

Current Challenges in Millennial Investment: An Analysis of Herding Bias through Gender and Technology

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Abstract

Good investment decisions can be influenced by various behavioral biases, which cause rational decisions to be irrational, this is a challenge for the millennial generation in investing. The purpose of this study is to analyze the moderating effect of gender on the influence of herding bias on the individual decisions of millennial generation investors in Indonesia, which is moderated again by the characteristics of a technologically literate generation. The object of this study is the moderating effect of gender and the sub-moderation of technology-savvy generational characteristics, with herding bias as the independent variable and investment decisions as the dependent variable. Of the 3,451,513 retail investors listed on the Indonesia Stock Exchange, 1,070 valid questionnaires were collected through Google Forms distributed at 9 regional points in Indonesia. The research findings are that herding bias has a significant effect on investment decisions. Gender can moderate the effect of herding bias on investment decisions. The moderating effect of gender on the relationship between herding bias and investment decisions is highly dependent on the characteristics of the technology-literate generation. Women and men who are not technologically literate are very vulnerable to herding bias and vice versa.

Keywords: Herding Bias, Investment Decisions, Gender, Technology.

Introduction

In this era of globalization, the development of technology has brought major changes in various aspects of life, including finance and investment. From a traditional financial system that involves a lot of manual transactions, we now see the development of modern finance that is more sophisticated and efficient. However, although modern finance has many advantages, there are still many people who still trust the traditional financial system. A combination of traditional and modern finance might provide the best solution to today's financial problems and help expand access to financial services for people.

Recent developments in financial markets address the differences between traditional finance and behavioral finance. Over the previous years, experts in traditional finance have contributed to the economic utility theory which states that the market is informationally efficient, investors behave rationally in making investment decisions and

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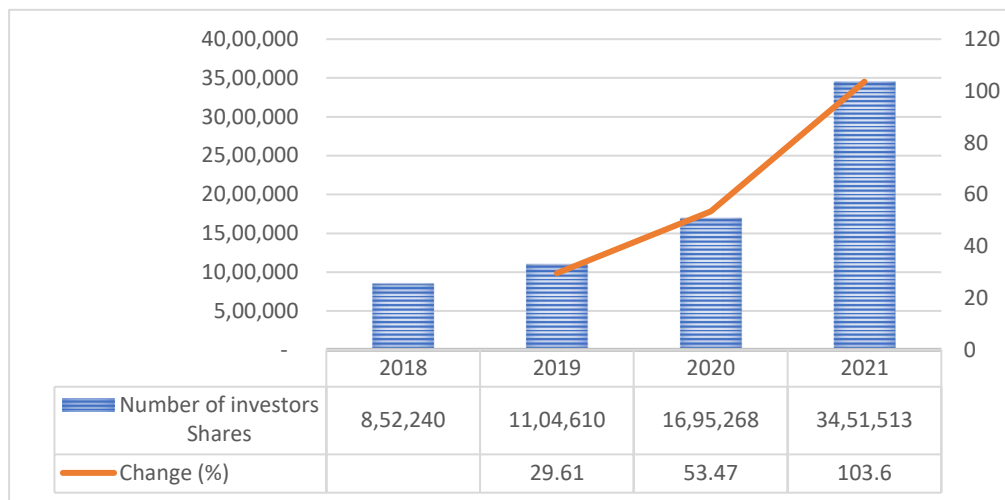
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they know how to get maximum satisfaction (Jain et al., 2020). In reality, investors tend to behave irrationally, so behavioral finance emerged. Behavioral Finance is a process of making investment decisions that are influenced by various behavioral biases that encourage investors to make irrational investment decisions. Usually, investor behavior deviates from rational decisions to irrational decisions (Pompian, 2021). In addition, behavioral finance provides insights from psychology, finance, and other disciplines to study the behavior of various markets that deviate from standard assumptions and show inefficient markets (Shiller, 2013). Prospect theory and heuristics (Kahneman & Tversky, 1979) stated that these hypotheses are inconsistent and unable to explain why investors behave in unpredictable ways. Behavioral finance shifts the paradigm from traditional finance to behavioral finance and has identified many behaviors that contradict rationality. Daniel et al. (1998) stated that individual investors are prone to various behavioral anomalies, which can be an obstacle to maximizing wealth. Reasoning errors are difficult to eliminate, so understanding the different behavioral biases associated with investment decision-making is important (Tversky & Kahneman, 1992).

The behavioral finance model explains the phenomenon of financial behavior. Some behavioral biases that exist occur in investor behavior ranging from individual investors, company managers, and financial advisors (Zahera & Bansal, 2018). Bias is a major study of individual investor behavior. Investors are influenced to adopt certain methods of activity following biases, in addition, intuitive reasoning and judgment drive investors in making decisions (Wahl & Kirchler, 2018), (Wahl & Kirchler, 2020). Based on a map of research studies that have been conducted by examining behavioral finance, shows that behavioral biases such as herding bias affect the investment decision-making process of investors in non-emerging countries and emerging market countries. (Mittal, 2019), (Zahera & Bansal, 2018), (Nigam et al., 2018), (Costa et al., 2017) and (Kumar & Goyal, 2015). In a recent study, the researchers distinguished a list of specific biases and identified 40 biases that occur in individual investor behavior (Mittal, 2019). So various behavioral biases such as herding bias, occur in investors, especially individual investors, which cause rational decisions to become irrational and have an impact on suboptimal investment results. Herding bias cannot be avoided but how investors can adapt and manage the biases they have in these investment decisions. For this reason, it is important to continue herding bias research in emerging countries such as Indonesia, to identify relevant herding biases affecting millennial generation investors with gender and technological literacy of these investors.

To see the state of investors in emerging market countries Indonesia associated with individual investors or retail investors can be seen from the number of single investor identification (SID) stock investors in Figure 1.

Figure 1: Number of SID stock investors in Indonesia



Source: KSEI (2021), Data processed 2022

In Indonesia, during the Covid-19 pandemic, there was an increase in the number of stock investors by 103.6% (KSEI, 2021). This shows that the number of investors has increased significantly and that investors are interested in investing in the capital markets of emerging countries such as Indonesia. There is an increase in the number of investors, which turns out to be filled with millennials (KSEI, 2021). The millennial generation has unique characteristics. This increase in investors will support the development of better investment because the millennial generation is a long-term investor, therefore it needs to be maintained and even increased for better investment, especially for the millennial generation. Previous research has examined the behavioral factors that influence investment decisions in the millennial generation in Malaysia (Rahman & Gan, 2020). Therefore, it is important to examine younger generation groups such as the millennial generation. This research is different from other studies because it includes elements of gender and technological literacy in the characteristics of the tech-savvy millennial generation in making investment decisions to determine a good investment there are many influencing factors such as herding bias, gender, and investor technological literacy. Gender effects need to be included in the research because investors have a gender that can strengthen or weaken herding bias in making investment decisions, while technological literacy, especially the tech-savvy millennial generation, to see the characteristics that make this millennial generation different and invest a lot during the covid-19 pandemic. For this reason, further research needs to be carried out to find out the perspective of the moderating effect of gender and technological literacy for different millennial generations on the influence of herding bias on individual investor decisions in Indonesia's emerging markets, so that they can make better investment programs.

2. Literature Review

2.1 Investment Decision

In a business, investment decisions are very important in achieving the main goal of making a profit. Likewise, an investor has the main goal of making good decisions and getting maximum results. Markowitz, (1999) suggests Modern Portfolio Theory which studies that decision-makers find choices for investment and compare them to make relationships in these choices. Prospect theory suggests that people make irrational decisions under risk and uncertainty and violate the axioms of expected utility theory (Kahneman & Tversky, 1979).

An investor spends money to obtain investment products in search of expected returns. The main objective of an investor is to maximize returns and minimize risk. There are many investment objectives such as safety against liquidity, growth, and inflation and have a choice of risk and return (Rahman & Gan, 2020). Most investors make a proper evaluation of investment products before making a decision. Investor behavior in making investment decisions has a significant role in the financial growth of investors (Ahmed et al., 2021).

2.2 Behavioral Finance and Behavioral Biases

Traditional finance theory assumes that investors are rational in making investment decisions in the market such as the modern portfolio theory (Markowitz, 1999) and the capital asset pricing model (Sharpe, 1977). In contrast, the relatively modern behavioral finance field seeks to summarize the combination of behavioral and cognitive factors that lead to irrational financial decisions (Barberis & Thaler, 2003). Behavioral finance is a process in investment decision-making that is influenced by various behavioral biases that encourage investors to make irrational investment decisions. Usually, investor behavior deviates from rational decisions to irrational decisions (Pompian, 2021).

In financial markets, investors can be influenced by the behavior of individual investors in the behavioral finance method (De Bondt & Thaler, 1985). Individual behavior deviates from rational and logical decisions due to the influence of behavioral bias. This bias will affect the rationality of investors in the decision-making process (Kumar & Goyal, 2015). Furthermore, a 40-year literature study conducted in several countries found that many behavioral biases occur in investment decision making including herding bias (Mittal, 2019), (Zahera & Bansal, 2018). The results of studies on investor behavioral biases in investment decision-making occur in non-emerging countries and other emerging markets so this study focuses on one of the dominant financial behavioral biases that occur in investors, namely herding bias.

Herding Bias

Irrational behavior in collective decision-making is shaped by biases including herding bias, heuristic bias, and others. Herding bias is the behavior of individuals who follow the direction or actions of others (Rahman & Gan, 2020). Herding has an interdependent relationship between information availability and peer behavior. When information is uncertain, investors are more likely to imitate the decisions of others or groups (Granda Revilla & Trujillo Fernández, 2011). The herding effect can cause stock prices to deviate from fundamental value (Tan et al., 2008). In addition, herding bias has a relationship with conformity bias, i.e., the fact that people experience increased comfort following others around them (Hirshleifer, 2015).

There are several indicators of the factor of following or herding other people's investment decisions, namely buying and selling decisions of other investors, the choice of shares to be traded by other investors, other investors' decisions in choosing the type of shares have an impact on your investment decisions, the volume of shares to be traded by other investors, and the speed of herding (Kengatharan, 2014). However, there is no significant asymmetric behavior during up and down market periods (Coskun et al., 2020). The results showed that herding bias harms the formation of behavioral bias (Suresh G, 2021). In addition, the existence of herding behavior due to low volatility and the significant influence of uncertainty on anti-herding behavior so the existence of herding in financial markets will always be researched by academics and practitioners.

2.3 Gender and Technology Effects

Gender

Gender was the first demographic factor examined in the study. Research by Loibl & Hira, (2011) in developed countries, namely the United States, suggests that there are

differences between male and female investors in obtaining information sources and the frequency of their use. Identified demographic and attitudinal characteristics can lead to differences in information search strategies. Agree with the results of research in Pakistan which states that men have more financial knowledge compared to women and most are under 25 years old (Rasool & Ullah, 2020). (Phan et al., 2018) also stated that investment activities depend on gender.

The behavioral biases that occur in investor decision-making can be attributed to gender. Men are more confident than women, as a result, men engage in over-trading which leads to less returns (Barber & Odean, 2000), (Grinblatt & Keloharju, 2001).. Male investors describe overconfidence more than female investors. Another interesting observation is that male and female investors have differences in trading volume (Paisarn et al., 2021). This result is consistent with (Jiang et al., 2020). Furthermore, Pompian, (2021) showed some statistically significant relationships between personality type, gender, and investors.

The sociodemographic characteristics of investors in warrants also found that over nearly 10 years of trading behavior of retail investors in the Portuguese financial market found that younger and less educated men were more apt to invest in warrants whereas investors with more skilled occupations were more apt to invest in stocks only (Abreu & Mendes, 2020). Furthermore, behavioral factors that influence individual investment decisions in the millennial generation, state that investment decision-making is significantly different when viewed based on gender, employment status, and income allocation (Rahman & Gan, 2020). For this reason, we developed a model to ascertain whether gender correlates with susceptibility to any of the biases identified in the behavioral finance literature in decision-making over time in emerging market countries.

Technology Literacy

The characteristics of millennial generation or Generation Y is a generation that lives in the age of technology. A generation that is close to digital and information technology. Millennials can work and spend their entire lives in a digital environment, therefore the millennial generation has advantages and disadvantages in cognitive, emotional, and social outcomes.

To find out which year the millennial generation was born, there are several opinions. There is no general agreement on the starting and ending point for the millennial generation (Brosdahl & Carpenter, 2011a). However, a key characteristic of the millennial generation is its starting point at a time in their lives when they are often exposed to technology, therefore the millennial generation has strengths and weaknesses in cognitive, emotional, and social outcomes (Immordino-Yang et al., 2012). The millennial generation is also defined as the generation of a person born during the 1980s and early 1990s, mainly consisting of the children of baby boomers and usually close to digital technology and electronics (Rahman & Gan, 2020). For the characteristics of the millennial generation, is often referred to as the digital native generation, not digital immigrants (Bolton & At.al, 2013). The millennial generation is the first generation that can spend their entire lives in a digital environment. Information technology has greatly influenced the way millennials live and work (Wesner & Miller, 2008). Based on this opinion, it can be concluded that the characteristics of the millennial generation are a generation that lives in the age of technology. A generation that is close to digital and information technology or technology literacy. The millennial generation can work and spend their entire lives in a digital environment, therefore the millennial generation has advantages and disadvantages in cognitive, emotional, and social outcomes.

2.4 Hypothesis of the Study

Based on the theories that have been described, a framework can be by with the problems and research objectives to facilitate analysis and operational definition and explain the

relationship between research variables. This framework model explains the overall herding bias as in Figure 2 below:

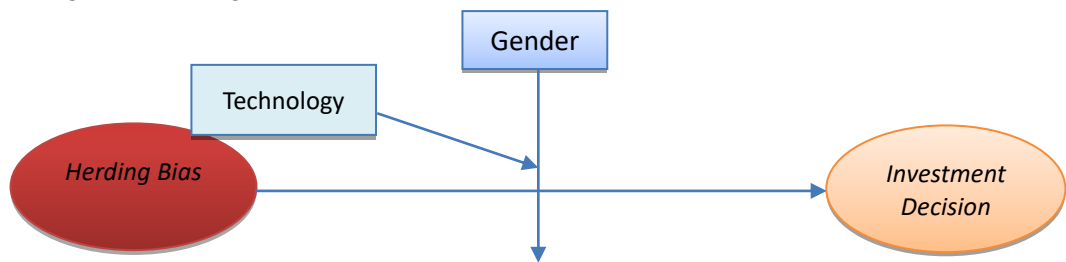


Figure 2. Research Model

Based on Figure 2, the research model in this study is to test the independent variable on the dependent variable using moderation and sub-moderation variables. This research model shows that the moderating effect of gender on the influence of herding bias on individual investor decisions in the Indonesian emerging market is moderated again by technology. Furthermore, the following research hypothesis can be formulated:

H1 : Herding bias affects investment decisions.

H2 : Gender moderates the direct effect of herding bias on investment decisions.

H3 : The moderating effect of gender on herding bias on investment decisions is moderated again by technology.

3. Methodology

3.1 Population and Sample

This study used primary data collected using survey techniques. To generalize the research results, it is based on two data points, namely gender (male and female) and technology (technology literate and not literate). The reason for choosing these characteristics is by the research criteria, by making a comparison between the two characters in men and women of the millennial generation who are literate and not literate in technology.

The population in this study includes all Single Investor Identification (SID) retail stock investors registered as C-BEST investors, namely a total of 3,451,513 investors registered with the Indonesia Stock Exchange. Many of these stock investors are dominated by local individual investors (KSEI, 2021). These investors were chosen because theoretically and empirically they have various characteristics that follow the topics and objectives of this study. The sample in this study was 1,070 millennial generation investors collected from valid questionnaires. Distribution of questionnaires via Google form based on the distribution of domestic investors in Indonesia.

3.2 Measurement Model

The variables in this study include the dependent variable (Y), namely investment decisions, independent variables, namely herding bias (X), moderating variables, namely gender (W) and sub-moderating variables that have secondary effects, namely technological literacy (Z). The statistical diagram that fits this research model will require two or more antecedent variables. W and Z are one of these antecedents. The conceptual diagram in this study as a whole is as follows.

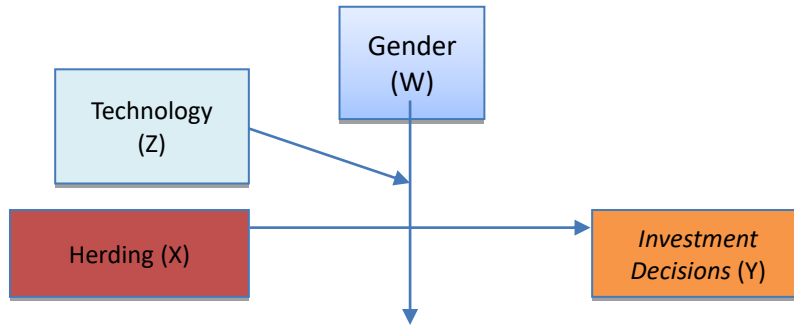


Figure 3. Conceptual Diagram

Source: Data Processed Source Hayes, 2018

In this study, technological literacy (Z) is divided into two, namely technological literacy and non-technological literacy, so to clarify the research, the statistical diagram will be divided into three analyses, namely:

- Y1 for tests on herding bias and investment decisions
- Y2 for tests on the herding bias, gender, and investment decisions
- Y3 for tests on the herding bias, gender, and technology literacy

In the conceptual diagram of this study, when viewed with a statistical diagram, there is a diagram in Figure 4 below:

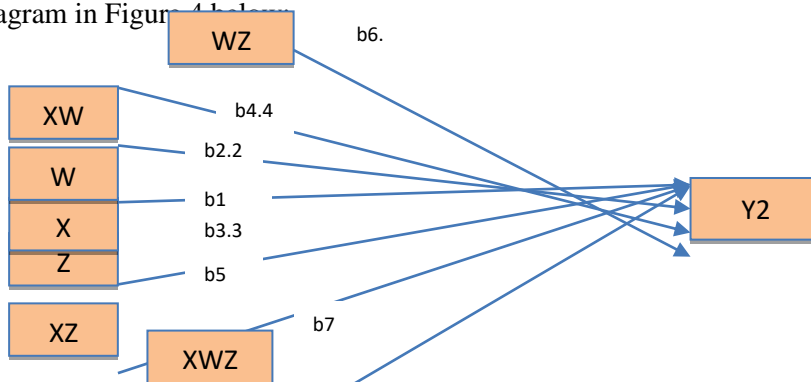


Figure 4. Test on the herding bias, gender, technology literacy, and investment decision

In this study, the multiple regression model equation has three equations, namely:

$$Y1 = iy + b1X + ey \dots \dots \dots 1)$$

$$Y2 = iy + b1X + b2W + b3XW + ey \dots \dots \dots 2)$$

$$Y3 = iy + b1X + b2W + b3Z + b4XW + b5XZ + b6WZ + b7XWZ + ey \dots \dots \dots 3)$$

Before conducting multiple regression tests with the Hayes process, the research instruments were tested for validity and reliability. Then the classical assumption test is carried out, namely the normality test, heteroscedasticity test, and multicollinearity test.

4. Result

In this study, the validity test analysis r_{count} using the corrected item-total correlation while for r_{table} uses Pearson product-moment with the formula of $(n-2)$, so the minimum requirement is $r_{table} > 0.361$. The results of the validity test in this study are:

Table 1. Results of Validity Testing of Research Variables

Statement	r _{count}	r _{table}	Conclusion
Herding Bias			
I usually buy stocks following member group investors.	0,808	0,361	Valid
I sold shares following the investor group members.	0,766	0,361	Valid
My investment decisions are often based on recommendations from analysts or brokers.	0,731	0,361	Valid
I seek opinions from friends and colleagues on investment decisions.	0,791	0,361	Valid
Company news (newspapers, TV, magazines, social media) influences my investment decisions.	0,588	0,361	Valid
If my friend's investment is successful and I consider it good then I will follow suit.	0,711	0,361	Valid
Technology Literacy			
Knowledge of using technology in investing	0,839	0,361	Valid
Skill in using technology in investing.	0,757	0,361	Valid
Use of the Internet to find information	0,509	0,361	Valid
Investment Decision			
Investment returns can improve financial well-being.	0,547	0,361	Valid
I prioritize the return on the investment product I choose.	0,564	0,361	Valid
I get investment returns that are in line with my expectations.	0,714	0,361	Valid
I have stock investments that show increasing cash flow.	0,684	0,361	Valid
I manage my risk and return tolerance limits.	0,689	0,361	Valid
I expect little risk from my investment.	0,600	0,361	Valid

Source: Research Data, 2023

Based on Table 1, shows that all statement items on each variable have a value greater than the value $r_{table} > 0.361$. So the research instrument is suitable for use in further research data collection. The reliability test in this study used the Cronbach alpha coefficient > 0.60 . If the Cronbach alpha result is more than the value of 0.60, the research statement is declared reliable (reliable). The results of the reliability test in this study are:

Table 2 Results of Reliability Testing of Research Variables

Variables	Cronbach Alpha	Terms	Conclusion
Herding	0,901	0,60	Reliable
Gender	0,852	0,60	Reliable

Technology Literacy	0,830	0,60	Reliable
Investment Decision	0,848	0,60	Reliable

Source: Research Data, 2023

The reliability test results in Table 2 show that all variables have a Cronbach alpha value greater than 0.60. This states that all variables in this study are declared reliable. The reliability test results contained in Table 2 have important implications for the reliability of the measurement instruments used in this study. The fact that all variables including herding biases, gender, technology, and investment decisions have Cronbach alpha values that exceed 0.60 indicates that the measurement instruments used in this study have an adequate level of consistency.

Furthermore, the classical assumption test used in this study is the normality test, heteroscedasticity test, and multicollinearity test. The normality test is used to determine whether a sample of data is normally distributed or not. The normality test is carried out based on the observation of the histogram graph. In this study, data points spreading and following the diagonal line, it can be stated that the data is normally distributed.

In this study, the heteroscedasticity test was used by observing the pattern of the scatterplot graph to determine the presence or absence of heteroscedasticity. In this study, it is seen that the scatterplot graph has a spread pattern or irregular data, so it is stated that there is no heteroscedasticity disorder.

The basis for seeing whether there is a correlation or not can be seen from the tolerance value and Variance Inflation Factor (VIF). If the tolerance value is greater than 0.1 or the variance inflation factor (VIF) is smaller than 10, there is no multicollinearity and vice versa (Ghozali, 2016). In this study, it shows that the results of the VIF multicollinearity test are < 10 with a tolerance > 0.1 , this means that the research model shows no multicollinearity.

Based on the results of the classical assumption test on this research data, it is obtained that the data is normally distributed, there is no heteroscedasticity disorder and there is no multicollinearity in the research data. After that, the analysis can be continued using multiple regression analysis with the Hayes process.

The Effect of Herding Bias on Gender-Moderated Investment Decisions

The results of this study suggest three research models, namely model I is used to test the effect of herding bias on investment decisions. Model II takes into account the gender variable (GE) as a moderating factor. The model III tests gender (GE) as a moderating factor and technological literacy as a sub-moderation. The effect of herding bias on investment decisions moderated by gender is a study to see how psychological factors such as herding bias, can affect the way individuals, based on gender, make investor investment decisions. GE is a variable used to see if there is a reaction or response that affects investment decisions. The details of the results of data processing with the Hayes process obtained a multiple regression test model with moderation and sub-moderation in Table 3 below:

Table 3. OLS Regression Output Moderated by Gender (W) Moderated by the Characteristics of Generation Y Technological Literacy (Z)

Run MATRIX procedure:

***** PROCESS Procedure for SPSS Version 4.2 beta *****

Written by Andrew F. Hayes, Ph.D. www.afhayes.com

Documentation is available in Hayes (2022). www.guilford.com/p/hayes3

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Model : 3

Y : Y

X : X

W : W

Z : Z1

Sample

Size: 1070

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OUTCOME VARIABLE:

Y

Model Summary

	R	R-sq	MSE	F	df1	df2	p
	.6332	.4009	3.4467	101.5204	7.0000	1062.0000	.0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	-24.3592	9.0497	-2.6917	.0072	-42.1165	-6.6018
X	.6531	.1292	5.0544	.0000	.3995	.9066
W	13.2504	6.2530	2.1190	.0343	.9807	25.5200
Int_1	-.1867	.0878	-2.1263	.0337	-.3591	-.0144
Z1	23.0961	4.9879	4.6304	.0000	13.3088	32.8835
Int_2	-.3024	.0710	-4.2570	.0000	-.4418	-.1630
Int_3	-8.6664	3.4048	-2.5453	.0111	-15.3473	-1.9855
Int_4	.1222	.0477	2.5585	.0107	.0285	.2158

Product terms key:

Int_1 : X x W
 Int_2 : X x Z1
 Int_3 : W x Z1
 Int_4 : X x W x Z1

Test(s) of highest order unconditional interaction(s):

R2-chng	F	df1	df2	p
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X*W*Z .0037 6.5459 1.0000 1062.0000 .0107

Focal predict: X (X)

Mod var: W (W)

Mod var: Z1 (Z)

Test of conditional X*W interaction at value(s) of Z:

Z1	Effect	F	df1	df2	p
1.2987	-.0281	.9365	1.0000	1062.0000	.3334
1.6724	.0176	1.0627	1.0000	1062.0000	.3028
2.0000	.0576	10.0543	1.0000	1062.0000	.0016

DATA LIST FREE/

X W Z1 Y .

BEGIN DATA.

64.6637	1.0000	1.2987	22.6529
72.0804	1.0000	1.2987	24.3758
79.4971	1.0000	1.2987	26.0988
64.6637	1.0000	1.6724	23.6902
72.0804	1.0000	1.6724	24.9137
79.4971	1.0000	1.6724	26.1372
64.6637	1.0000	2.0000	24.5998
72.0804	1.0000	2.0000	25.3854
79.4971	1.0000	2.0000	26.1709
64.6637	2.0000	1.2987	22.8321
72.0804	2.0000	1.2987	24.3467
79.4971	2.0000	1.2987	25.8613
64.6637	2.0000	1.6724	23.5828
72.0804	2.0000	1.6724	24.9365
79.4971	2.0000	1.6724	26.2903
64.6637	2.0000	2.0000	24.2410
72.0804	2.0000	2.0000	25.4537
79.4971	2.0000	2.0000	26.6663

END DATA.

GRAPH/SCATTERPLOT=

X WITH Y BY W /PANEL ROWVAR= Z1.

***** ANALYSIS NOTES AND ERRORS *****

----- END MATRIX -----

Source: Data processed 2023

Based on the research results in Table 3. obtained equations for models I, II, and III, namely

$$Y1 = -24.3592 + 0.6531X + e \dots \dots \dots (1)$$

$$Y2 = -24.3592 + 0.6531X + 13.2504W - 0.1867XW + e \dots \dots \dots (2)$$

$$Y3 = -24.3592 + 0.6531X + 13.2504W - 0.1867XW + 23.0961Z - 0.3024XZ - 8.6664WZ + 0.1222XWZ \dots \dots \dots (3)$$

Model I is a test that aims to identify the effect of herding bias on investment decisions, in this model I describes a one-way relationship between herding bias (X) has a positive effect on investment decisions (Y) ($b_1 = 0.6531$, $t = 5.0544$, $p < 0.000$). The coefficient (b_1) of 0.6531 indicates how much change in investment decisions occurs due to changes in herding bias. In this context, the value of $p < 0.000$ indicates that there is a significant influence between herding bias and investment decision. To answer hypothesis 1, which identifies whether there is an influence between herding bias and investment decision, it can be concluded that H_0 (null hypothesis) is rejected. This result indicates that there is a significant influence between herding bias on investment decisions.

Furthermore, model II is a test that aims to identify the effect of herding bias on investment decisions, with gender moderation (W). Gender is used as a proxy that aims to measure the extent to which gender moderates herding bias that affects investment decisions. The results in model II show a two-way relationship, namely gender can moderate the influence of herding bias (X) on investment decisions (Y). For gender (W) affects investment decision (Y) ($b_2 = 13.2504$, $t = 2.1190$, $p = 0.0343 < 0.05$). Furthermore, gender also negatively moderates herding bias on investment decisions ($b_3 = -0.1867$, $t = -2.1263$, $p = 0.0337 < 0.05$). The coefficient value (b_3) of -0.1867 indicates how much change in investment decisions occurs due to changes in behavior in herding bias. In this context, the negative value (0.1867) indicates that there is a negative relationship between herding bias and investment decision. This means that when herding bias decreases, investment decisions tend to increase and vice versa when herding bias increases, investments tend to decrease. This is an early indication that there is a negative correlation between the herding bias factor and investment decisions. The inclusion of gender moderator variables into this model can improve the feasibility of the model. So both men and women can moderate in this model II.

A p-value of less than 0.05 indicates that the results of the analysis are highly significant. In this context, this means that there is strong statistical evidence that the relationship between herding bias and investment decisions is not coincidental. This is a further indication that herding bias has a significant influence on investment decisions.

Thus, it can be concluded that there is a negative and significant effect of herding bias (X) on investment decisions (Y). In the context of statistical analysis, an increase in herding bias tends to hurt investment decisions. Based on this description, to answer hypothesis 2, whether gender moderates the effect of herding bias on investment decisions in the emerging Indonesian capital market. So it can be concluded from the results of this study that H_0 is rejected. In other words, gender, whether male or female, can moderate the relationship between herding bias and the investment decision of millennial investors in the Indonesian capital market.

The Effect of Herding Bias on Investment Decisions Moderated by Gender and Moderated by the Characteristics of the Technologically Literate Generation

In the era of increasingly complex investments, understanding investor behavior is important in understanding how psychological factors can influence investors' investment decisions. Research on the influence of behavioral biases in the investment context has become a major focus of attention in the modern financial literature. Moreover, this phenomenon becomes even more interesting when we consider the role of gender and the characteristics of the technology millennial generation (generation Y) in moderating the influence of herding bias on investment decisions.

This third model is a test that aims to determine the effect of herding bias on investment decisions, which is moderated by two moderating variables, namely gender (W) as the main moderating variable and technological literacy (Z) as the second moderating variable. This model approach is based on research conducted by Smith (2021), which indicates that gender factors have a significant effect on moderating investment behavior.

Based on the research results in Table 3, the equation for model III is obtained:

$$Y_3 = -24.3592 + 0.6531X + 13.2504W - 0.1867XW + 23.0961Z - 0.3024XZ - 8.6664WZ + 0.1222XWZ.....(3)$$

Model III in this study explains the relationship between the influence of herding bias on investment decisions, with gender acting as the main moderator and the characteristics of the technology-literate generation as a secondary moderator. In this mediated moderation model, the main focus is on the coefficient that describes the three-way interaction between the variables of herding bias (X), gender (W), and technological literacy (Z). Model III describes the interaction between the effects of herding bias, gender (both male and female), and technological literacy. In the results listed in Table 3, it can be concluded that herding bias (X) has a significant influence on investment decision (Y) ($b_1 = 0.6531$, $t = 5.0544$, $p < 0.000$). In addition, the characteristics of the tech-savvy generation (Z) also have a significant influence on investment decisions ($b_4 = 23.0961$, $t = 4.6304$, $p = 0.0000 < 0.05$).

In Model III, there is a three-way interaction relationship that has a coefficient value of $b_7 = 0.1222$, with a statistical value of $t = 2.5585$, and $p = 0.0107 < 0.05$. These results indicate that there is strong evidence of a three-way interaction between the variables of herding bias (X), gender (W), and the characteristics of the tech-savvy generation (Z). If there is an increase in the interaction between these three variables, the investment decision will increase by 0.1222. Thus, it can be concluded that the moderating effect of gender on the relationship between herding bias and investment decisions is highly dependent on generational characteristics, whether they are tech-savvy or not, among millennial investors.

In Table 4, it can be seen that all variables have a significance level of $p < 0.050$. Thus, this model has a high level of statistical significance. A summary of the model can be found in Table 4 below.

Table 4. Model II Summary I

R	R-sq	F	p
0,6332	0,4009	101,5204	0,0000
Interaction	ΔR^2	F	p
X*W*Z	0,0037	6,5459	0,0107

Source: Data processed 2023

Based on Table 4, the analysis results show that the resulting R-squared (R^2) value is 0.4009. From these results, it can be concluded that the effect of herding bias moderated by gender and the characteristics of the tech-savvy generation on investment decisions is 40% of the variation in the model, while the rest is influenced by other variables outside of this research model.

In addition, the addition of the moderating variable of technology-savvy generation characteristics into this model significantly improves the quality of the model by 0.0037 or about 0.37% ($\Delta R^2 = 0.0037$, F change = 6.5459, $p = 0.0107 < 0.05$). The value of this 'moderation of moderated' equivalent test explains that about 0.37% of the variation in the effect on investment decision can be explained by the interaction between variables X, W, and Z, which in this model has used a mean-centering technique for these variables.

A visualization of the conditional effect of herding bias on investment decision (ID) as a function of gender (GE) and technology literate generation (IT) characteristics in the moderated moderation model can be seen in the graph below:

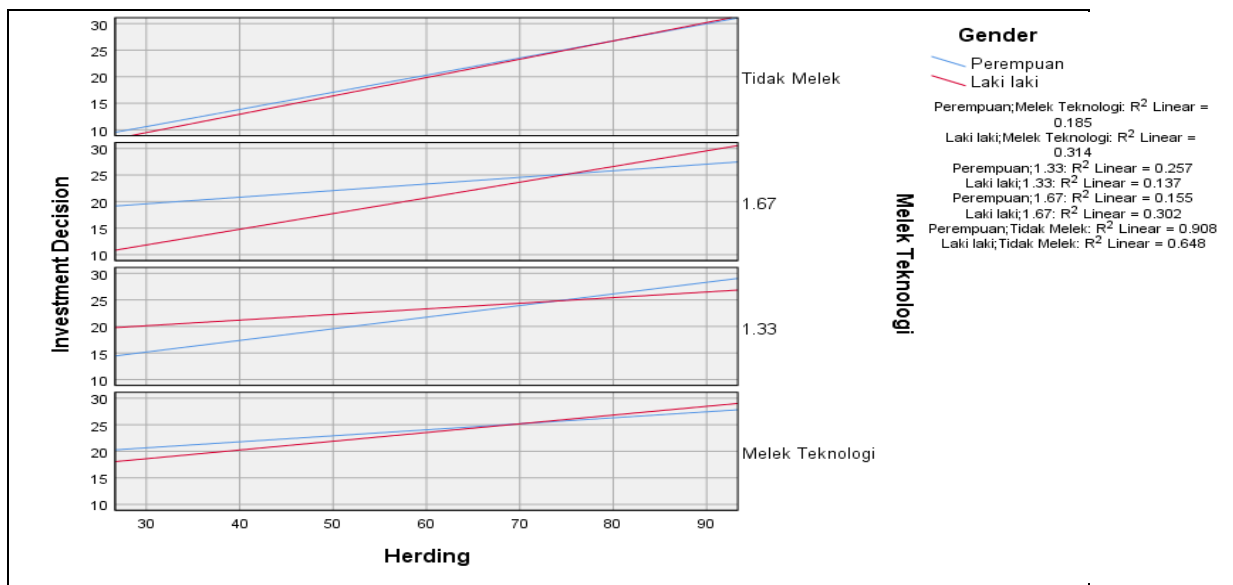


Figure 5. Conditional Effects in Model II I

Source: Data processed 2023

Based on the results of data processing in Model III, it can be concluded that the interaction between herding bias (X) and gender moderation variables (W) in the context of the characteristics of the tech-savvy generation (Z) has a significant impact on investment decisions, with a contribution of 40%. Visually, the difference in this interaction is very evident in Figure 5.

In Figure 5, it can be seen that the effect of herding bias on investment decisions shows a consistent positive pattern. However, the differences in this effect become clear when viewed from various conditions, such as the gender of the investor (male or female) and the characteristics of the millennial generation (tech-savvy or not tech-savvy), as well as its effect on the level of investment decisions made by investors.

Specifically, the effect of herding bias on investment decisions tends to be higher for women who are not technologically literate and men who are not technologically literate. Women who are not technologically literate are 0.908 (90%) prone to bias while men who are not technologically literate are 0.648 (65%) prone to herding bias. So both male investors and female investors who are not technologically literate are more susceptible to herding bias in the investment decision-making process. The effect of herding bias on investment decisions is lower or less on male and female investors who are technologically literate.

Based on the description above, to answer hypothesis 3, whether gender moderates the relationship of herding bias to investment decisions in the emerging Indonesian capital market depends on the characteristics of millennial generation investors who are literate or not literate in technology. So it can be concluded from the results of this study that H0 is rejected. In other words, gender, whether male or female, moderates the relationship between herding bias and the investment decisions of millennial investors in the Indonesian capital market depending on the characteristics of millennial generation investors who are literate or not literate in technology.

5. Discussion

The results of this study provide important insights into the relationship between herding bias and investment decisions in the context of individual investors. Herding bias is a bias that arises in the investment decision-making process and often results in irrational investment decisions in millennial investors.

Furthermore, herding bias is the behavior of following what other investors are doing, especially when there is a market trend or sentiment. When investors have low levels of herding bias, they may be more likely to make independent investment decisions based on sound analysis rather than following the crowd. This can reduce the risk of getting caught up in market trends that may not be based on strong fundamental information (Başarir & Yilmaz, 2019; Galariotis et al., 2015; Mahadevi & Asandimitra, 2021).

These findings suggest that herding bias influences the investment decision-making process of millennial investors in Indonesia. This finding tends to be the same as the pattern of previous research in Indonesia (Asandimitra & Novianggie, 2019), (Natasya et al., 2022) and other emerging countries such as Malaysia (Rahman & Gan, 2020), Pakistan (Bashir et.al, 2013). Behavioral biases that affect investment decision-making are overconfidence bias and herding bias in investors in India (Sharma & Kumar, 2020), (Jain et al., 2020b), herding bias positively affects the investment intention of investors in India (Altaf & Jan 2023), (Gothe & Mishra, 2023). In Turkey, herding bias is found in non-professional investors, they tend to be exposed to herding bias when making large stock investments (Dalgıç et al., 2021).

Herding bias often occurs when market uncertainty increases. During the COVID-19 pandemic, herding behavior had a significant effect on market volatility, causing the market to be inefficient, herding bias affected the construction and performance of investor portfolios in Greece (Gavrilakis & Floros, 2021). In addition, herding bias is seen in investors on the Ho Chi Minh Stock Exchange (HOSE) with falling stock prices leading to pessimistic selling. This knowledge is empirical evidence of herding bias in the Vietnamese stock market proving useful for investors in determining the intrinsic value of stocks and for policymakers who want to improve the efficiency of the equity market (Nguyen, 2020).

Furthermore, in developed countries, herding bias also affects investors' investment decisions such as Spain (Vidal-Tomás et al., 2019). In the UK, there is a significant tendency for investors to be exposed to herding bias, and social information about the decisions of others has an impact on individual investor decisions (Baddeley, 2010). Heterogeneous patterns of herding bias occurred in ten countries including Italy, Sweden, and America during the COVID-19 pandemic, this was due to stricter government measures restricting mobility and was positively associated with economic support (Rubesam & Raimund, 2019). Herding bias tends to occur when market uncertainty increases. However, there is no static herding behavior, herding behavior is significant and varies over time (Bouri et al., 2019).

Based on the results of the study, it is described that herding bias affects the investment decisions of millennial generation individual investors in Indonesia. The findings of this

study tend to be the same as previous research patterns in several emerging countries which suggest that herding bias affects investment decisions. However, the high and low bias that occurs in investors varies between investor groups in a country. The existence of technological advances in developed or developing countries such as India can help in reducing the behavioral bias of retail investors (Bhatia et al., 2020). Different findings in Egypt suggest that with increasing investor experience, investors tend to ignore emotional factors such as behavioral bias cannot affect investment decisions (Metawa, 2019).

The influence of herding bias differs between developing and developed countries, especially in the context of investment and financial decision-making. This factor may affect the way millennials in developing and developed countries access market information, conduct financial transactions, and manage investment portfolios.

In emerging economies, access to investment platforms and market information may be more limited in developing countries. Millennials are more dependent on limited sources of information, which may increase the potential for information bias. In addition, financial literacy levels are lower among millennials. Lack of investment experience due to underdeveloped financial markets or lack of opportunities to invest may make millennials in emerging economies more susceptible to herding behavior or decisions based on emotions.

Furthermore, gender on herding bias suggests that both women and men are vulnerable to herding bias, women among the millennial generation in Indonesia tend to be affected by herding bias more often than men. This is because women are more influenced by social opinions and opinions. Herding bias reflects group behavior in which a person follows the decisions or actions of the majority. If women are more sensitive to social expectations, they tend to be more susceptible to herding bias. In addition, if they lack knowledge and experience in investment, women are more likely to follow majority decisions or market trends as a way to reduce risk or financial insecurity. Furthermore, intense communication and social interaction as well as information patterns obtained through social media or other online platforms so that they are more likely to follow trends and majority opinions can increase herding bias.

This finding tends to be in line with previous research patterns in several other emerging countries such as Malaysia, behavioral factors that influence individual investment decisions such as herding bias. Investment decision-making among investors in Malaysia differs significantly when viewed or moderated by gender, employment status, and income allocation (Rahman & Gan, 2020). Female investors show a higher preference for stock trading volume, stock price, and dividend payments compared to male investors, so there is a gender gap in investment behavior (Tariqul, 2016).

Herding bias also occurs in investors in developed countries such as the UK. Investors in the UK tend to follow group decisions, as revealed by these findings using Bayesian statistical inference principles. This research describes the results of a herding task designed to better understand the analysis. The strong tendency to follow the group and be informed by the decisions of others affects individual decisions. This research involves identifying the relationship between herding bias tendencies and individual characteristics such as gender, age, and personality traits such as impulsivity and adventurousness (Baddeley et al., 2010).

Based on the thoughts of several previous studies, there is important information that behavioral biases such as herding bias affect investment decision-making while gender, both male and female, tends to moderate and clarify this biased behavior. So in the context of investment decision-making, there is a tendency for behaviors influenced by herding bias to tend to take excessive risks, decisions based on limited information, or follow the market flow. Importantly, however, gender, whether male or female, can act as a moderating factor, reducing the impact or controlling the intensity of the herding bias.

This provides further insight into how gender differences may affect the way an individual assesses and responds to financial information.

Furthermore, the results of this study suggest that in generational characteristics other than gender, technological literacy can also moderate the relationship between behavioral bias and investment decisions in millennial-generation investors in Indonesia. In this study, technologically literate are than those who are not technologically literate, namely 65% of investors know technology.

The results of this study outline that female and male investors who are not technologically literate are more susceptible to herding bias than female and male investors who are technologically literate do not experience herding bias. So both women and men who are technologically literate can reduce the influence of herding bias.

The findings of this study tend to be in line with the pattern of previous research in other emerging economies such as India, Robo-advisors can help in reducing the behavioral biases of both female and male retail investors in making investment decisions. However, Robo-advisors still need to reduce investor bias when conducting risk analysis and creating investor profiles (Bhatia et al., 2014). Furthermore, there is a relationship between the tendency of herding bias and individual characteristics such as gender, age, and personality traits in investors in the UK. (Baddeley et al., 2010). Personality traits and investor characteristics have a positive effect on investment decision-making (Rehman et al., 2023).

Generational characteristics (technology) moderate herding bias in investment decisions. Millennials, born between 1981 and 2000, grew up in the digital age, leading to a strong emphasis on technology-enabled investing tendencies. These generational differences in investment are influenced by each group's unique historical, economic, and technological experiences, thus shaping their attitudes and behaviors toward financial decisions (Brosdahl & Carpenter, 2011). Millennials' use of social media has both positive and negative consequences for their behavior and well-being, impacting individuals, companies, and society as a whole. The existence of technology and information can reduce herding biases in gender in making investment decisions.

Based on the discussion above, the results of this study can be drawn as important information that the millennial generation is a generation that lives in the digital era, which leads to a strong emphasis on the tendency to invest in technology. These generational differences in investment are influenced by the unique historical, economic, and technological experiences of each group, thus shaping their attitudes and behaviors toward financial decisions (Brosdahl & Carpenter, 2011). However, both women and men are vulnerable to herding bias in investment decisions, although women experience more herding bias than men. In addition, groups of women who are not technologically literate tend to be very vulnerable to herding bias. So the more technologically literate female investors are, the more they can reduce bias and vice versa. Likewise, the more technologically literate men are, the more they can overcome herding bias. So both female and male investors are more technologically literate, the more they can overcome herding bias towards investment decisions and vice versa. The results of this study when compared with other emerging countries tend to have the same pattern that both men and women are still vulnerable to herding bias. This is because there is still a lack of technological knowledge in investment and investment goals are still a lot of short and medium term so there is not much experience in long-term investment. In addition, psychological, economic, educational, and market structure factors also affect behavioral bias.

6. Conclusion

Based on the results of the study investigating herding bias, investment decisions, gender, and technology-savvy generational characteristics of individual investors in Indonesia, several important conclusions can be drawn:

1. This study found that herding bias affects the investment decision-making of investors in the millennial generation in Indonesia. The findings of this study tend to be similar to previous research patterns in several emerging and developed countries. However, in developed countries, herding bias is lower due to more sophisticated technological factors. The magnitude of the influence of this bias varies, due to several factors such as access to technology and information, level of financial literacy, personality, market structure, investment experience, and economy. These factors can influence the way millennials access market information, conduct financial transactions, and manage investment portfolios.
2. This study also highlights that gender can moderate the influence of herding bias on investment decisions. Both female and male investors are susceptible to herding bias. Women among the millennial generation in Indonesia tend to be affected by herding bias more often than men in making investment decisions.
3. This study shows that gender can moderate the effect of herding bias on investment decisions, which is moderated again by the characteristics of a technologically literate generation. There are differences in the effect of herding bias on investment decisions of gender (male or female) and millennial generation characteristics (technologically literate or not technologically literate), as well as its effect on the level of investment decisions made by investors. Female and male investors who are not technologically literate are highly susceptible to herding bias and conversely, female and male investors who are technologically literate are less exposed to herding bias. So technological literacy can reduce herding bias that occurs in investors in making investment decisions.

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