfidence bias overestimates intuitive reasoning, judgment, and cognitive abilities (Ahmad & Shah, 2020). These investors trade more and have negative, abnormal stock returns. According to Kansal and Singh (2018), overconfidence occurs when investors think they know more. Overconfidence bias is characterized by overestimation, over precision, and over placement (Vörös, 2020).

The disposition effect is an investor's tendency to sell a stock when prices rise and hold it when prices fall (Zahera & Bansal, 2019). Investors are always seeking to avoid regretful actions. It has been observed that some investors exited the stock market due to the COVID-19 pandemic leading to a fall in prices, while others were still holding onto their stocks. Trejos, Van Deemen, Rodríguez, and Gomez (2019) suggest that selling an appreciated asset validates the initial acquisition and creates pride.

A report by the Statista Research Department (2022) narrated that the world economy has been shaken by the coronavirus pandemic. Investor apprehension over what would happen next and how long the pandemic would last has a negative impact on the world financial markets. Uncertain economic conditions frequently lead to investors selling their stocks or delaying planned investments, and some of the most significant stock market indexes experienced substantial declines. Many investors' perspectives and behaviors changed because of the crisis's volatility. In 2020, as the pandemic continued, investors' confidence in the market's future began to wane. As a result of the uncertain future, a higher percentage of investors globally converted a significant portion of their portfolios to lower-risk assets or transferred them into cash, which was a clear indication of diminishing optimism. When the crisis became apparent, most investors made modifications to their portfolios. However, not all investors reacted in the same manner; some investors transferred some or a larger amount of their portfolio to higher-risk investments. Because more investors from the silent generation maintained the same level of risk in their portfolios despite the coronavirus outbreak than did millennials, younger investors appeared to respond to the crisis more strongly than older investors.

A study by Song, Hao, and Lu (2021) explored the influence of the COVID-19 pandemic on investor emotion in China's financial market between October 2019 and June 2020. The pandemic outbreak hurt investor sentiment. A prospective industry heterogeneity study demonstrated that the pandemic had boosted pharmaceutical investor confidence while hurting non-pharmaceutical sectors. The pandemic had a negative influence on China's private and foreign-invested sectors, leading to stock market decline.

Bradley and Stumpner (2020) reported that before the COVID-19 pandemic broke out, the stock market reached its zenith, which precipitated a freefall in share prices. Capital markets were effective forerunners because they combined investors' future expectations. This perspective brings to light the new realities that must be dealt with.

According to Ahmad and Shah (2020) findings, risk perception completely mediates the connections between the overconfidence heuristic, investment, decisions, and performance. Financial literacy moderates these relationships at the same time. The findings imply that while financial knowledge and risk perception might enhance the quality of investment decisions and performance, overconfidence can degrade both. The researchers conducted the study using a cross-sectional design, with 183 individual investors trading on the Pakistan Stock Exchange (PSX) as respondents to the questionnaire, analyzed with PROCESS and Structural Equation Modeling (SEM).

Mumtaz, Saeed, and Ramzan (2018) study examined how different variables, such as heuristics, risk aversion, financial instruments and procedures, corporate governance of the company, and daily experience, affected an investor's decision-making. Seven hundred and one (701) individual investors who traded on the Pakistan Stock Exchange made up the sample. According to the research, heuristics, financial tools, risk aversion, and tactics all positively and significantly influence how investors choose to invest their money.

Ady (2018) objectives of the research were to comprehend and examine the psychological bias that investors encounter when choosing investments. Investors' psychological bias resulted in poor judgment and

devastating losses. The goal of the study was to explore the phenomenon of decision-making from the perspective of investors using a qualitative interpretive phenomenology approach. The findings demonstrated that the phenomenon of cognitive bias and psychological bias behavior occurs in nearly all informants. Psychology bias could be divided into two categories, namely: expected emotion bias behavior and immediate emotion bias behavior, experience, financial market knowledge, and effective emotion management determine the level of psychological stability and minimize bias behavior that could increase return.

Novianggie and Asandimitra (2019) research aimed to determine how behavioral, cognitive, and emotional biases affected investment decisions, utilizing financial literacy as a moderator. Using a comprehensive questionnaire, restricted interview, and multiple regression analysis, 212 college students in Investment Gallery Surabaya were sampled. Herding bias, overconfidence, risk perception, representativeness, and financial literacy significantly affected investment decisions. Disposition effect and experience did not significantly affect the investment decision. Financial literacy was not a moderator but an independent variable. Financial knowledge could not control investment herding tendencies and overconfidence. College students in Surabaya made investment decisions based on recommendations from brokers or friends, past investment experience, and magazine or internet news.

This study is organized based on an introduction, methodology, results, and, discussion format, where the sections are made up of the following: introduction, methodology, results, and discussion. As shown in Figure 1, the problem of the study or the dependent variable is investment decision-making; the proposed solutions or independent variables are heuristic techniques and cognitive biases; and the mediator variable is COVID-19 pandemic.

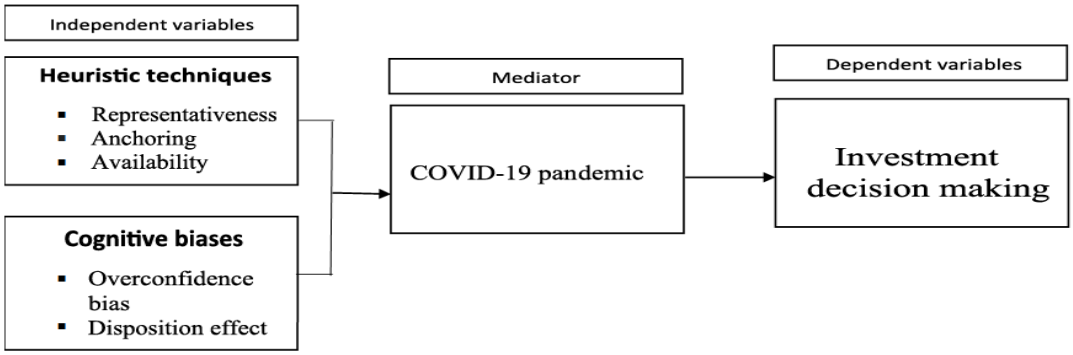

Figure 1. The mediating effect of COVID-19 pandemic on heuristic techniques and cognitive biases on investment decision-making.

2. Methodology

The research adopted a causal research design and mediation analysis to explain how or why the COVID-19 pandemic accounted for the association between heuristic techniques and cognitive biases in investment decision-making in the United States of America. The research used the snowball sampling technique as in Jan et al. (2022) study in China to recruit investors who directly or indirectly traded on the U.S. stock exchange and authorized a buy or sell stock transaction between March 11, 2020, and May 5, 2023, when the World Health Organization (WHO) declared COVID-19 a pandemic. To detect .8 power for full mediation and the partial-mediation requirements effect as Baron and Kenny (1986) study, this research used 500 sample size (Fritz & MacKinnon, 2007). The respondents answered a self-constructed cross-sectional Likert-scale survey questionnaire. The variables were measured as quantitative variables in that equal interval Likert-scale questionnaires were treated as such and large sample size ($n > 30$) of 500 respondents allowed for the violation of normality test assumptions as postulated by Kristof (1967); Sullivan and Artino Jr (2013); Pallant (2020); Elliott and Woodward (2007) and Boone Jr and Boone (2012).The instrument was validated with a pilot study of 108 respondents who were excluded from the main study with Exploratory Factor Analysis and reported as *good*, where the KMO Measure of Sampling Adequacy was 0.7 and Bartlett's Test of Sphericity ($X^2 = 1414$, $p = <.001$) and 50% explained variance with an oblimin rotation with hiding loading below 0.3. Streiner (1994) postulated that an explained variance of at least 50% is an acceptable construct or instrument. Cronbach Alpha was used to check the instruments' reliability, as shown in Table 1.

Table 1. Reliability test.

Variables	Number of items	Cronbach alpha	Verbal interpretation
Heuristic techniques	5	0.836	Good
Cognitive biases	5	0.782	Acceptable
COVID-19 pandemic	5	0.871	Good
Investment decision-making	6	0.704	Acceptable
Verbal interpretation is based on George and Mallery (1999) rule of thumb for reliability tests.			

The strength of the relationship and the magnitude, as well as the p-value for significance and their verbal interpretations as used in this research, are shown in Table 2. As human subject research, this study went through an ethical review process to ensure the anonymity and confidentiality of the respondents. A first-party data collection approach was employed. The statistical test of mediation was computed with the Jamovi software (The Jamovi Project, 2023).

Table 2. Scoring system and verbal interpretation.

The strength of relationship			
Absolute correlation value/Estimate	**Scoring system**	**Verbal interpretation**	
0.01-0.29	Small	Low	
0.30-0.49	Medium	Moderate	
0.5-1.0	Large	High	
Verbal interpretation is based on Cohen (1988) effect size			
P-value	Scoring system	Null hypothesis decision	Verbal interpretation
p<0.05, **p<0.01, ***p<0.001	Statistically significant	Reject	Specific predictor/Does not happen by chance
p > 0.05	Not statistically significant	Fail to reject	Happen by chance

Note: Flag of significance ** p < .01, *** p < .001.

The demographics of the respondents are split based on their sex of birth, ethnicity, and years of investing, as shown in Table 3, Table 4, and Table 5.

Table 3. Frequencies of sex at birth.

Sex at birth	**Counts**	**% of total**	**Cumulative %**
Female	124	24.8 %	24.8 %
Male	376	75.2 %	100.0 %

Table 4. Frequencies of ethnicity split by sex at birth.

Ethnicity	**Sex at birth**	**Counts**	**% of total**	**Cumulative %**
White	Female	34	6.8 %	6.8 %
	Male	47	9.4 %	16.2 %
Hispanic/Latino	Female	16	3.2 %	19.4 %
	Male	81	16.2 %	35.6 %
Black/African American	Female	14	2.8 %	38.4 %
	Male	92	18.4 %	56.8 %
Asian	Female	32	6.4 %	63.2 %
	Male	54	10.8 %	74.0 %
Native American	Female	14	2.8 %	76.8 %
	Male	52	10.4 %	87.2 %
Pacific Islander	Female	14	2.8 %	90.0 %
	Male	50	10.0 %	100.0 %

Table 1. Frequencies of years of investing split by se at birth.

Years of investing	**Sex at birth**	**Counts**	**% of total**	**Cumulative %**
1-5 years	Female	17	3.4 %	3.4 %
	Male	133	26.6 %	30.0 %
6- 10 years	Female	55	11.0 %	41.0 %
	Male	84	16.8 %	57.8 %
11-15 years	Female	27	5.4 %	63.2 %
	Male	64	12.8 %	76.0 %
16 –20 years	Female	10	2.0 %	78.0 %
	Male	45	9.0 %	87.0 %
21-25 years	Female	15	3.0 %	90.0 %
	Male	25	5.0 %	95.0 %
Above 25 years	Female	0	0.0 %	95.0 %
	Male	25	5.0 %	100.0 %

3. Results and Discussion

A series of regressions were tested to determine the mediation effects as per the research questions and the hypotheses based on the indirect effects, the significance (Sobel, 1982), and the percentage of mediation or mediation proportion in estimating the proportion of exposure effect on the outcome as explained by a mediating variable (Buse et al., 2020). Following strictly the rule of thumb prescribed by Baron and Kenny (1986) in mediation analysis, which stated the following, as depicted in Figure 2,

a. A variable serves as a mediator when it satisfies the following criteria: (a) there is a significant relationship between variations in the independent variable and variations in the presumed mediator (Path a); (b) there is a significant relationship between variations in the mediator and variations in the dependent variable (Path b); and (c) when controlling for Paths a and b, a previously significant relationship between the independent and dependent variables becomes non-significant, with the most robust evidence of mediation observed when Path c is equal to zero. With respect to the previous condition, it is possible to conceptualize a continuum. When Path c is diminished to a value of zero, there is compelling evidence supporting the existence of a single and influential mediator. If the residual path c is non-zero, it suggests the presence of numerous mediating elements.

b. To create mediation, it is necessary for the following conditions to be met: There are three key requirements in this study. Firstly, the independent variable should have an impact on the mediator, as indicated in the first equation. Secondly, the independent variable needs to demonstrate its influence on the dependent variable, as demonstrated in the second equation. Lastly, the mediator must influence the dependent variable, as depicted in the third equation. If all these requirements are met in the anticipated manner, it can be inferred that the impact of the independent variable on the dependent variable will be comparatively diminished in the third equation as compared to the second equation. This is termed partial mediation. The condition of full mediation is satisfied when the influence of the independent variable is rendered insignificant when the mediator is held under control.

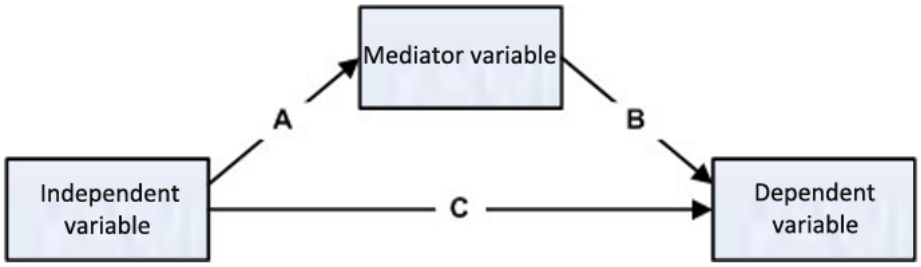

Figure 2. Paradigm for mediation.

In addressing the research question one null hypothesis, which was that the COVID-19 pandemic does not mediate the relationship between heuristic techniques and investment decision-making, the path estimates were checked as directed by the rule of thumb prescribed by Baron and Kenny (1986), and they were found to be statistically significant as shown in Table 6. Therefore, as shown in Table 7, the study concluded that the COVID-19 pandemic was a *specific moderately significant mediator* (Effect = 0.413, p = < .001) *on* the *low positive significant* relationships between heuristic techniques and investment decision-making (r = 0.133, p = 0.005, as shown in Table 6. Therefore, the study *rejects* the null hypothesis. In detail, the COVID-19 pandemic could explain the cause of using heuristic techniques on the effect of investment decision-making among United States of America investors by 75.6%. Again, there was a significant relationship between heuristic techniques and investment decision-making by 24.4%.

The implication of the findings is that the reason why or how the capital market experienced price volatility, speculative tendencies, market anomalies, and extreme market crash scenarios during the COVID-19 pandemic from a behavioral finance perspective (psychological traits) as related to investment decision-making was based on calculated guesses related to prior knowledge (Heuristic techniques) of US Investors. The COVID-19 pandemic is the situation that has affected the capital market. Some United States investors remembered how the capital market bounced back after some catastrophic global events like the phenomenon commonly referred to as the Dutch Tulip Bulb Market Bubble, which is also known as Tulipmania, occurred in 1637 (Narron & Skeie, 2013). The Financial Crisis, as reported by Narron and Skeie (2013), that took place from 1791 to 1792 marked the initial stock market meltdown in the United States. The Crisis of 1772, which took place within the 13 colonies, preceded this event. Sobel (1988) recounted that on October 19, 1987, an event commonly referred to as Black Monday occurred, which resulted in the most significant single-day decrease in stock market values ever recorded. Figure 3 presents a timeline of the market crush of the US Stock market, which investors remembered and influenced their decision-making during the COVID-19 pandemic era.

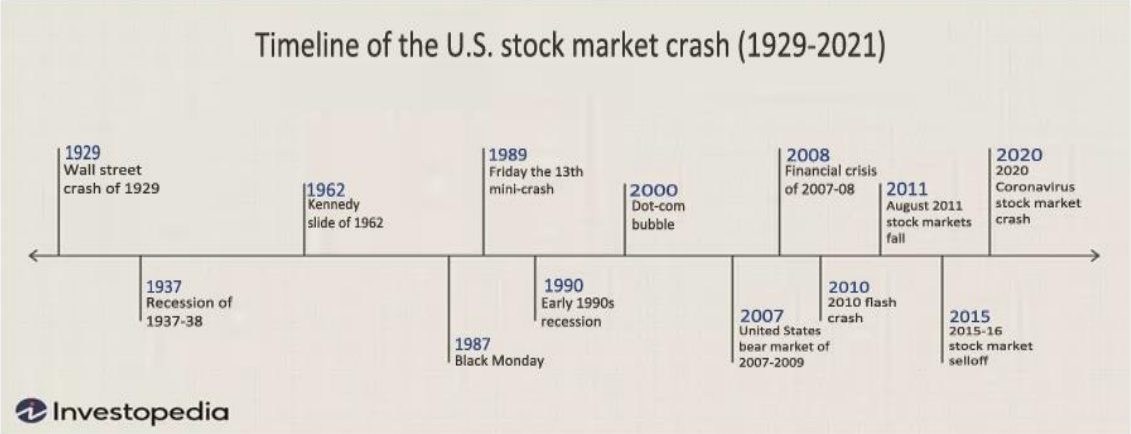

Figure 3. Timeline for stock market crash in the United States of America.

Source: Image by Sabrina Jiang © Investopedia 2021.

The heuristic technique findings of the way US investors reacted to the COVID-19 pandemic are in line with the rational expectations theory. The theory says that humans base their decisions on three basic factors: the information available to them, human rationality, and their past experiences (Begg, 1982). It was not surprising that the investors' reaction led to the high volatility of the capital market prices. The information that was available during the COVID-19 pandemic was not certain. The historical antecedents show that prices will fall; therefore, they reacted in the same manner.

Table 6. Path analysis.

Path estimates										
					95% confidence interval					
Variable path	Label	Estimate	IV	SE	Lower	Upper	Z	p	SS	IV
Heuristic techniques → COVID-19 pandemic	a	0.652	High	0.028	0.596	0.707	23.02	<0.001	S	SP
COVID-19 pandemic → Investment decision-making	b	0.633	High	0.053	0.529	0.737	11.97	<0.001	S	SP
Heuristic techniques → Investment decision-making	c	0.133	Low	0.048	0.039	0.228	2.78	0.01	S	SP

Note: Betas are completely standardized effect sizes.
S = Scoring system, S = Significant, NS = Not significant, IV=Verbal interpretation, SP = Specific predictor, HBC=Happened by chance.

Table 2. COVID-19 pandemic mediates heuristics techniques and investment decision-making.

Mediation estimates												
					95% confidence interval						Mediation	
Effect	Label	Estimate	IV	SE	Lower	Upper	Z	p	SS	IV	%	Type
Indirect	a × b	0.413	Moderate	0.039	0.336	0.489	10.62	<0.001	S	SP	75.6	Partial
Direct	C	0.133	Low	0.048	0.039	0.228	2.78	0.01	S	SP	24.4	
Total	c + a × b	0.546	High	0.038	0.4716	0.62	14.38	<0.001	S	SP	100	

Note: Betas are completely standardized effect sizes.
SS = Scoring system, S = Significant, NS = Not significant, IV=Verbal interpretation, SP = Specific predictor, HBC=Happened by chance.

Research question two had a null hypothesis that stated that the COVID-19 pandemic does not mediate the relationship between cognitive biases and investment decision-making. The path estimated a *full mediation* as the path association of cognitive biases and investment decision-making was not statistically significant (r = 0.07, p-value = 0.184), as shown in Table 8. Therefore, as shown in Table 9, the study concluded that the COVID-19 pandemic was a *specific moderately significant mediator* (Effect = 0.4874, p = < .001) *on* the *low positive, not significant* relationship between cognitive biases and investment decision-making (r = 0.070, p = 0.184, as shown in Table 8.

Table 8. The path analysis.

Mediation estimates												
Effect	**Label**	**Estimate**	**IV**	**SE**	**95% confidence interval**			**p**	**SS**	**IV**	**Mediation**	
					Lower	**Upper**	**Z**				**%**	**Type**
Indirect	a × b	0.413	Moderate	0.039	0.336	0.489	10.62	<0.001	S	SP	75.6	Partial
Direct	c	0.133	Low	0.048	0.039	0.228	2.78	0.01	S	SP	24.4	
Total	c + a × b	0.546	High	0.038	0.472	0.62	14.38	<0.001	S	SP	100	

Note: Betas are completely standardized effect sizes.
SS = Scoring system, S = Significant, NS = Not significant, IV=Verbal interpretation, SP = Specific predictor, HBC=Happened by chance.

Table 9. COVID-19 pandemic mediates cognitive biases and investment decision-making.

Mediation estimates												
Effect	**Label**	**Estimate**	**IV**	**SE**	**95% confidence interval**			**p**	**SS**	**IV**	**Mediation**	
					Lower	**Upper**	**Z**				**%**	**Type**
Indirect	a × b	0.487	Moderate	0.043	0.403	0.571	11.36	<0.001	S	SP	87.5	Full
Direct	c	0.070	Low	0.052	-0.033	0.172	1.33	0.184	NS	HBC	12.5	
Total	c + a × b	0.557	High	0.043	0.472	0.642	12.83	<0.001	S	SP	100	

Note: Betas are completely standardized effect sizes.
SS = Scoring system, S = Significant, NS = Not significant, IV=Verbal interpretation, SP = Specific predictor, HBC=Happened by chance.

Therefore, the study *rejects* the null hypothesis. In detail, the COVID-19 pandemic could fully explain the cause of using cognitive biases on the effect of investment decision-making among United States of America investors by 87.5%. Again, there was not a significant relationship between cognitive biases and investment decision-making, indicating that this cause-and-effect prediction happened by a 12.5% chance. As per the implication of this result, some US investors accidentally made errors in trades during the COVID-19 pandemic era due to their worldview or thinking, causing the reason why or how the capital market experienced price volatility, speculative tendencies, market anomalies, and extreme market crash scenarios during the COVID-19 pandemic from a behavioral finance perspective (psychological traits). This situation accounted for or predicted the investment decisions made by some US investors by 87.5%. The US investors used a systematic but supposedly inconsistent pattern to respond to the COVID-19 pandemic in making their investment decisions. In investigating the mediating effect of the COVID-19 pandemic on how US investors made their decisions using either heuristics techniques or cognitive biases by strictly following Baron and Kenny (1986) set conditions for a mediation study, the outcome predicted the case of partial and full mediation. The results showed that the COVID-19 pandemic was a *specific moderate to partial significant mediator on* the *low positive significant* relationships between heuristic techniques and investment decision-making, and COVID-19 pandemic was a *specific moderate to full significant mediator on* the *low positive not significant* relationships between cognitive biases and investment decision-making among US investors. The COVID-19 pandemic specifically and significantly explained US investors' decisions by 75.6% and 87.5% when considering heuristics techniques and cognitive biases, respectively, in causing the capital market crash from the standpoints of technical analysis, valuation, and behavioral finance. US investors' technical analysis valuation investment decision-making during the COVID-19 pandemic era was mostly based on unintentional errors in their worldview and calculated guesses related to prior knowledge. The findings of this study contradicted the studies done in China by Song et al. (2021) and Jan et al. (2022) that showed that the pandemic outbreak hurt investors' confidence in investment decision-making. The US investors were better positioned based on their experience and market information availability. The heuristic techniques and cognitive biases findings of the way US investors reacted to the COVID-19 pandemic are in line with the rational expectations theory. The theory says that humans base their decisions on three basic factors: the information available to them, human rationality, and their past experiences (Begg, 1982). It was not surprising that the investors' reaction led to the high volatility of capital market prices. The information that was available during the COVID-19 pandemic was not certain. The historical antecedents showed that prices would fall; therefore, their reaction. The limitation of the study is that it excluded fundamental analysis and valuation in investment decision-making. The snowball sampling technique adopted for the study is non-probability sampling, and it may impact the generalizability of the findings. The researchers recommend that probability sampling be used in the future to investigate this problem.

References

Abu-Bader, S., & Jones, T. V. (2021). Statistical mediation analysis using the sobel test and hayes SPSS process macro. *International Journal of Quantitative and Qualitative Research Methods*, *9*(1), 42-61.

Ady, S. U. (2018). The cognitive and psychological bias in investment decision-making behavior: (Evidence from Indonesian Investor's Behavior). *Journal of Economics and Behavioral Studies*, *10*(1), 86-100. https://doi.org/10.22610/jebs.v10i1.2092

Ahmad, M., & Shah, S. Z. A. (2020). Overconfidence heuristic-driven bias in investment decision-making and performance: Mediating effects of risk perception and moderating effects of financial literacy. *Journal of Economic and Administrative Sciences*, *38*(1), 60-90. https://doi.org/10.1108/jeas-07-2020-0116

Ayaa, M. M., Peprah, W. K., Mensah, M. O., Owusu-Sekyere, A. B., & Daniel, B. (2022). Influence of heuristic techniques and biases in investment decision-making: A conceptual analysis and directions for future research. *International Journal of Academic Research Business and Social Sciences*, *12*(5), 1252-1267. https://doi.org/10.6007/ijarbss/v12-i5/13339

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Begg, D. K. (1982). *The rational expectations revolution in macroeconomics: Theories and evidence*. Baltimore: Johns Hopkins University Press.

Bellé, N., Cantarelli, P., & Belardinelli, P. (2018). Prospect theory goes public: Experimental evidence on cognitive biases in public policy and management decisions. *Public Administration Review*, *78*(6), 828-840. https://doi.org/10.1111/puar.12960

Bisati, A. I., Ganai, S. I. H. U. J., & Gulzar, I. (2021). Decision making in financial markets: A thematic review and discussion. *Journal of Business Strategy Finance and Management*, *3*(1-2), 48. https://doi.org/10.12944/jbsfm.03.01-02.06

Boone Jr, H. N., & Boone, D. A. (2012). Analyzing likert data. *The Journal of Extension*, *50*(2), 1-5.

Bradley, C., & Stumpner, P. (2020). *The impact of COVID-19 on capital markets, one year in. McKinsey & Company*. Retrieved from https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/the-impact-of-covid-19-on-capital-markets-one-year-in

Buse, J. B., Bain, S. C., Mann, J. F., Nauck, M. A., Nissen, S. E., Pocock, S., . . . Monk Fries, T. (2020). Cardiovascular risk reduction with liraglutide: An exploratory mediation analysis of the LEADER trial. *Diabetes Care*, *43*(7), 1546-1552. https://doi.org/10.2337/figshare.12106860

Cohen, J. W. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dumm, R. E., Eckles, D. L., Nyce, C., & Volkman-Wise, J. (2020). The representative heuristic and catastrophe-related risk behaviors. *Journal of Risk and Uncertainty*, *60*(2), 157-185. https://doi.org/10.1007/s11166-020-09324-7

Edwards, R. D., Magee, J., & Bassetti, W. C. (2018). *Technical analysis of stock trends*. Boca Raton: CRC Press.

Elliott, A. C., & Woodward, W. A. (2007). *Statistical analysis quick reference guidebook: With SPSS examples* (1st ed.). London: Sage.
Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science, 18*(3), 233-239. https://doi.org/10.1111/j.1467-9280.2007.01882.x
George, D., & Mallery, P. (1999). SPSS for windows step by step: a simple guide and reference. *Contemporary Psychology, 44*, 100-100.
Goodell, J. W., Kumar, S., Rao, P., & Verma, S. (2023). Emotions and stock market anomalies: A systematic review. *Journal of Behavioral and Experimental Finance, 37*, 100722. https://doi.org/10.1016/j.jbef.2022.100722
Haq, M. N. (2020). Impact of covid 19 on the global economy. *COVID-19 Pandemic Update 2020, 11*(8), 956-969.
Jan, N., Jain, V., Li, Z., Sattar, J., & Tongkachok, K. (2022). Post-COVID-19 investor psychology and individual investment decision: A moderating role of information availability. *Frontiers in Psychology, 13*, 846088. https://doi.org/10.3389/fpsyg.2022.846088
Kansal, P., & Singh, S. (2018). Determinants of overconfidence bias in Indian stock market. *Qualitative Research in Financial Markets, 10*(4), 381-394. https://doi.org/10.1108/qrfm-03-2017-0015
Kristof, W. (1967). A foundation of interval scale measurement. *ETS Research Bulletin Series, 1967*(1), 1-31. https://doi.org/10.1002/j.2333-8504.1967.tb00371.x
Madaan, G., & Singh, S. (2019). An analysis of behavioral biases in investment decision-making. *International Journal of Financial Research, 10*(4), 55-67. https://doi.org/10.5430/ijfr.v10n4p55
Mumtaz, A., Saeed, T., & Ramzan, M. (2018). Factors affecting investment decision-making in Pakistan stock exchange. *International Journal of Financial Engineering, 5*(04), 1850033. https://doi.org/10.1142/s2424786318500330
Narron, J., & Skeie, D. (2013). *Crisis chronicles: Tulip Mania, 1633-37*. Retrieved from https://libertystreeteconomics.newyorkfed.org/2013/09/crisis-chronicles-tulip-mania-1633-37/
Novianggie, V., & Asandimitra, N. (2019). The influence of behavioral bias, cognitive bias, and emotional bias on investment decision for college students with financial literacy as the moderating variable. *International Journal of Academic Research in Accounting, Finance and Management Sciences, 9*(2), 92-107.
Owusu, S. P. (2020). *Exploring the human factor in decision making: Anchoring bias and investor behavior*. Doctoral Dissertation. Ashei University.
Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS*. UK: McGraw-Hill Education.
Richardson, R. C. (2017). Heuristics and satisficing. In: W. Bechtel and G. Graham (Eds.), A companion to cognitive science. In (pp. 566-575). Oxford, UK: Blackwell.
Shah, S. Z. A., Ahmad, M., & Mahmood, F. (2018). Heuristic biases in investment decision-making and perceived market efficiency: A survey at the Pakistan stock exchange. *Qualitative Research in Financial Markets, 10*(1), 85-110. https://doi.org/10.1108/qrfm-04-2017-0033
Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equations models. In S. Leinhart (Ed.), Sociological methodology. In (pp. 290-312). San Francisco: Jossey-Bass.
Sobel, R. (1988). *Panic on wall street: A classic history of America's financial disasters with a new exploration of the crash of 1987*. New York: Plume Books.
Song, Y., Hao, X., & Lu, Z. (2021). The impact of the coronavirus disease 2019 pandemic on investor sentiment—evidence from a-share listed companies in China. *Frontiers in Psychology, 12*, 743306. https://doi.org/10.3389/fpsyg.2021.743306
Statista Research Department. (2022). *Topic: Covid-19 and investment behavior worldwide. Statista*. Retrieved from https://www.statista.com/topics/7856/covid-19-and-investment-behavior-worldwide/
Streiner, D. L. (1994). Figuring out factors: The use and misuse of factor analysis. *The Canadian Journal of Psychiatry, 39*(3), 135-140. https://doi.org/10.1177/070674379403900303
Sullivan, G. M., & Artino Jr, A. R. (2013). Analyzing and interpreting data from Likert-type scales. *Journal of Graduate Medical Education, 5*(4), 541-542. https://doi.org/10.4300/jgme-5-4-18
The Jamovi Project. (2023). *Jamovi*. Retrieved from https://www.jamovi.org
Trejos, C., Van Deemen, A., Rodríguez, Y. E., & Gomez, J. M. (2019). Overconfidence and disposition effect in the stock market: A micro world based setting. *Journal of Behavioral and Experimental Finance, 21*, 61-69. https://doi.org/10.1016/j.jbef.2018.11.001
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases: Biases in judgments reveal some heuristics of thinking under uncertainty. *185*(4157), 1124-1131.
Viscusi, W. K. (2020). Pricing the global health risks of the COVID-19 pandemic. *Journal of Risk and Uncertainty, 61*(2), 101-128. https://doi.org/10.1007/s11166-020-09337-2
Vörös, Z. (2020). Effect of the different forms of overconfidence on venture creation: Overestimation, overplacement and overprecision. *Journal of Management & Organization*, 1-14. https://doi.org/10.1017/jmo.2019.93
Yamashiro, J. K., & Roediger III, H. L. (2021). Biased collective memories and historical overclaiming: An availability heuristic account. *Memory & Cognition, 49*(2), 311-322. https://doi.org/10.3758/s13421-020-01090-w
Zahera, S. A., & Bansal, R. (2019). A study of prominence for disposition effect: A systematic review. *Qualitative Research in Financial Markets, 11*(1), 2-21. https://doi.org/10.1108/qrfm-07-2018-0081
Zhang, H., Bij, H. V. D., & Song, M. (2020). Can cognitive biases be good for entrepreneurs? *International Journal of Entrepreneurial Behavior & Research, 26*(4), 793-813. https://doi.org/10.1108/ijebr-03-2019-0173
Zhang, L., & Zhang, B. (2014). Statistical heuristic search. *Quotient Space Based Problem Solving, 2*, 1–11. https://doi.org/10.1007/BF02943312