Journal of Money and Economy
Vol. 18, No. 3, Summer 2023
pp. 387-416
DOI: 10.61186/jme.18.60.387

Original Research Article

Simulating the Shareholders' Behavior Pattern in Capital Market Considering the Monetary Policies of the Central Bank of Iran

Elnaz Zoghi[*] **Mehdi Pedram**[†]

Received: 14 Dec 2023 Approved: 21 Oct 2024

The purpose of this article is to simulate the behavior pattern of shareholders in the Iran's capital market according to the monetary policies of the Central Bank of Iran. The research method in the first stage was qualitative (interview) and in the second part it was quantitative (statistical and inferential tests). According to the purpose of the research, the research method was of fundamental-applied type and based on the research method of survey type. The statistical population of the research consists of the shareholders of the Tehran Stock Exchange, whose number was about 650 stock companies until the end of the fiscal year 2023. Semi-structured interviews with experts of this market have been used to identify model indicators. Then, by coding the data obtained from the interviews, a research questionnaire was designed. Finally, to extract the model from the factor-based model (ABM) using the exploratory factor analysis method, Netlogo software was used for simulation.

The investigated period can be divided into three periods without applying a targeted monetary policy to control the behavior of shareholders. The first period is the period when economic variables such as exchange rate, inflation rate and interest rate are constant. In this situation, the number of buyers in the capital market has increased and purchases have taken place in this market (in this purchase, the share of emotional buyers is higher). In the second period, when inflation decreases and the interest rate remains the same, the number of shareholders in the market is reduced, but purchases still occur, but the share of volatile buyers is higher in this period. In the third period, when the inflation rate and the interest rate both increase, with the greater effect of expansionary policies (increasing the volume of money) than the increase in the interest rate, the number of shareholders and the amount of purchases increase.

[*] Department of Economics, Faculty of Social Sciences and Economics, Alzahra university, Tehran,Iran; Email: e.zoghi93@gmail.com
[†] Department of Economics, Faculty of Social Sciences and Economics, Alzahra university, Tehran,Iran; Email: mehdipedram@alzahra.ac.ir (Corresponding Auther)

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[DOI: 10.61186/jme.18.60.387]

The study of the behavior of shareholders and their buying and selling in this market indicates that the profit from the buying and selling of volatile shareholders in the period under review is more than that of emotional shareholders and shareholders who hold their shares for a while in order to gain profit with a long-term view.

The results indicate that due to uncertainty, this market, which has the nature of long-term financing, has lost its function and the shareholders' view of this market is short-term profit.

Keywords: Agent-Based Model, Simulation. Shareholders' Behavior Pattern, Monetary Policies.
JEL Classification*:* C63, E37, G41 , E58

1 Introduction

The main basis of the neoclassical school of economics is based on the principle of rational behaviour of individuals and companies in the economy, but the theory of behavioural finance, taking into account psychological issues in financial knowledge, challenged the basic principle of neoclassical economics and tried to identify human psychological phenomena in the entire market. Unlike classical economists, psychologists believe that economic man ignores the internal conflicts of individuals (Ritika and Kishor, 2022; Ghosh and Dutta, 2021). On the other hand, in classical economic models, people's decision-making is not done by adjusting existing incompatibilities between their individual goals and their social value, which has no place in the definition of rational economic models (Yue et al., 2020). It was the occurrence of such conflicts that gave rise to the presentation of behavioural models.

Behavioural finance theory focuses on emotional judgments because these judgments can disrupt the decision-making process and lead to sub-optimal results, the reason for this is that emotions dominate people's control and shape their behaviors (Carboni and Medda, 2021; Park et al., 2020).

In the last decade, the use of monetary policy rules to evaluate and describe the central bank's policy performance in different markets has expanded rapidly, and currently, these rules are used by financial market analysts and monetary policymakers (Wang and Xia, 2022). Since monetary and financial policies play an important role in the economic stabilization of developing countries, economic policymakers in such countries, by applying monetary policy tools and evaluating its effect on other macroeconomic variables, can aim to achieve the desired results, but despite the importance given to monetary policy in these countries, the mechanism of monetary policy influence has not been seriously studied. Therefore, there is a noticeable research gap in the field.

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Researchers believe that not all stakeholders have the same perception of information and even their sources of information are different, which causes them to not react the same to trades (Liao et al., 2022; Reddic, 2021; Wang et al., 2019; Li and Wang, 2019). In this regard, the results of research conducted in this field indicate that shareholders may behave irrationally; that their behaviour leads to cognitive bias or psychological factors of shareholders and can have an impact on their investment decisions (Wang et al., 2022; Jani, 2021). Therefore, the volatility of the stock price is not only dependent on the subjective perceived value of the shareholder but also reacts to the irrational behaviour of the investors, which can be used to measure the intentions of the shareholders.

Another important issue is that existing research indicates that the behavioural factors that result from monetary policy changes can influence the shareholders' desires; however, few studies in this field have been able to explain how this relationship is presented. In this regard, Rahmani et al. (2021) presented a framework to explain the effect of monetary policies on the stock index in the capital market and the behaviour of investors. They showed that the transmission of monetary shocks to the capital market imposes many fluctuations on this market and monetary policy, as a political variable at the macro level and as part of an individual's asset portfolio can affect the stock index. Therefore, according to the importance of this issue in monetary markets, the present research has focused on modelling the behavior of common and preferred shareholders towards monetary news or monetary policy changes of the central bank. In the next parts of the paper, the review of the literature and the background of the research are discussed, then the research methodology is presented, and then the results of the data analysis and the discussion and conclusions of the research are presented.

But looking at the state of the stock market in Iran, it shows that in recent years, on the one hand, this market has grown significantly, so that the total price index of the stock market, which is the most important indicator that shows the behavior and state of the stock market during the period The investigated item has increased more than 4 times. And the ratio of transaction value to GDP, which indicates the depth of the capital market, reached from 0.04 at the beginning of the period to 1.2 in the best days that the market experienced in that year. Also, the number of companies in the stock market increased from 343 to 650 at the end of the period. On the other hand, Iran's stock market, like most developing countries, has a high degree of extreme price fluctuations and stock returns, and these fluctuations have caused the loss of investors' confidence. And the monetary base, as the main monetary

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instrument of the central bank, has tripled during this period, which shows the high monetary growth and the existence of monetary irregularities in the country, and indicates that the policies of the central bank, as a deterrent to this instability, it did not have the required efficiency.

Since monetary policies are no longer capable of explaining this market behavior, the role of behavioral finance in clarifying the behavior of shareholders becomes prominent. Behavioral finance is a subset of behavioral economics that focuses more on human decisions in financial markets. In this decision-making, concepts such as limited logic, cognitive biases and biases, the role of information and its source, reference-related preferences, the role of emotions and learning, must be considered.

This article consists of five parts, the first part is the introduction, the second part is the subject literature, the third part is the methodology, the fourth part is the research findings and the last part is the result of the current research.

2 Literature Review

In economic literature, man is a rational being who makes decisions with complete information. This rational creature always seeks to optimize its desired interests and by collecting all the information that affects its options and decisions, it creates an ideal situation for itself.

In recent years, by simultaneously studying behaviorism, psychology, sociology, decision-making patterns, and behavioral models, they built their theories based on hypotheses in opposition to the basic hypotheses of modern finance by violating the two basic hypotheses of the rationality of investors and the efficiency of markets. These studies have shown that due to the lack of accountability of modern finance alone in the analysis of some phenomena in the financial markets, proponents of behavioral finance believe that the behavioral and psychological aspects of investors, as well as the recognition of their decision-making patterns, in modeling behavior and investment decisions play a role (Hsu and Chow, 2013).

The fundamentalists believed that by analyzing the key financial and economic variables, the real value of stocks could be estimated with the "Efficient Market Theory". According to this theory, in the long term, no one earns more returns than the amount of risk he has incurred. In such a market, the share price reflects the information related to that share, and its price fluctuation does not have a specific and predictable pattern. If the market is indifferent to new information and does not show the necessary reaction, the

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market is no longer efficient. But in the 1990s, econometric analyses of time series of prices, cash profits, and earnings led to models that linked people's psychology to financial markets. Based on this, researchers faced many contradictions in financial markets and the belief was formed in them that psychological phenomena play an important role in determining behavior in financial markets (Barberis and Thaler, 2003).

Dressler and Mugerman (2022) concluded that forecasts of future rates in the stock exchange are highly sensitive to economic status and are therefore stable during periods of monetary policy uncertainty. This volatility in rate forecasts should affect consumption and investment decisions and thus overall economic activity, and this is important for central banks because it highlights the key role of clear communication for effective monetary policy implementation. Klyver et al. (2017) developed and examined a gendered social capital model of altruistic investment behaviour that describes why several informal investors expect high returns on their investments while others expect no payback at all.

Determining the role of psychological phenomena in determining the behavior of financial markets was expanded by researchers in this field in the 1990s. As a result, despite the presentation of previous theories, they encountered new deviations in this field, which has been manifested under the title of behavioral finance (khojasteh et al., 2017).

The channel of influence of monetary policy on the financial behavior of shareholders:

From an empirical point of view, evaluating the effectiveness of monetary policy transmission channels leads to better decision-making by the central bank by creating a suitable insight. Monetary transmission is a process that transfers monetary policy measures to the economy and is considered a central issue in macroeconomic discussions. The structural features of the economy and financial markets affect the effectiveness of different channels of monetary policy transmission. Monetary policy works mainly by affecting the total demand and its direct effect on the supply side of the economy depends on the degree of interest rate stability and price stickiness. There are several channels for monetary policy transmission, but the effectiveness of this mechanism varies among different countries. This is due to the difference in the extent and volume of financial intermediation, the difference in the development of domestic capital markets and the structural conditions of the economy (Cevik, 2012).

In general, in the last decade, monetary policy has been the center of gravity of discussions related to improving sustainable growth and low

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inflation in every economy. In order to succeed in such a serious matter, the monetary authorities must have an accurate assessment of the timing and effect of monetary policies on the economy, so it is necessary to know the mechanism by which monetary policy affects the economy and macroeconomic variables (Meshkin, 1996). In this regard, the channels of monetary policy influence and the transmission of its effects should be investigated. These channels are as follows:

Interest rate channel: The interest rate channel is the standard path of monetary policy transmission from Keynesian's point of view, in such a way that the reduction of real interest rate reduces the cost of capital and increases investment expenses. As a result, total demand and output (product) also increase. Lower real interest rates increase commercial fixed capital, domestic household investment, durable consumer spending, and capital stock, and all of the aforementioned items also increase total output (production). Of course, in many New Keynesian discussions, the effect of monetary policy on consumption is the main axis. This works by changing the real interest rate and its effect on the future outlook of consumers. Of course, a part of household expenses that is transferred from one period to the next due to the change in the real interest rate may be insignificant and may even be different in different economies and countries (Milles, 2015).

Credit channel: Monetary policy should show its transfer effect not only by influencing loan demand, but also by influencing the supply of loans. The credit channel can be divided into two separate channels including the bank lending channel and the balance sheet channel (Mukherji, 2014, 5).

Based on the lending channel of banks, the contractionary monetary policy such as increasing legal reserves causes a decrease in the usable reserves of commercial banks. Also, the controlled monetary policy reduces the attraction of deposits in commercial banks by affecting economic activities and as a result, reducing the supply of existing loans, especially to small companies, and reducing investment activities. Monetary policy also affects the balance sheet of companies. In the sense that it affects the value of assets that companies can use as collateral. High interest rates reduce cash flow and affect the price of financial assets in a negative direction, and as a result, reduce the net worth of companies and investment expenses. Weaker balance sheets also increase the issues related to inappropriate selection and moral hazard, and lead to a decrease in companies' access to loanable funds, thus affecting investment and national production.

Asset price channel: The asset price channel includes two channels, including the exchange rate channel and the shareholder's asset value channel.

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The exchange rate channel is activated when policy rate adjustments (central bank) cause leverage changes in the short-term market, deposit rates and facilities. The placement of the exchange rate next to the lending channel of the banks causes the effect of the exchange rate to expand on the output. Also, the exchange rate reacts to changes in the short-term rates of government bonds (Ghazanchyan, 2014). In countries with flexible exchange rates, the exchange rate channel can be a stronger mechanism for the effects of monetary policy (Mukherjee, 2011). There are two channels that are related to the equity channel and are important in discussing the monetary policy transmission mechanism.

Dahmene et al. (2021) examined nonlinearity in stock returns. They investigated the role of risk aversion, investor sentiment and monetary policy shocks in stock returns and found that after a positive shock to the volatility index for most of the markets, index returns fall as investors become more risk averse. They concluded that a restrictive monetary policy negatively affects index returns, in the low regime for some countries, and such an effect turns to be larger in the high regime for more liquid markets. According to the heterogeneous reactions of market participants and the degree of compensation for taking additional trading risks, the market smoothly switches from bear to bull states, when investors exhibit extreme pessimism or optimism.

These two channels are: Tobin's q theory regarding investment and the effect of wealth on consumption. Tobin provides a mechanism to influence the monetary policy of the economy by influencing the value of the company's assets. Tobin defines q as the market value of companies that is distributed by the replacement cost of capital. If q is high, the market value of the companies is high compared to the replacement cost of capital, and capital machinery and equipment will be cheaper than the market value of commercial companies, and as a result, companies can issue shares. This leads to an increase in capital and ultimately total production in the economy. In the discussions of monetarists, when the supply of money increases, the society estimates it more than its needs and therefore, tries to reduce the amount of money kept by increasing its expenses. A suitable place to spend money is the stock market, which can increase the demand for stocks and, as a result, increase their prices, and with the increase in stock prices, the market value of companies, or Tobin's q, increases (Meshkin, 1996). Another channel of monetary policy transmission is realized through the value of shareholders' assets through the effect of wealth on consumption.

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Rajasekar et al. (2022) concluded that personality traits (extraversion, emotional stability, conscientiousness, agreeableness, and openness to experience) are positively correlated to investment attitude and investment strategy. They found that risk capacity moderates the link between personality traits and investment attitude. Also, investment priority moderates the link between personality traits, risk capacity and investment strategy through investment attitude. Nayebmohseni et al. (2022) found that fundamental factors which influence investors' decision-making include: regret aversion, cognitive dissonance, reputation, anchoring, self-attribution biases, greed, fear, loss aversion, gambling pleasure, endowment bias, representativeness biases, false excitement, investment thinking, herding behaviour, overconfidence biases, hindsight bias, trading asymmetry, similarity error, magnet effect, regency bias, mental accounting, the illusion of control bias, gambler's fallacy, experience, age, gender, motivation, time horizon, first profit effect.

Artana et al. (2022) believe that a flexible financial law helps reduce the negative effects of financial fluctuations on the capital market. They noted that after a positive shock to the volatility index in most markets, the return of the index decreases because investors become more risk-averse. Gorjizadehbaee and Khan Mohammadi (2021) examined the behaviour of individual investors after the release of financial statements. They reported that the release of financial statements (good or bad news) has a significant effect on the behaviour of individual investors.

Liao et al. (2022) showed that the investment strategies and behaviours of shareholders are different and past transactions (trades) activities of individual investors have had a significant impact on their current trading behaviours more than any other factor.

Pourmansouri et al. (2022) examined the nexus between Major Shareholders' Behavior and Corporate Governance Performance before and after the Pandemic. They asserted that the existence of uncertainty and risk in the economy causes a change in the expected effects of policies, the impossibility of planning, and a change in investment behaviour, and as a result, it causes a decrease in economic growth. Sarfaraz et al. (2022) analyzed the investment behaviour in the Iranian Stock Exchange during the COVID-19 Pandemic. They proposed a Hybrid DEA and Data Mining techniques to analyse the investment behaviours. They found that, among 23 industries listed on the stock market in Iran, only nine were efficient in 2019. Moreover, in 2020, the number of efficient industries further decreased to six industries.

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Rahmani et al. (2021) examined the impact of financial and monetary policy on the stock market using the DSGE Model. They reported that a positive money shock leads to a rise in Shareholders' investment, stock price index, and inflation. They asserted that the reaction of the stock demand to the money supply shock was negative and the reaction of stock demand and stock price index to the government expenditure shocks was negative. Besides, a stock market shock leads to a rise in inflation. So, it might have a different effect on shareholders' investment behaviour.

3 Methodology

The research method in the first stage was qualitative (interview) and in the second part it was quantitative (statistical and inferential tests). According to the purpose of the research, the research method was of the fundamental-applied type, and according to the research method, it was of the survey type. The statistical population of the research consisted of all the preferred shareholders of the Tehran stock exchange, whose number was about 350 registered by the end of the fiscal year 202۳. Semi-structured interviews with twelve experts were used to identify the indicators of the model and to discover the initial hidden dimensions in the research variable. Then, by coding the data obtained from the interviews, a research questionnaire was designed. In order to choose the appropriate test for the exploratory factor analysis test, it is necessary to examine the assumption of normality of the research constructs. For this purpose, the Kolmogorov-Smirnov test was used. Also, the Agent-Based model (ABM) was used to extract the model using the exploratory factor analysis method, which is a suitable method for simulating complex economic and social systems (e.g. Steinbacher et al., 2021). Finally, Netlogo software was used for simulation.

3.1 Mathematical Model

Agent-based modeling grew out of research on nonlinear dynamics and artificial intelligence and was facilitated by the introduction of personal computers in the 1980s and early 1990s. An agent-based model is a computer program that creates an artificial world of heterogeneous agents and enables the investigation of interactions between these agents and other factors and aspects such as time and space, and adds them together to form patterns that exist in the real world. Typically, an agent represents a person, but it can be a household, a firm, or even a country.

As mentioned, in this model, the factors are divided into two categories: shareholders and the central bank, and the modeling is done using NetLogo

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software. In the following, the required inputs of each of the factors and how they function are examined separately.

In the research model, the identified factors were investigated in two categories of "shareholders' behaviour" and "the monetary policies of the central bank". In the following, the required inputs of each of the above two factors and how to evaluate them are explained.

3.1.1 Shareholders' Behavior

The stakeholders in the research model were assumed to have feelings that their behaviour pattern follows an exponential distribution according to Garas (2012). The exponential distribution model is expressed as follows:

If X is a continuous random variable with support of non-negative real numbers and its density function is written as follows, it has an exponential distribution:

$$f(x) = \lambda e^{-\lambda x} \qquad x > 0 \tag{1}$$

In this case, we write X-E(λ) and read that X has an exponential distribution with parameter λ. Of course, sometimes the following representation is used to display the density function (probability mass) of such a random variable:

$$f(x) = \frac{1}{\theta} e^{\frac{-1}{\theta}x} \qquad x > 0 \tag{2}$$

It is clear that in the above equation of the density function, there is the following relationship between θ and λ:

$$\lambda = \frac{1}{\theta}$$

In the exponential distribution, we know that the average number of events (success or failure) per unit of time is the same as the Poisson distribution parameter, λ. That is, in each unit of time, λ times of success are observed on average. As a result, one can expect to observe an event during $1/\lambda$ time. Therefore, the average length of time to reach the first success in the exponential distribution is equal to θ. For this reason, sometimes equation 2 is used instead of equation 1 to represent the density function, so that the probability density function has a parameter that represents the average length of waiting time to reach the first success.

In this approach, the sentiments of the shareholders are determined based on the amount of their assets, in such a way that shareholders with low assets

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are considered dissatisfied, shareholders with large assets are considered satisfied, and shareholders with medium assets are considered neutral, but shareholders with medium and large assets are also considered unhappy if they find themselves in a situation where their tolerance exceeds their emotional threshold. Here, 20 shareholders are considered and we determined the level of the emotional state of the first category "react", the second category "do not react" and the third category "react with a slower speed". Therefore, shareholders are divided into two groups in terms of personality type: personality type A is a group in which if any of their shareholders buy or sell shares, they will also buy or sell shares. Personality type B is the people who need at least 20% of the shareholders to revolt against the change of the central bank's monetary policies so that they also react.

The percentage of shareholders with personality types A and B was collected through the questionnaire of personality types A and B. According to the statistical results obtained from the data analysis of the personality type questionnaire, 38% of the shareholders had an A personality type and 62% had a B personality type.

Dissatisfied shareholders who buy and sell according to their personality type should be restrained by the central bank's monetary policies. In the user interface, there is a capital market that includes the probability of the shareholders being affected by the policies of the central bank. Therefore, based on this number, the government's incentive policies are also effective (of course, the reward that the central bank receives from the government is also effective in motivating him to be more loyal to the government.) Therefore, the probability of shareholders being harmed must be determined. If this value is low, dissatisfied shareholders will leave the market and the probability of the shareholders being harmed is low because according to the instructions and behaviour observed from the central bank, the central bank does not fundamentally change monetary policies unless they are pressured by the government or the economic situation is dire. In this research, this probability was considered equal to 4% according to the proportion of situations that happened during consecutive years.

3.1.2 The Monetary Policies of the Central Bank

The relative number of monetary policies of the central bank is also specified in the user interface of the model, which according to the ratio of 1 to 5 monetary policy shareholders of the central bank to the population of shareholders, 70 monetary policy shareholders were considered in the model. For this purpose, we included 20% of the considered 350 preferred shareholders in the research model. The monetary policies of the central bank,

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like the shareholders, follow an exponential distribution presented in equation 1 and 2. If the monetary policies have high benefits, they will be satisfied and if they have low benefits, they will be dissatisfied. The central bank, like the shareholders, can observe their surroundings and have a memory of the events; therefore, published news or information rent and changes in monetary policies such as interest rates and taxes are among the factors that are effective in the reaction of industrial shareholders and in this research was used.
The model runs for two weeks in each period and a maximum of 150 periods (depending on the combination of factors and parameters) were implemented, which was equivalent to 300 weeks (about 5 years).

4 Results

4.1 Results of the Research Model Analysis

The investigated period can be divided into three periods without applying a targeted monetary policy to control the behavior of shareholders. The first period is the period when economic variables such as exchange rate, inflation rate and interest rate are constant. In this situation, the number of buyers in the capital market has increased and purchases have taken place in this market (in this purchase, the share of emotional buyers is higher). In the second period, when inflation decreases and the interest rate remains constant, the number of shareholders in the market is reduced, but purchases still occur, but the share of volatile buyers is higher in this period. In the third period, when the inflation rate and the interest rate are both increasing, the number of shareholders and the amount of purchases are increasing with the greater effect of expansionary policies (increasing the volume of money) than the increase in the interest rate.

The results indicate that regardless of the monetary policies of the central bank, the shareholders who have a long-term view of profit from this market have received less profit than the volatile shareholders in this market.

The results indicate that due to uncertainty, this market, which has the nature of long-term financing, has lost its function, and the shareholders' view of this market is short-term profit.

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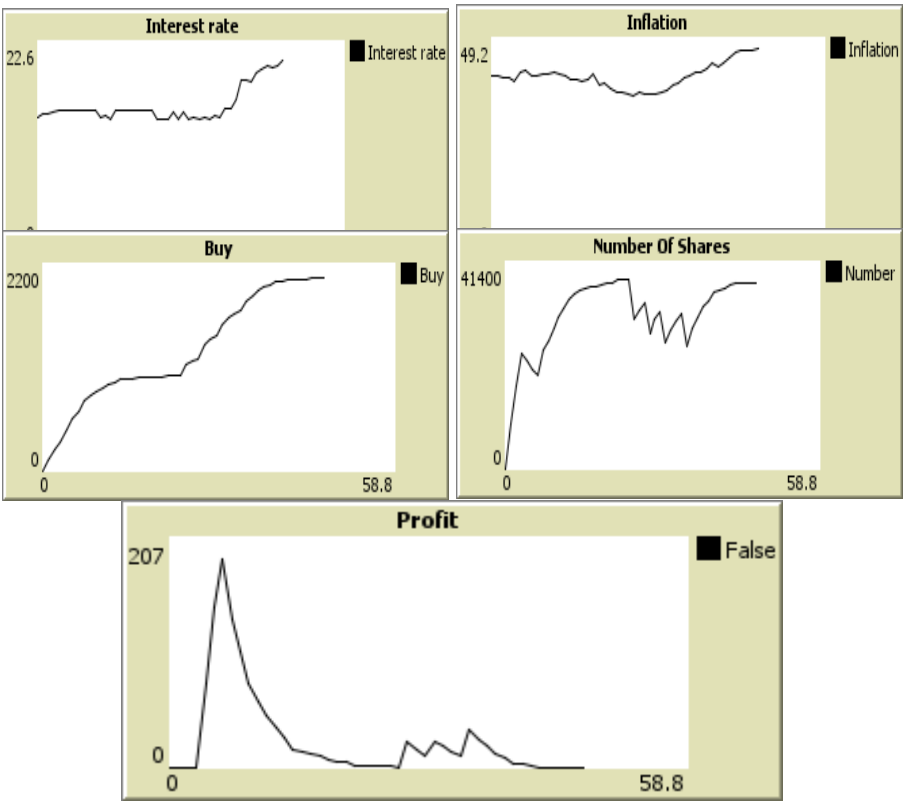

Figure1. The stock market in the last five years regardless of the characteristics of the shareholders' behavior
Source: Research findings
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The most important output of the model is the state of the shareholders, which is displayed in the NetLogo program and includes the states of effective monetary policies, victory of the shareholders or the government. If the number of affected shareholders reaches zero, the model will stop with the victory of the central bank's monetary policies. If all the shareholders do not pay attention to the change in the central bank's monetary policies, the model will stop with the victory of the shareholders, and in other cases, the model will stop after 150 execution periods with the result of system disruption.

The results of the research model analysis were as follows:

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A) The first status: Assuming the change of monetary policies (such as interest rate, money volume) with the behaviour of the shareholders, the model was run 9 times, and the results have been presented in Table 1.

Table 1
The results of the model assuming a high level of profit for shareholders with Interest Rate Policy

Runtime	**Results**	**Periodicity**	**Shareholders' Number**	**Dissatisfied Shareholders' Number**	**Affected Shareholders' Number**	**The number of people who refuse to implement monetary policies**	**The number of people dissatisfied with the change in monetary policies**
1	Interest rate	102	202	18	148	0	0
2	Interest rate	113	191	13	159	0	0
3	Interest rate	135	134	20	216	0	0
4	Affected Shareholders	150	162	11	188	0	0
5	Interest rate	109	182	13	168	0	0
6	Affected Shareholders	150	184	10	166	0	0
7	Interest rate	110	182	14	168	0	0
8	Affected Shareholders	150	165	10	185	0	0
9	Interest rate	138	152	12	198	0	0

Source: Research findings

As shown in table 1, as a result of running the model with these assumptions, there have been 6 times of interest rate change policy and 3 times of affected shareholders.

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Table 2
The results of the model assuming a high level of profit for shareholders with the Money Volume Policy

Runtime	Results	Periodicity	Shareholders' Number	Dissatisfied Shareholders' Number	Affected Shareholders' Number	The number of people who refuse to implement monetary policies	The number of people dissatisfied with the change in monetary policies
1	Money Volume	130	230	23	143	0	0
2	Money Volume	134	240	15	143	0	0
3	Money Volume	135	213	26	209	0	0
4	Money Volume	150	173	10	190	0	0
5	Money Volume	145	176	27	157	0	0
6	Affected Shareholders	150	180	10	160	0	0
7	Money Volume	128	176	17	161	0	0
8	Affected Shareholders	139	183	19	175	0	0
9	Money Volume	142	191	21	194	0	0

Source: Research findings

As can be seen in Table 2, the result of running the model with these assumptions shows that 7 times the policy of changing Money Volume and 2 times Affected Shareholders have occurred.

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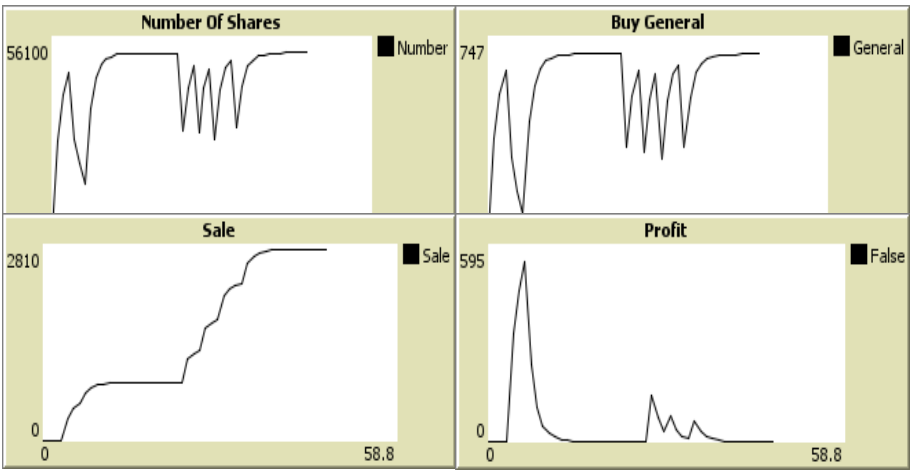

Figure 2. The behavior of shareholders assuming the stability of monetary policy
Source: Research Findings

b) The second status: Assuming the change of monetary policies and the average level of profitability of shareholders due to monetary policies, the model was run nine times and the results are presented in Table 3:

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Table 3
The results of the model assuming an average level of profit for shareholders with Interest Rate policy

Runtime	Results	Periodicity	Shareholders' Number	Dissatisfied Shareholders' Number	Affected Shareholders' Number	The number of people who refuse to implement monetary policies	The number of people dissatisfied with the change in monetary policies
1	Affected Shareholders	150	225	16	125	18	18
2	Affected Shareholders	150	199	18	151	11	11
3	Affected Shareholders	150	191	25	159	17	17
4	Affected Shareholders	150	166	16	184	12	12
5	Affected Shareholders	150	148	13	202	15	15
6	Interest Rate	116	192	22	158	17	17
7	Interest Rate	142	160	7	190	16	16
8	Affected Shareholders	150	210	19	140	7	8
9	Affected Shareholders	150	179	11	171	16	16

Source: Research findings

As can be seen in Table 3, the result of running the model with these assumptions was 7 times of shareholders and 2 times of interest rate change policy. Therefore, it is clear that in this case, compared to the previous case, the probability of effective interest rate change policy is less and affected shareholders are more likely.

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Table 4
The results of the model assuming an average level of profit for shareholders with the Money Volume policy

Runtime	Results	Periodicity	Shareholders' Number	Dissatisfied Shareholders' Number	Affected Shareholders' Number	The number of people who refuse to implement monetary policies	The number of people dissatisfied with the change in monetary policies
1	Affected Shareholders	150	225	16	125	18	18
2	Affected Shareholders	150	199	18	151	11	11
3	Affected Shareholders	150	191	25	159	17	17
4	Affected Shareholders	150	166	16	184	12	12
5	Affected Shareholders	150	148	13	202	15	15
6	Money Volume	116	192	22	158	17	17
7	Money Volume	142	160	7	190	16	16
8	Money Volume	150	210	19	140	7	8
9	Money Volume	150	179	11	171	16	16

Source: Research findings

As can be seen in table 4, the result of running the model with these assumptions was 5 times of shareholders and 4 times of money volume change policy. Therefore, it is clear that in this case, compared to the previous case, the probability of effective money volume change policy is less and affected shareholders are more likely.

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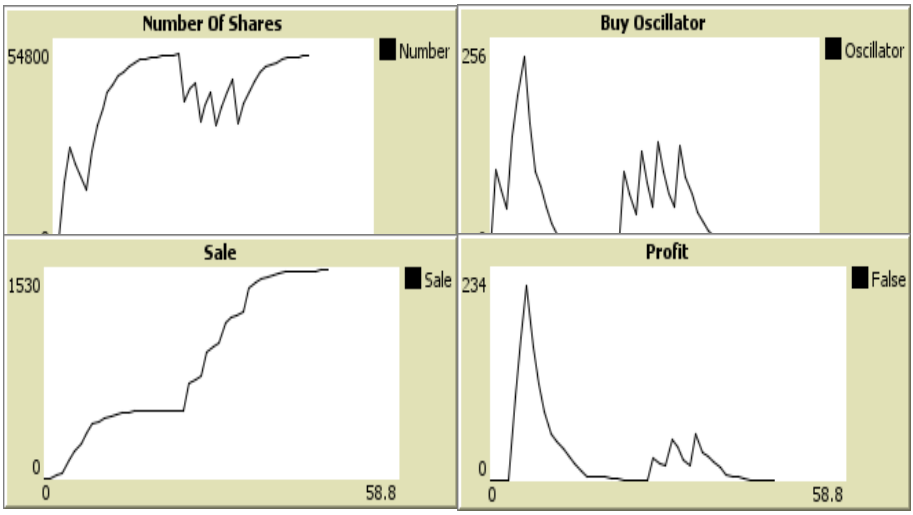

Figure 3. The behavior of shareholders assuming a change in monetary policy (change in interest rate)
Source: Research Findings

c) The third status: when the change in monetary policies (Interest Rate and Money Volume) and the low profitability level of the shareholders caused by monetary policies (Interest Rate and Money Volume): the model was executed 9 times and the results have been presented in Table 5.

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Table 5
The results of the model assuming a low level of profit for shareholders with the Interest Rate policy

Runtime	Results	Periodicity	Shareholders' Number	Dissatisfied Shareholders' Number	Affected Shareholders' Number	The number of people who refuse to implement monetary policies	The number of people dissatisfied with the change in monetary policies
1	shareholders' interest	5	349	346	1	70	70
2	shareholders' interest	4	346	345	4	70	70
3	shareholders' interest	5	343	342	7	70	70
4	shareholders' interest	5	347	346	3	70	70
5	shareholders' interest	5	347	345	3	70	70
6	shareholders' interest	4	349	346	1	70	70
7	shareholders' interest	5	346	345	4	70	70
8	shareholders' interest	4	348	347	2	70	70
9	shareholders' interest	4	347	346	3	70	70

Source: Research findings

As can be seen in table 5, the result of running the model with these assumptions has been to the detriment of the shareholders in all 9 times with the change of interest rate.

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Table 6
The results of the model assuming a low level of shareholders' interest considering changing money volume policy

Runtime	Results	Periodicity	Shareholders' Number	Dissatisfied Shareholders' Number	Affected Shareholders' Number	The number of people who refuse to implement monetary policies	The number of people dissatisfied with the change in monetary policies
1	shareholders' interest	5	346	347	1	70	70
2	shareholders' interest	4	349	349	3	70	70
3	shareholders' interest	5	342	341	5	70	70
4	shareholders' interest	5	340	346	6	70	70
5	shareholders' interest	5	339	345	4	70	70
6	shareholders' interest	4	349	346	7	70	70
7	shareholders' interest	5	346	345	3	70	70
8	shareholders' interest	4	347	347	5	70	70
9	shareholders' interest	4	349	340	4	70	70

Source: Research findings

As seen in Table 6, the result of running the model with these assumptions, in all 9 times, the change of money volume was to the detriment of the shareholders.

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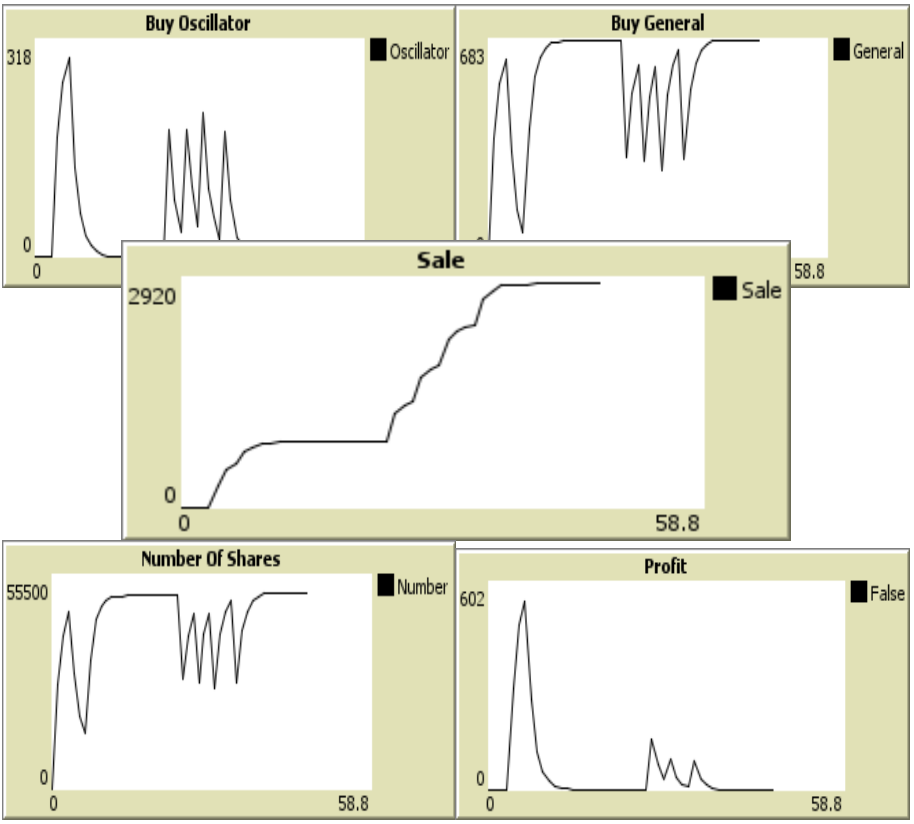

Figure 4. The behavior of shareholders assuming a change in monetary policy (change in the amount of money)
Source: Research Findings

The comparison of results for all three levels had been shown in table 7:

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Table 7
The comparison of results for all three levels

Simulation result	**Money Volume change policy status**	**Simulation result**	**Money Volume change policy status**
Affected Shareholders< Interest Rate Policies	Interest rate change policy level with high benefits	Affected Shareholders< Money Volume change	Money Volume change level with high benefits
Affected shareholders > Interest Rate Policies	Interest rate change level with moderate benefits	Affected shareholders> Money Volume change	Money Volume change level with moderate benefits
shareholders' interest	Interest rate change level with low benefits	shareholders' interest	Money Volume change level with low benefits

Source: Research findings

Based on the results obtained from the simulation, it can be concluded that when the level of shareholders' interest due to the change of interest rate and money volume for shareholders is very low, the probability that the profit of the rebellious shareholders will increase. Also, when the profit of the shareholders is independent from the change of the central bank's monetary policies, the probability of the shareholders being vulnerable to market fluctuations will be less.

4.2 Sensitivity Analysis

The parameter that is quickly affected when that model is changed is the possibility of shareholders suffering due to the monetary policy change. When the monetary policies change, the behaviour of the shareholders is affected by the probability that they will suffer, even if they have an average profit, it will take a considerable time for the model to reach a perfect state and the monetary policies will be effective.

The final parameter that was tested in the sensitivity analysis was the emotional threshold of the shareholders, which decreases even if the shareholders' interest is moderate, they become affected shareholders. This conclusion proves the fact that whether the shareholders are personality type A or B when their emotional threshold is low, they will react when they see a few affected shareholders and a herd or mass behaviour will be created.

4.3 Model Validation

According to Macal and North (2009) by examining the codes used for simulation, it can be ensured that the presented model works according to the intended purpose of the research. To check that the model behaves as expected, we used the "internal validity" index of the model and the obtained

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results showed that there was no logical error in translating the model into code or programming error. Therefore, we can be confident that the research model has appropriate validity. To further ensure the accuracy of the model, the conceptual validation method was also used. Also, the selected stakeholders of the research confirmed the results of the model. Therefore, it can be ensured that this model includes all the necessary details to achieve the research goals, to study and simulate the assumptions, probability distribution and placement of factors. As can be seen in the graph below, the error rate is 3%.

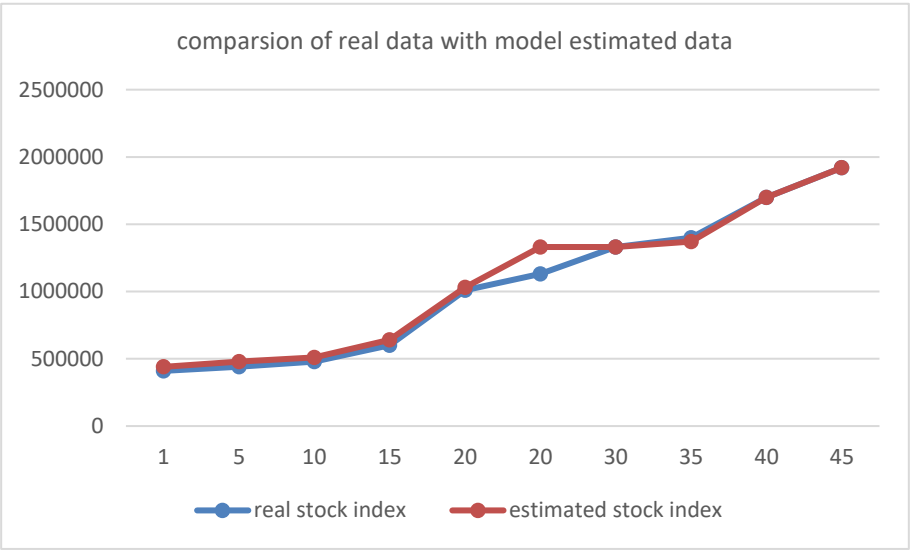

Figure 5. Comparison chart of real data and results from model execution
Source: Research Findings

5 Conclusion

In the financial markets, there are investors who use the strategy of imitation and alignment in the stock market. This group of investors makes decisions by measuring stock price trends, news, regional developments and decisions of the monetary authorities, etc. and may be in one of the buying and selling or inactive modes. Therefore, the way these investors operate depends on understanding their behavior.

This research examines the behavior of two groups of investors by taking into account their personality characteristics and based on their reaction to

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changes in the central bank's monetary policy and their predictions regarding the change in stock prices in order to gain more profit from this market.

Therefore, based on the assumptions of this research and the results obtained from the simulation, when the profit level of the shareholders is low, the model predicts that the risk-taking shareholders are more likely to win. The comparison of the results of the model in the situation of low, medium and high income of the shareholders in response to monetary policies shows that if the profit of the shareholders is high, the probability of monetary policies is more and when the profit of the shareholders is at the average level, the shareholders are more likely to suffer. And when the profit of the shareholders is low, the probability of the victory of the shareholders will increase and the monetary policies (interest rate and money volume) of the central bank will not be effective and will create distrust.

The results indicate that regardless of the monetary policies of the central bank, the shareholders who have a long-term view of profit from this market have received less profit than the volatile shareholders in this market.

The results indicate that due to uncertainty, this market, which has the nature of long-term financing, has lost its function, and the shareholders' view of this market is short-term profit.

6 Suggestions

The practical suggestions of research are as follows:

1) Monetary policies (interest rate and money volume) should be changed according to the behavior and shareholders' interest according to financial policies in the direction of macroeconomic prosperity.
2) Monetary policies (interest rate and money volume), before the change by the central bank, the people and shareholders should be informed to take the necessary information regarding their shares.
3) Monetary policies should not be aimed at providing the government's budget deficit so that the shareholders who are affected by it will not lose their confidences.
4) Strengthening social capital through people's participation in solving economic issues and monetary policy changes that affect the financial market.

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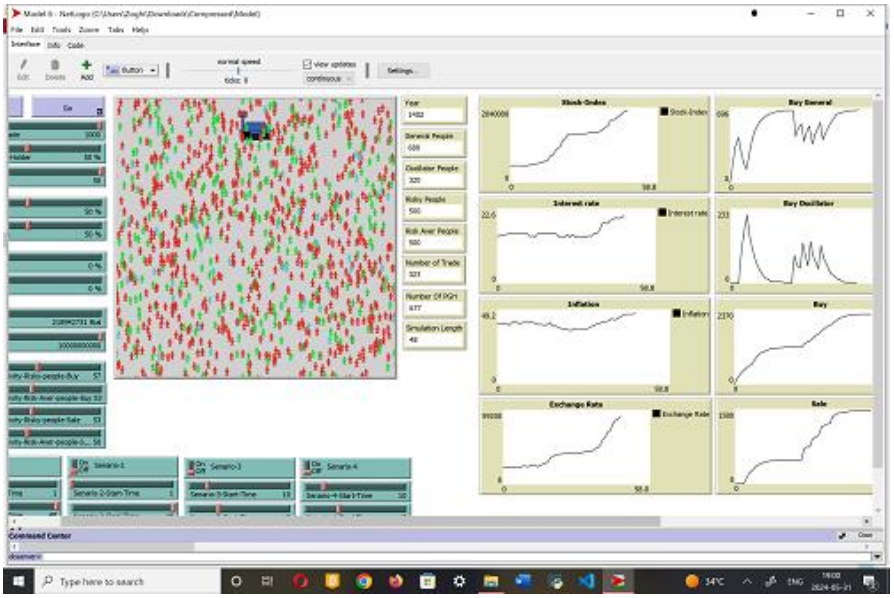
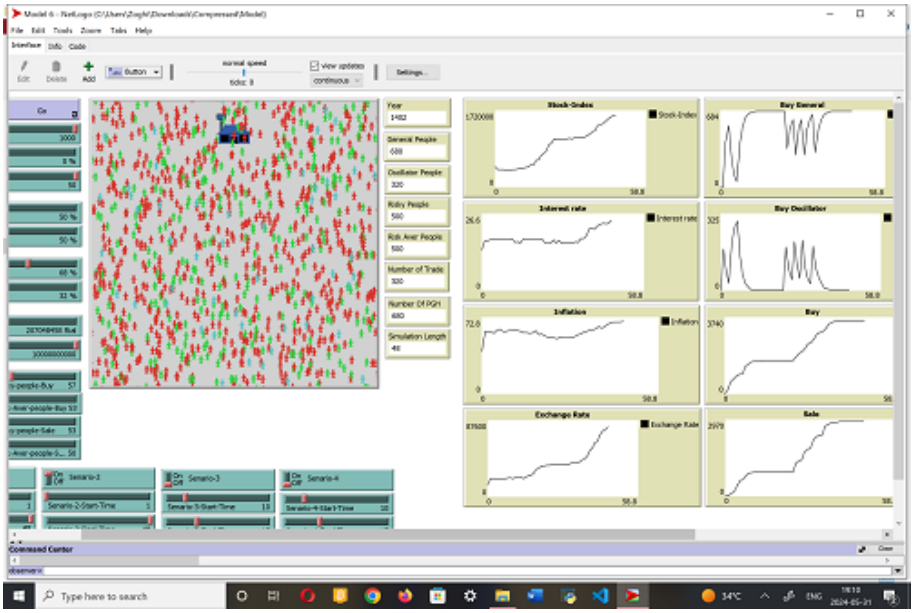
Project Outcome





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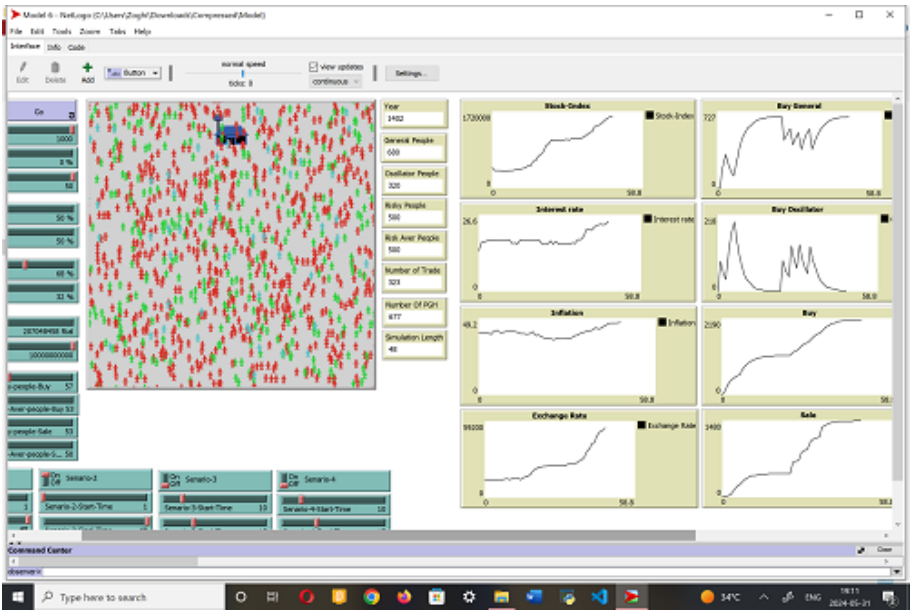

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