Racionalidade e Vieses: Por que o investidor avesso ao risco não faz boas escolhas?

Rationality and Biases: Why Don't Risk-Averse Investors Make Good Choices?

Racionalidad y sesgos: ¿Por qué el inversor reacio al riesgo no toma buenas decisiones?

Felipe Souza Massafera[1]

Resumo: O propósito deste trabalho é explicar por que investidores avessos ao risco não fazem boas escolhas na seleção de ativos financeiros. Para isso, discute-se a escolha eficiente de ativos do ponto de vista das finanças clássicas em contraste com os vieses das finanças comportamentais. Este trabalho traz, predominantemente, uma abordagem bibliográfica e explicativa. Além disso, analisam-se as decisões de investimento no ativo mais popular do Brasil, a Caderneta de Poupança, durante o período de 2015 a 2022, utilizando dados quantitativos para avaliar a eficiência dessa escolha. Os resultados indicam que muitos investidores optaram por investimentos com rentabilidade real negativa, sugerindo que vieses comportamentais, como o viés da aversão à perda, status quo, confirmação e excesso de opção, desempenham um papel significativo na tomada de decisão. O estudo destaca a necessidade de uma compreensão complementar entre a teoria financeira tradicional e das finanças comportamentais para uma melhor otimização do portfólio, proporcionando uma visão mais aderente à realidade dos investidores.

Palavras-chave: Aversão ao risco; Finanças comportamentais; Escolha de ativos financeiros; Caderneta de Poupança.

Abstract: The purpose of this study is to explain why risk-averse investors make suboptimal

1 PhD student in Economics at the Federal University of Juiz de Fora (UFJF) and specialist in Finance at PUC-RS. ORCID: https://orcid.org/0009-0004-0825-7465; E-mail: felipemassafera554@gmail.com.

choices in the selection of financial assets. To achieve this, the study discusses the efficient selection of assets from the perspective of classical finance, contrasting it with the biases identified in behavioral finance. This work predominantly adopts a bibliographic and explanatory approach. Additionally, the study analyzes investment decisions in the most popular financial instrument in Brazil, the Savings Account, during the period from 2015 to 2022, utilizing quantitative data to evaluate the efficiency of this choice. The findings indicate that many investors opted for investments with negative real returns, suggesting that behavioral biases, such as loss aversion, status quo bias, confirmation bias, and choice overload, play a significant role in decision-making. The study underscores the need for a complementary understanding between traditional financial theory and behavioral finance for better portfolio optimization, thereby offering a more accurate reflection of investors' reality.

Keywords: Risk aversion; Behavioral finance; Financial asset selection; Savings account.

Resumen: El propósito de este estudio es explicar por qué los inversores aversos al riesgo toman decisiones subóptimas en la selección de activos financieros. Para ello, se discute la selección eficiente de activos desde la perspectiva de las finanzas clásicas, contrastándola con los sesgos identificados en las finanzas conductuales. Este trabajo adopta predominantemente un enfoque bibliográfico y explicativo. Además, el estudio analiza las decisiones de inversión en el instrumento financiero más popular de Brasil, la cartilla de ahorro, durante el período de 2015 a 2022, utilizando datos cuantitativos para evaluar la eficiencia de esta elección. Los resultados indican que muchos inversores optaron por inversiones con rendimientos reales negativos, lo que sugiere que los sesgos conductuales, como la aversión a las pérdidas, el sesgo del statu quo, el sesgo de confirmación y la sobrecarga de opciones, desempeñan un papel significativo en la toma de decisiones. El estudio subraya la necesidad de una comprensión complementaria entre la teoría financiera tradicional y las finanzas conductuales para una mejor optimización de la cartera, proporcionando así una visión más acorde con la realidad de los inversores.

Palabras clave: Aversión al riesgo; Finanzas conductuales; Selección de activos financieros; Cartilla de ahorro.

Introduction

Economics is the study of how society manages its scarce resources. Scarcity implies that resources are limited, meaning that each individual in a society cannot achieve the high standard of living to which they aspire (Mankiw, 2017). Therefore, the study of economics seeks to understand the best way to optimize choices to generate maximum utility given the limited resources. In particular, the study of finance seeks to understand how individuals make decisions regarding money and how it is distributed over time.

Regarding these decisions, there are two main theories in the financial and economic field. The first, from the point of view of classical economics, the Efficient Market Hypothesis (EMH), defended by Fama (1970), argues that prices fully reflect the available information, that is, efficiency occurs in the sense that any new information that reaches the market will be fully and quickly reflected in the current prices of assets (Yen and Lee, 2008). Thus, this idea is based on the full rationality of agents and their ability to evaluate the available information in relation to investment options. In line with this theory, the Expected Utility Theory (EUT), explained by Kumar and Goyal (2015), proposes that investors act rationally by evaluating their alternatives based on their expected utility and risk and, thus, make a balanced decision.

In contrast to the classical theory explained above, behavioral finance emerged from the divergences observed in attempts to explain and address traditional finance theories and serves as a supplement to classical finance, introducing behavioral aspects to decision-making (Aguirre and Aguirre, 2023). The Prospect Theory, as it became known, by Kahneman and Tversky (1979), brought a new concept that combines behavioral and psychological aspects in economic and financial decision-making. This new theory challenges the efficient market perspective and helps to understand why investors behave in a certain way when investing in financial assets. It is an alternative to the EUT to explain decision-making under uncertainty. The behavioral finance suggests that the investor is not marginalist and the investment decision-making process is influenced by several behavioral biases that encourage them to deviate from rationality and make inefficient decisions from the point of view of risk and expected return.

From the perspective of these two theories, this paper aims to analyze the efficiency of asset choices by conservative Brazilian investors and identify the behavioral biases that influence these decisions. To this end, this paper proposes to (i) explain the process of optimizing the choice of financial assets under uncertainty based on the Expected Utility Theory; (ii) analyze the investment profile of Brazilians and compare their preference for Savings Accounts over other accessible options such as assets indexed to the CDI and Selic rates; and (iii) discuss the behavioral biases, explained through the Prospect Theory, that prevent investors from making more efficient capital allocations.

This study contributes by exploring how behavioral biases directly influence inefficient low-risk investment choices by Brazilian investors with a risk-averse profile, a segment that is still little addressed in the literature. Thus, this article broadens the academic discussion by practically integrating two distinct theoretical approaches: classical financial

theory and behavioral finance. As noted by Sattar et al. (2020), a full understanding of the investment decision-making process requires consideration of both the objective foundations of financial theory and the psychological factors that shape investor behavior. Thus, this study becomes relevant not only for academia, but also for investors and finance professionals, promoting a more complete and realistic view of the decision-making process.

To achieve its objectives, this paper is divided into 5 chapters. Chapter 2 discusses the classical theory of asset selection (2.1) and the Prospect Theory (2.2). Chapter 3 discusses the methods used in the research, the database, and the estimation calculations. Then, the discussion in Chapter 4 is divided into three parts. First, the efficiency of asset selection under uncertainty for the representative risk-averse individual is discussed (4.1). Then, in (4.2) the profile and choice made by Brazilian investors are analyzed, as well as the trade-off in relation to other available investment options. In (4.3) the aim is to discuss the biases that lead investors to not make the best investment decisions. Finally, Chapter 5 presents the final considerations.

Efficient Markets and Behavioral Economics: Two Views on Portfolio Choice

The literature that deals with individual behavior in uncertain scenarios is vast and, at times, the behavior observed in people in relation to their finances may differ from the traditional model that deals with decision-making from the point of view of homo economicus. According to Varian (1987), in many cases a deeper model of consumer behavior is necessary to describe their choices more accurately.

The discussion of these theories will be divided into two parts: first, the neoclassical approach to market efficiency will be addressed, and then the set of theories will be discussed from the perspective of behavioral finance.

Market efficiency and rational choice

Fama (1970) was the precursor of the so-called Efficient Market Hypothesis (EMH), which argued that the ideal market is one in which prices provide accurate signals that help agents allocate their resources. In other words, it is a market in which companies make production and investment decisions and investors choose between securities that represent ownership of the companies' activities under the assumption that the prices of these

securities, at all times, reflect all available information. Therefore, when prices appropriately reflect market information, this market is considered efficient (Fama, 1970, p.383).

To test this hypothesis, Fama (1970) created three categories of tests to determine whether, in fact, the information available about companies is reflected in stock prices. These are the weak, semi-strong and strong form tests. Yen and Lee (2008) explain that, in the weak form, all past information (history) relevant to the company under analysis is fully and quickly reflected in the current price of its shares. In semi-strong efficiency, in addition to the information presented in the weak form, all new relevant public information is also incorporated. Thus, past and current information is already reflected in the current price, and it would not be possible to achieve returns above the market with known information. Finally, efficiency in its strong form represents all information about the company, including all information presented in the other forms (weak and semi-strong), as well as private information, which is quickly and fully reflected in stock prices. In other words, in the strong form the investor would not obtain returns above the market, even if he had access to the company's private information, as all of this information is already incorporated into the share price.

Empirical studies by Fama (1970, p. 388) concluded that prices appear to adjust efficiently to publicly available information and that there was insufficient evidence against the weak and semi-strong forms of market efficiency. Furthermore, only limited evidence against the strong form was observed, i.e., monopolistic access to price information did not appear to be a prevalent phenomenon in the market.

Haddow et al. (2013) explain that households look at information not only to make investments but also to anchor their future expectations. When making everyday economic decisions—about work, spending, investing, education, and so on—people use the information around them to form judgments about what might happen. In periods of uncertainty shocks that lead to recessions, Bloom (2009) explains that the volatility of stock, bond, and foreign exchange markets and the GDP growth rate increase sharply.

At higher levels of uncertainty, according to Haddow et al. (2013), families tend to save more to increase their safety margin in a possible future scenario in which there is an increase in concern about a decrease in income. However, the effect on savings is temporary and dissipates when families save an amount they consider sufficient to provide them with financial security to get through the period of income fluctuation.

Individuals' perceptions of the future directly impact their portfolio choices. Heaton and Lucas (1997) explain that, in general, traditional models predict that people save

to smooth consumption over time, and that they divide these savings between a diversified portfolio of risky assets and risk-free assets, with portfolio weights determined by the investor's propensity for risk. Thus, Heaton and Lucas (1997) developed a model that seeks to observe the optimal portfolio choice given the uncertainty and variability in income. The predicted level of savings is sensitive to preference parameters, transaction costs, and risks involving future income. Although the model predicts that savings are mostly allocated to risky assets (such as stocks), the authors recognize that this result may seem unfamiliar given that most households keep a large part of their portfolio allocated to low-risk fixed income, and of the few that do hold stocks in their portfolio, their diversification is not done efficiently.

In turn, Viceira's (2001) dynamic rational portfolio choice model innovates in relation to the previous one by adding a temporal parameter to the analysis, that is, the optimal investment choice is related not only to income uncertainties, but also to whether or not the agent is retired. Retirement is defined as the period in which the agent no longer has income from work and begins to live exclusively on the income from savings accumulated in the period prior to retirement. The model reinforces the notion that people should invest more in risky assets during their working period than during their retirement period. This is due to the fact that employed investors have an additional source of income (from their own work), so they can support a more risky investment portfolio to the detriment of retirees, who live exclusively on the income from their investments.

Furthermore, Viceira (2001) argues that it is rational for investors to hedge their portfolios so that fluctuations in investment income do not affect their usual level of consumption. This protection becomes even more important in periods of increased risk in income from work. In fact, in these periods, investors are less willing to invest in risky assets and are more willing to increase their savings rate.

Regarding the increase in the volatility of labor income, the author argues that it has two effects:

> "First, it makes labor income look more like the risky asset than the riskless asset, so that the investor is less willing to assume portfolio risk; second, it causes an increase in the level of savings that reduces the importance of labor income relative to financial wealth as a source of consumption for the employed investor, who becomes more like a retired investor when making her portfolio decisions" (Viceira, 2001, p. 460).

In other words, in periods when the investor observes greater variability (or uncertainty) in relation to his income from work, he opts for safer assets (such as low-risk

fixed income, government bonds, etc.) to balance the risks involving his total future income and maintain, on average, his consumption pattern throughout the period of uncertainty. In relation to increasing savings, the investor seeks to increase the relevance of his income from his financial assets (passive income) to the detriment of his income from work (active income), given that there are uncertainties involving the latter.

Finally, Bernard, Chen and Vanduffel (2015) perform an analysis of the rationalization of investor choice based on the classic Expected Utility Theory of Von Neumann and Morgenstern (2007). In this model, the optimal choice of portfolio with a limited budget is rationalizable when there is a utility function, the solution of which is its maximization, given the expected income distribution in various choice scenarios. In other words, when the individual observes his income distribution – which is the probability of return given the amount of risk taken by the portfolio – he is aware of his level of risk aversion. A second point considered in the optimal choice, in addition to the level of risk aversion, is the distribution of the asset pricing core, given that there are periods in which the market presents a positive risk premium. By analyzing these issues, the individual makes the decision that maximizes the expected utility of the portfolio.

Behavioral Finance and Biased Choice

The traditional finance, discussed based on the Efficient Market Hypothesis (EMH) and Expected Utility Theory (EUT), where markets respond perfectly to available information and agents make rational choices based on this set of information, was questioned by Kahneman and Tversky (1979) through Prospect Theory. Their work presented and discussed several classes of choice problems in which individuals' preferences systematically violated the axioms of EUT. Furthermore, the authors argue that utilitarian theory, as it is normally interpreted and applied, is not an adequate descriptive model of choice under uncertainty, since it does not incorporate characteristics of human nature that can lead to inefficient decision-making.

Bortoli et al. (2019) explain that with interdisciplinary elements of economics and psychology, behavioral finance seeks to understand the decision-making process in risky situations. The agent defined by behavioral finance is not perfectly rational, but is an ordinary agent, whose choices are made under the influence of emotions and cognitive biases. Kahneman and Tversky (1974) argue that individuals rely on a limited number of heuristic principles, which reduce the complex tasks of assessing probabilities and predicting values to

simpler judgment operations. In general, these heuristics are quite useful, but sometimes they lead to serious and systematic errors. These errors are called biases.

The Prospect Theory explains that investor choices are based on the potential for gains and losses rather than the final investment endowment (Kumar and Goyal, 2015). This justifies how cognitive biases affect investors' judgment in the field of gains and losses. For Kahnman and Tversky (1974), people demonstrate risk aversion in the domain of gains and risk attraction in the domain of losses, especially when the probabilities of losses are substantial. To demonstrate these preferences, the authors created a value function defined in relation to gains and losses. "The value function is concave in the domain of gains and convex in the domain of losses, and considerably steeper for losses than for gains" (Kahneman and Tversky, 1974, p. 304). These preferences can be observed when, in a situation of high probability of gain, people tend to have a substantial fear of the occurrence of a loss, even if its probability of occurrence is low. At the same time, when faced with a situation with a low probability of winning, such as a lottery, people demonstrate an optimism that is more than proportional to the probability of winning. In other words, the probabilities of winning and losing affect individuals' expectations in a biased way, which is not very consistent with mathematical expectation.

Risk perception is the way someone interprets the probabilities of gain and loss of a given investment. This does not necessarily reflect the distribution of probabilities, but it affects the investment decision more than the actual risk itself. This perception is inversely proportional to the risk of the agents' portfolio, "the higher the level of risk perception by the investor, the lower the chances of that individual investing in high-risk funds" (Ainia and Lutfi, 2019, p. 410).

Availability bias directly affects risk perception. Kahneman and Tversky (1974, p. 297) explain that a class whose occurrences are easily recoverable will appear to be more numerous than another class of equal frequency whose occurrences are less recoverable. Thus, if an individual has frequently observed people around him having returns with a certain high-risk investment, he soon judges that his chances of return are greater than they really are. Similarly, if the conservative investment fund of a well-known bank has an atypical fluctuation in its returns, and this is constantly reported in the news, investors usually begin to have a perception of risk much greater than the reality, as was observed in the case of Nubank's fixed income funds[2].

On the other hand, overconfidence bias occurs when investors believe that they will achieve a higher level of profitability and low risk in their investments, even if there is no

guarantee in this regard (Ainia and Lutfi, 2019). Overconfidence encourages individuals to opt for risky assets (McCannon, Assad and Wilson, 2016) and they tend to hold falling assets to avoid taking a loss (Chu et al; 2012).

Herd behavior is one of the most important biases when analyzing investment decisions. This bias occurs when a group of investors act together without centralized direction and this ends up being an endogenous instrument of financial instability that increases the volatility and amplitude of the financial system. Herd behavior is usually linked to financial bubbles, where the price of an asset (or set of assets) rises due to the euphoria of a group of investors in relation to that asset and not due to a rational analysis of the price that reflects realistic expectations (Dewan and Dharni, 2019). Although there are reports of speculative bubbles in the Netherlands in the 17th century, Dewan and Dharni (2019) argue that herd behavior, as a behavioral bias, gained its popularity after being the main reason behind the bursting of the "dot.com bubble" in the late 1990s.[2]

In short, investment in financial assets is influenced by psychological variables, contrary to classical theory. From the perspective of behavioral finance, behavioral biases are the cognitive factors that influence investors' decisions in financial markets. These biases locate the causes of investors' irrational and illogical behavior, and expose how they make mistakes and errors in making judgments (Dewan and Dharni, 2019).

Methods and materials

This work presents a bibliographical and explanatory approach. The use of a multidisciplinary analysis of technical and cognitive tools makes it possible to verify the variables that influence the individual's decision-making in their investments, in the face of market risks.

The bibliographic research "explains and discusses a topic or problem based on theoretical references already published in books, magazines, periodicals, scientific articles, etc." (Silva, 2003, p. 60). Thus, traditional finance theories were used to analyze the optimal choice of assets from a utilitarian point of view. On the other hand, to understand the biased and suboptimal choices of agents, behavioral finance theories were used to counter the

---

[2] According to the newspaper Correio Braziliense, investors in the fixed income fund of the digital bank Nubank were affected because the product set aside to make up the emergency reserve invested almost 1% of its assets in debentures of the retailer Americanas of the b2W group. The fact that Lojas Americanas recorded a drop of 82.35% in five days affected both investors in the company, on the Stock Exchange, and people who put money in the Nu Reserva Imediata fund, offered by the digital bank Nubank.

traditional theory. Therefore, both theories are discussed in relation to the choices of the risk-averse Brazilian investor.

Together, an explanatory approach was used, which has as its main objective to make something intelligible, deepening the knowledge of reality and, thus, explaining the reason and why of things (Silva, 2003). In this way, the aim is to (i) show the reader the relevance of two distinct theories on investment decisions, and to analyze, from a classical point of view, the optimal portfolio choice; (ii) understand how Brazilians make these choices and compare them with other options; and (iii) discuss the most common biases that affect the efficiency of portfolio choice from a behavioral point of view.

For the discussion in chapter 4.1, the Selic and CDI rate series, made available by B3, for the period 2015-2022 were used. In 4.2, the ANBIMA survey (2022) was used, which sought to understand the profile of Brazilians in relation to their savings and investment habits. To analyze the investor's choice, descriptive statistics were calculated in relation to the annual profitability of the Savings Account, made available by the Central Bank, in comparison with the Selic rate, also for the period 2015-2022. In addition to the descriptive statistics, to assess the exponential growth of equity among assets, the variable "Future Value" was estimated, referring to the hypothetical investment in the Savings Account through the specification:

$$VF_j = \text{R\$}100.000 * \left(1 + i_{t,j}\right) * \left(1 + i_{t+1,j}\right) * \ldots * \left(1 + i_{t+7,j}\right) \quad (1)$$

Where VFj represents the accumulated future value in relation to the investment in asset j. The value of R\$100,000 was used only as a simulation value of capital available for investment at time t; it,j represents the rate of return of asset j at time t (where t is the initial analysis period 2015, t+1 refers to 2016, ..., t+7 refers to 2022). The variable j assumes the asset Savings Account (exempt from income tax), the net return of bonds indexed to 100% of the Selic rate for an IR of 15% and for an IR of 22.5%. To calculate the net return of the Selic rate, the specification was used:

$$S_{l,t}^{22,5} = S_t - (0,225 * S_t) \quad (2)$$

Where $S_{l,t}^{22,5}$ is the Selic rate net of income tax for IR of 22.5% in time t and S_t is the "gross" Selic rate at time t. Similarly, at the lower IR limit of 15%, the net Selic rate is given by[3]:

$$S_{l,t}^{15} = S_t - (0,15 * S_t) \quad (3)$$

Substituting specifications (2) and (3) into equation (1), we obtain the equity value in the final period (principal + compound interest) of the investment in assets indexed to the Selic rate if there is an IR incidence of 22.5% in (4) and if the IR is 15% in (5), so that the net results of these investments can be compared with the Savings Account.

$$VF_j = \text{R\$}100.000 * \left(1 + S_{l,t}^{22,5}\right) * \left(1 + S_{l,t+1}^{22,5}\right) * ... * \left(1 + S_{l,t+7}^{22,5}\right) \quad (4)$$

For j referring to the Selic rate net of IR of 22.5% and

$$VF_j = \text{R\$}100.000 * \left(1 + S_{l,t}^{15}\right) * \left(1 + S_{l,t+1}^{15}\right) * ... * \left(1 + S_{l,t+7}^{15}\right) \quad (5)$$

Para j referente a taxa Selic líquida ao IR de 15%.

Also in chapter 4.2, the variable "Return (r)" was presented, referring to the accumulated return when investing in asset j for the period 2015-2022. Therefore, to calculate the percentage rate of equity variation (r), we used:

$$r(\%) = \frac{VF - VP}{VP} * 100 \quad (6)$$

Where VF is the final value of the investment and VP is the capital invested in the initial period, which in this case was assumed to be R\$100,000.00. Similarly, the variable "Selic/CP" calculated the percentage return that Selic (in the forms of gross and net income of

---

[5] The X-Ray of the Brazilian Investor (5th edition) is a study carried out by ANBIMA (Brazilian Association of Financial and Capital Market Entities) between November 9 and 30, 2021 through interviews with 5878 people covering the five regions of the country. Available a: https://www.anbima.com.br/pt_br/especial/raio-x-do-investidor-2022.htm

[6] According to ANBIMA, fixed income assets (such as CDBs and Government Bonds, with the exception of LCIs, LCAs and Savings Accounts) are subject to regressive income tax and IOF. The regressive tax occurs with respect to he rate decreases the longer the investment term. For taxable fixed income securities, for example, the regressive table works as follows: up to 180 days, the rate is 22.5%; from 181 to 360 days: 20%; from 361 to 720 days: 17.5% and above 720 days: 15%. The IOF is charged only if the investment is redeemed in a period of less than 30 days and is also regressive: going from 96% for one-day investments, and decreasing day by day, until the rate reaches zero on the 30th day. Available at: https://comoinvestir.anbima.com.br/noticia/imposto-regressivo-o-que-e-e-como-impacta-seus-investimentos.

IR at 15% and 22.5%) obtained more than the Savings Account. For this, the specification was used:

$$r_{S,CP}(\%) = \frac{r_{j,t+7} - r_{cp,t+7}}{r_{cp,t+7}} * 100 \quad (7)$$

Where $r_{j,t}$ is the accumulated future value of asset j at t+7, that is, at the end of 2022 and $r_{CP,t+7}$ is the accumulated return of the Savings Account at the end of 2022.

Finally, to calculate the real return on assets, that is, their return above inflation, the annual IPCA series calculated by IBGE7 was used. Therefore, to define the real return, the specification was used:

$$R_{j,t} = \frac{(1+r_{j,t})}{(1+\pi_t)} - 1 \quad (8)$$

where: the real rate of return on asset j at time t ($R_{j,t}$) is equal to the nominal rate of return on asset j at time t discounted by accumulated inflation over time $_t$ (π_t)

Results

The economic agents, including those with less affinity with economic science, seek to obtain the best possible result from their choices in light of the trade-offs they frequently face. However, what will be discussed below is how the choices of Brazilian investors are, in most cases, inefficient from the perspective of classical finance. Understanding theories, both classical and behavioral, is relevant to increase the efficiency of investors' choices.

This chapter will be divided into three parts. In 4.1, the classical theory of finance will be discussed, which offers tools to assist the investor in the analysis. In 4.2, the investor's choices are discussed and compared with other options with the same risk profile. Finally, in 4.3, the biases that limit investors from making efficient portfolio selections are discussed, based on behavioral finance.

The Risk-Averse Investor and Optimal Choice

People make consumption and savings choices so that this allocation satisfies demands and preferences over time. This organization allows the individual to guard against uncertainties regarding the future, and is remunerated through interest. For Markowitz (1952),

portfolio diversification is an important tool to enable risk minimization and the greater the diversification, the closer the real return is to the expected return.

Neto (2021) explains that, in the investor's scale of preferences regarding the risk of their investments, there are numerous possibilities of equally attractive assets, presenting identical degrees of utility depending on the relationship between risk and expected return. Thus, following the behavior of a comparative nature, it is possible to rationally select the asset that maximizes its utility.

According to Markowitz's dominance principle (1952) in rational asset choice, the higher the expected return of an asset, the greater its utility; the riskier it is, the lower its utility and gambling should be avoided. Thus, among assets with the same variance (which is a measure of risk), the one with the highest expected return should be chosen. Similarly, among assets with the same expected rate of return, in rational choice, the one with the lowest variance should be chosen.

Based on these basic postulates, Markowitz (1952) demonstrated that it is possible to represent investor preferences using indifference curves. Along the curve, there are numerous optimal combinations of assets, whose expected profitability increases in conjunction with risk. Any combination below the curve is equally desirable. Endowments below the curve are suboptimal, as they offer a lower return than that practiced in the market for the given level of risk, that is, it is not a point that maximizes the investor's utility. Considering that the investor has full access to information, any point below the curve should not be considered by him.

On the other hand, any point above the indifference curve is desired, however, at least in the long term, this allocation is not feasible. The microeconomic principle that explains the choice of assets is related to the supply and demand curve. Varian (1987, p.203) explains that if there is an asset whose return is above those of peers with the same risk, then all investors would acquire this asset until, marginally, its price would increase (therefore, decreasing its return) gradually, until its equilibrium price is reached. In similar terms, an asset with a return below that traded by its peers in the market should lower its price (therefore, increasing the return), until the price of this asset balances with the price prevailing in the market.

In his model, Sharpe (1964, p. 425) demonstrated that the prices of capital assets adjust so that the investor, following rational procedures (mainly diversification), will be able to reach any desired point along the capital market line. This line is the classic representation that the investor can acquire more expected return, incurring more risk in his assets. Thus, the

market presents two prices: the price of time, which is a pure risk-free rate (also called the risk-free rate) and the price of risk (also called the risk premium), which is the additional return expected for each unit of risk supported. Figure 1 represents the capital market line.

Figure 1: Representation of the Capital Market Line
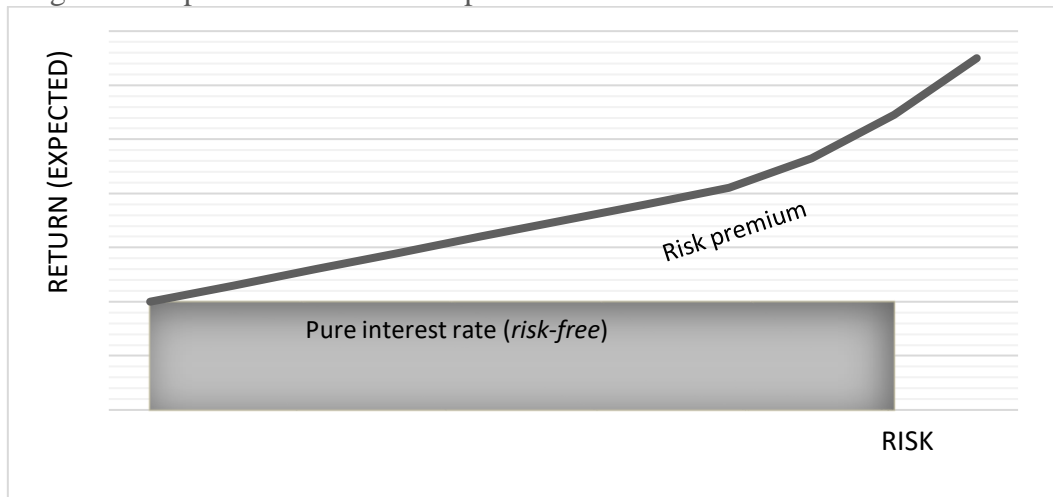
Source: own elaboration.

In Brazil, the Selic rate[8] is considered a risk-free rate, as it is guaranteed by the Government (Rubik and Costa, 2008). Therefore, in an optimal choice of assets, any investment considered "risk-free" should have the Selic rate as its basic remuneration. The asset linked to the Selic rate that has government guarantees is called LFT (or Tesouro Selic). According to Massafera[4] and Cândido (2022), among the government bonds available in Tesouro Direto, this asset is the most conservative, as it presented a positive daily variation in its profitability and proved to be adherent to its benchmark, which is the Selic rate itself.

The IDC (Interbank Deposit Certificate) rate is often related to the Selic rate. Many assets show their profitability as a function of some percentage of this rate. Figure 2 shows the variation of the CDI rate (blue area) and the Selic rate (orange line), in annual values, for the period between 2015 and 2022. It can be seen from the graph that assets that have profitability linked to the Selic and the CDI can be considered perfect substitutes. According to the study by Rubik and Costa (2008), these rates have an almost perfect positive correlation.

Therefore, in optimal conditions, any risk asset should offer a basic return, summarized by the remuneration of the Selic rate, plus the risk premium. The risk premium should be proportional to the risk of the asset. In other words, the distribution of the asset's returns

---

[7] Brazilian Institute of Geography and Statistics (IBGE).

should be analyzed in relation to its average (expected value). Assets considered having strong guarantees, such as those offered by the FGC[5], in the case of bank debt securities, which do not have immediate liquidity, suffer from the risk of the variability of the interest rate itself, which must be remunerated for this risk.

Figure 2: Relationship between the Selic rate and the IDC
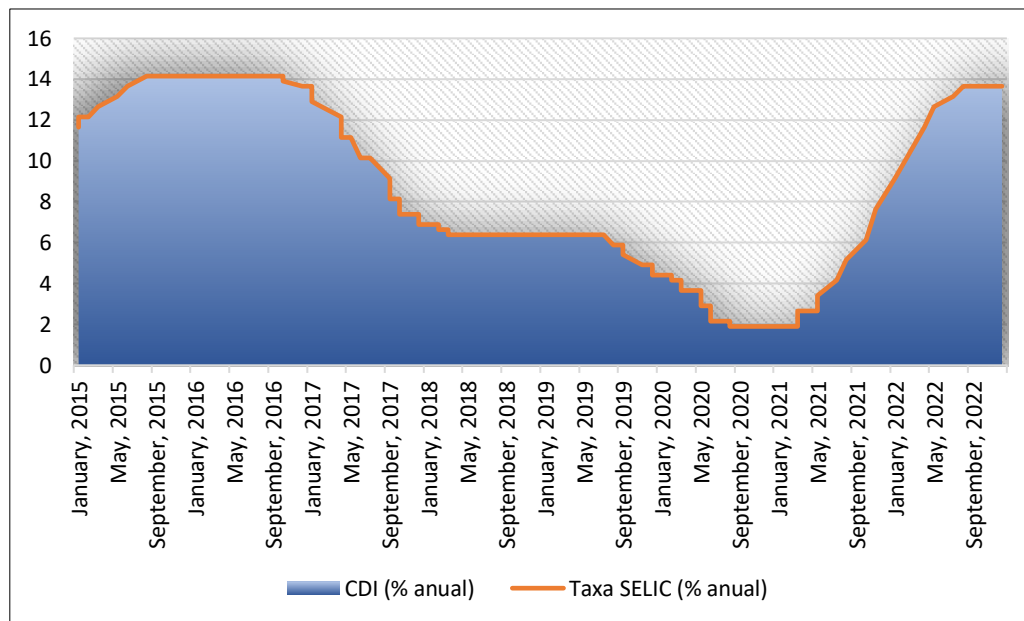
In short, for an individual to make an efficient decision, it is necessary to have access to the diversity of assets available on the market and knowledge of how the rates indexed to each of them work, as explained by the efficient market hypothesis. Second, it is necessary to compare different assets and exclude those that are not frontier optimal, that is, to select only assets that offer an efficient relationship between risk and return. Lastly, there is a risk-free rate, summarized by the Selic rate in Brazil, which will serve as a basis for profitability for assets considered risk-free, or with minimal risk. In addition to competitive profitability, these assets usually have a strong guarantee, such as that of the Government or the FGC, and are liquid, to avoid the inherent risk of interest rate variation in the long term.

After this discussion on theoretical tools for optimal asset selection, it will be possible to analyze the average investor profile through their choices and compare the trade-off of opting for more efficient assets from the point of view of risk and return.

---

[10] The Credit Guarantee Fund was created in August 1995, by a resolution of the National Monetary Council (CMN) authorizing the "creation of a private, non-profit entity, intended to administer protection mechanisms for credit holders against financial institutions". It offers coverage of up to the amount of R$250,000.00 per CPF for each financial conglomerate in the event of bank failure. Available at: < https://www.fgc.org.br/garantia-fgc/sobre-a-garantia-fgc >

The profile of the Brazilian investor: an analysis between assets

The ANBIMA (2022) survey sought to identify the profile of Brazilian investors in relation to their asset choices, savings habits and motivations. In this survey, 5,878 people were interviewed in the five regions of the country, from all social classes, economically active or not, with or without income and all aged 16 or over. According to ANBIMA (2022), it is estimated that this profile corresponds to 167.9 million inhabitants. Among those interviewed, 39% are investors and 61% have not made any type of investment.

As previously discussed, in order to make an efficient investment choice, one must be aware of market information as shown by the EMH. Therefore, first, it is important to analyze investors' knowledge regarding their options. The data showed that 43% of the population does not know any financial institution (this value increases to 66% for classes D/E). Traditional banks were the most cited (45%), followed by digital banks (10%) and then securities brokerages (4%). The high lack of knowledge among investors themselves is noteworthy, with 26% not knowing and/or not mentioning any institution spontaneously (ANBIMA, 2022).

Regarding knowledge about investments, the ANBIMA survey (2022) showed that the Savings Account was the most spontaneously mentioned investment (11%), followed by stocks (10%), investment funds (6%), government bonds (6%) and private bonds (6%). These values change considerably when separated by social class, where the lower the income, the lower the knowledge of financial products. Even so, 72% of the general population does not know any investment options, and this number increases to 91% among members of classes D/E. Thus, there is evidence that the hypothesis that the individual processes market information perfectly is still strong for individual investors in general.

Regarding the investor profile, the ANBIMA survey (2022) showed that security (44%) is the main reason for choosing portfolio assets, followed by financial return (23%). Furthermore, the biggest advantage of making investments, according to the survey, is acquiring financial security (44%). The biggest disadvantage of making investments is the low return (29%) and the lack of liquidity (6%), while for 30% there is no disadvantage. The main destination mentioned for investments is to acquire a home (29%) and to have money saved for emergencies (20%). In other words, the vast majority of investors has a conservative profile, as they prioritize security and have goals (such as a home and emergency fund) whose financial planning requires assets with greater predictability of return. For Costa et al. (2020),

the "conservative investor is one who is not willing to take risks and invest money in investments with large fluctuations."

The profile of the average investor reflects their portfolio choices. Savings accounts were predominantly the asset most chosen by respondents among both men (68%) and women (83%). The second most used option was investment funds of all types (12% for men and 6% for women). Risky assets, such as digital currencies and stocks, were much more popular among men, both with 11% of investors (among women, these values were, respectively, 4% and 3%). In turn, Government Bonds participated in the portfolios of 7% of men and 3% of women. Men, on average, have greater asset diversification than women. However, what is observed is still a large concentration in a single asset: Savings Accounts. This asset was the preferred asset for all age groups, although its preference increases the older the age group.

To analyze the efficiency of the Savings Account, in terms of risk and return, one must look for assets that can be used as perfect substitutes in relation to the security provided by the asset. As previously discussed, the Tesouro Selic, traded through Tesouro Direto, and fixed income assets tied to 100% of the IDC are a common and accessible option[6] investment, with strong guarantees and daily liquidity. For comparison between these assets, Figure 3 shows the series of profitability of the Savings Account between the period 2015 to 2022 of the Savings Account assets (dotted line), and of assets linked to Selic (blue line) that are subject to income tax that varies between 15% (green line) - for investments held for at least 2 years - and 22.5% (yellow line), for investments of up to 180 days. The tax rate is regressive, that is, it decreases the longer the investment is held and is only levied on the income.

In Figure 3, it is possible to observe how the Savings Account performed worse than assets indexed to the Selic rate throughout the analyzed period, even considering the net profitability, as in the case of the green and yellow lines. The difference in profitability is greater the higher the basic interest rate of the economy, which is the Selic rate (in blue). This occurs because the profitability of the Savings Account[7] is linked to Selic.

---

[11] In May/2023, the price of a fraction of LFT traded on Tesouro Direto was being sold for R$131.14. Private fixed income assets linked to at least 100% of the CDI vary in price, depending on the issuer. According to XP Investimentos, a CDB, for example, can vary between R$1,000 and R$30,000. Available at: < https://conteudos.xpi.com.br/aprenda-a-investir/relatorios/cdb/#valor > Accessed on: 05/08/2023.

[12] According to the Central Bank (2023), "the remuneration of savings deposits is composed of two installments: I - the basic remuneration, given by the Reference Rate - TR, and II - the additional remuneration, corresponding to: a) 0.5% per month, while the target Selic rate per year is higher than 8.5%; or 70% of the target Selic rate per year, monthly, in effect on the start date of the income period, while the target Selic rate per year is equal to or lower than 8.5%" (Central Bank of Brazil, 2018).

Figure 3: Annual profitability of savings accounts and assets indexed to the Selic rate for the period 2015-2022
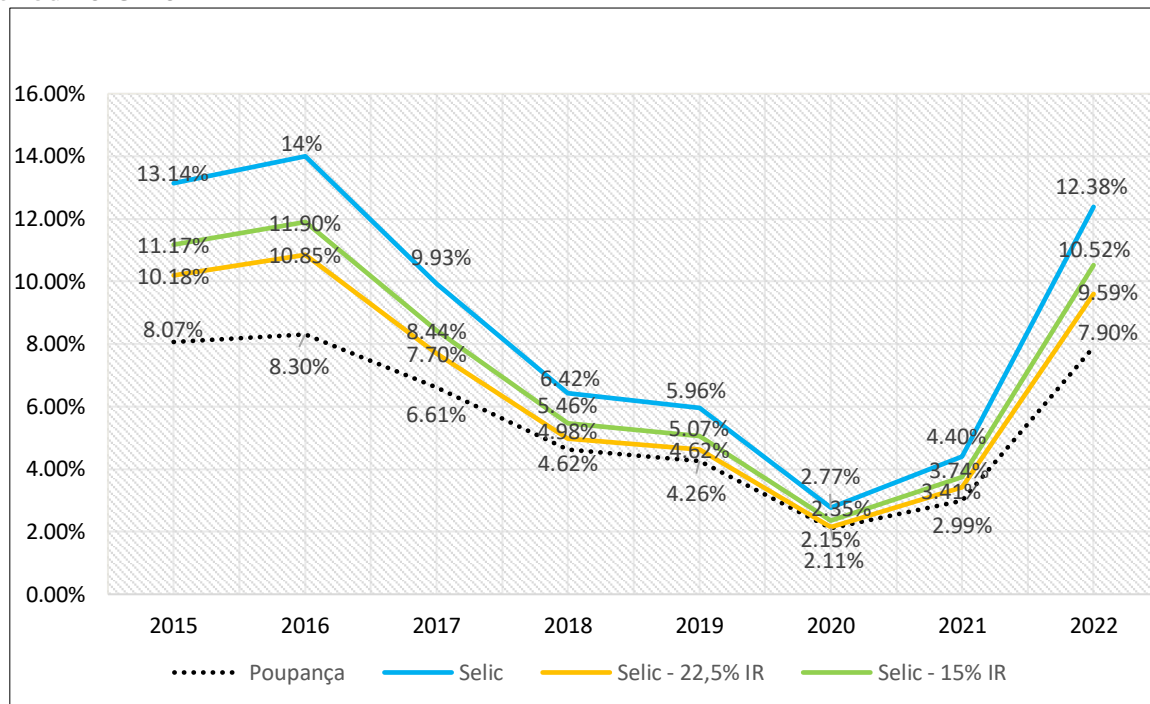
Source: prepared by the author (2023).

The table 1 shows the characteristics of the assets and compares the returns on savings accounts and assets linked to the Selic rate. On average, net returns in all tax brackets were higher than those on savings accounts. This can also be seen in the median. When comparing the minimum values, it is observed that the returns between the assets are similar. In periods of low interest rates, in order to maintain their profitability, investors increase their propensity to invest in risky assets (Lian, MA and Wang, 2019). As for the maximum values, the opposite effect is observed: as the interest rate increases, the profitability of savings accounts loses, marginally, its attractiveness in relation to other assets.

By analyzing only the profitability period by period, we end up forgetting the effect of the accumulation of assets (the "interest on interest" effect). Therefore, the annualized rates of each asset were used to simulate the future value (accumulated principal plus interest) corresponding to the investment of the principal of R$100,000.00 in the year 2015 until the end of the year 2022. The "return" variable shows the accumulated profitability in the period and the "Selic/CP" variable shows how much more the asset in question yielded than the Savings Account in the same period.

Table 1: Descriptive Statistics and Comparison between Selic rate and Savings Account for the period 2015-2022

	Savings Account	Selic	Selic – 22,5% IR	Selic – 15% IR
Average*	5.61%	8.63%	6.68%	7.33%
Median*	5.62%	8.18%	6.34%	6.95%
Minimum*	2.11%	2.77%	2.15%	2.35%
Maximum*	8.30%	14.00%	10.85%	11.90%
Future Value***	R$143.143,97	R$171.541,54	R$152.593,64	R$158.707,00
Return**	43.14%	71.54%	52.59%	58.70%
Selic/CP***	-	65.82%	21.90%	36.07%
Real Return*** **	-3.13%	20.87%	4.85%	9.98%

Source: own elaboration. *Annualized profitability. **Cumulative profitability between 2015-2022. *** Estimated value.

While the return in the period was 43.14% for the Savings Account, net investments (for the 15% rate) in the Selic had a return of 58.7%. In other words, the Selic had a return, on average, 36% higher than the Savings Account. The longer the investment horizon analyzed, the greater the accumulated difference between the returns of the Savings Account and the Selic, and the lower the tax rate that applies to assets linked to the Selic.

Blanchard (2017) argues that agents are concerned with increasing their consumption basket over time and not simply increasing cash. Therefore, it is important to analyze the real interest rate, which are interest rates expressed in terms of a basket of goods. This variable was called "Real Return" in the table. It can be seen that, for the period between 2015-2022, the Savings Account showed a loss of purchasing power (of approximately 3.13%). Investments linked to the Selic rate, in all income tax rate brackets, had real gains. For a rate of 15%, the real return of the Selic rate was approximately 9.98% in the period.

Therefore, it is clear that there is a possibility of an exchange of assets where, without increasing the risk of the asset, it is possible to increase the expected return. Furthermore, with the temporal effect, the gain from this exchange increases exponentially over time.

As discussed in Chapter 4.1, when an investor makes an investment choice, he or she faces a trade-off between risk and expected return. However, as observed by the data, this trade-off occurs only when the investor is on the Markowitz (1952) efficient frontier. When the choice of asset is suboptimal – as in the case of the Savings Account – there is the possibility of arbitrage that is, the exchange of assets with a certain gain.

The classical theory explains how rational investors make optimal investment decisions. However, it was found that, most of the time, the choices were not efficient and the most used investment presented returns lower than inflation in the period analyzed. According to ANBIMA (2022), 53% of investors state that rising inflation reduces their willingness to invest. In the next chapter, from the perspective of behavioral finance, we discuss the reasons why investors do not make a choice that brings them the best expected benefit.

Behavioral Finance and Biased Choice

As discussed, rationality is based primarily on two assumptions. First, those individuals process all information perfectly and update their beliefs according to the statistical probability distribution. Second, given their beliefs, the normatively accepted decision that maximizes expected utility is made. On the other hand, Barberis and Thaler (2003) argue that behavioral finance is a new approach to the financial market in response to traditional finance. According to the authors, there are some phenomena that can be better explained using models in which the agent is not entirely rational in his decisions.

For Ramiah, Xu and Moosa (2015), markets are not always efficient, because there are "anomalies" that can be explained in terms of the risk related to noise traders. Recently in the literature, "noise trader" is a term used to describe a market participant who makes investment decisions without using financial fundamentals, exhibits poor market timing, follows trends (herd behavior) and tends to overreact or underreact to good and bad news. According to the authors, the evidence suggests that traders do not operate rationally. In other words, active investors, in terms of market operations, make short-term speculation decisions that are not consistent with the "fundamental value" of the assets.

However, the fact that conservative investors who have enough time to analyze fixed income assets, carefully evaluate their options and still make inefficient investment decisions is an issue that challenges traditional finance theories. The individual presents biases that limit their choices. Sahi and Arora (2012) explain that biases are like a systematic deviation from the norm, or an inclination towards a certain judgment. Biases can be due to cognitive limitations, information processing strategies or heuristics (specific motivations, egocentric principle, affective influences, principles of perceptive organization and cognitive styles). Below, we will discuss some of the most common biases for the profile of the Brazilian investor (discussed in 4.2), who is risk averse and opts for the Savings Account in their investments.

The first bias is loss aversion, which occurs when a person is very risk averse and reluctant to accept losses. Fear of loss encourages excessive risk rejection, which can lead to decisions that negatively affect portfolio returns (Ainia and Lutfi, 2019). The criticism that individuals fear the loss of a certain amount disproportionately more than the gain of the same amount ignores the fact that for many investors, the parameters of gains and losses are different (Gal and Rucker, 2018). One investor might consider a return of, for example, 7%

per year as a gain, while another, expecting to be paid 11%, might consider the same 7% as a loss. However, the idea that gain and loss are subjective matters to the individual disregards the fact that there are "rational anchors" on which the individual can base their expectations, such as the economy's basic interest rate.

The status quo bias occurs when the agent does not make any new decisions, simply maintaining their previous decision or a previously established decision (Samuelson and Zeckhauser, 1988). For the authors, this bias is much more common to individuals than predicted by the canonical model. In fact, the ANBIMA (2022) survey shows that the Savings Account will continue to be the main destination for investment intentions in the future (21%). Maintaining one's portfolio position and investment choices is, in fact, more comfortable than questioning one's own individual choices and venturing out to discover new investment options. However, staying in the "comfort zone" (or the status quo) has its price, which is in relation to the opportunity cost in relation to the possibility of increasing the portfolio's remuneration.

Another limitation that is becoming increasingly present through virtual communities and messages targeted at the individual's profile is confirmation bias (Park et al; 2010). According to the authors, investors attribute great credit to evidence that confirms their point of view and discredit evidence that contradicts or invalidates it. In other words, the agent mainly validates information that reinforces their beliefs. Therefore, if a person believes in a savings account as an efficient investment, for example, they may give emphasis to any other person who has ventured into a new type of asset and has not obtained the desired results. However, when purchasing a new asset, it is always important to study its characteristics in advance, invest cautiously and analyze the effect of this new asset on the risk-return relationship of the investment portfolio.

Finally, it is assumed that in a modern society, the more investment options its citizens have, the better their choices will be. Especially when the individual is already well aware of the available options and their preferences. In this case, a greater variety of options would serve a greater number of consumers (or investors). However, studies by Iyengar and Lepper (2000) have shown that people may have difficulty managing complex choices. The choice overload bias shows that, although the offer of extensive options can sometimes still be seen as initially desirable, it can also prove unexpectedly demotivating in the end. Therefore, an individual who is unhappy with their returns on their savings account and wants a new investment will have to choose between government bonds, private fixed income, investment funds, real estate funds, stocks, crypto assets, etc. In other words, the number of

options available in the various investment classes can demotivate a person who is just starting out with their investments.

However, since the individual has time for analysis, it is possible to filter among the asset classes those that satisfy their preferences in relation to risk and liquidity that best satisfy their financial planning. Furthermore, there are several assets that can be considered perfect substitutes for each other because they have identical or similar guarantees – as discussed in the previous chapters.

The study of behavioral finance is relevant for investors to understand their cognitive limitations and then be able to make less biased choices. The study by Bortoli et al. (2019) observed that people with greater cognitive abilities that allow the individual to replace an impulsive and incorrect choice with a more considered one were less likely to take high levels of risk.

Final considerations

This paper sought to understand why, on average, Brazilians have been making inefficient investment decisions. To achieve this objective, we initially discussed the optimization of the choice of financial assets under uncertainty, based on classical finance theory. We then analyzed the investment decisions made by these investors, comparing them with other assets with a similar risk profile in the period from 2015 to 2022. Finally, in light of behavioral finance theories, we discussed the biases that limit the investor's ability to optimize portfolio selection.

This study contributes by directing the focus to the risk-averse investor who concentrates on fixed-income assets, an approach that is still little explored in the literature, which predominantly focuses on higher-risk assets, such as stocks, as discussed by Barberis and Thaler (2003) and Alquraan et al. (2016). By integrating two distinct and fundamental theories — classical financial theory and behavioral finance —, the study offers a more holistic view of the decision-making process of Brazilian investors with a conservative profile. In addition, the study discusses the application of this approach in the selection of financial assets that can provide increases in profitability without the need to assume additional risks.

The traditional financial models are based on the Efficient Market Hypothesis to define an individual who processes market information perfectly and, based on his/her risk

preference, makes efficient investment decisions regarding the trade-off between risk and return. Furthermore, according to the traditional model, it is observed that at minimum (or zero) levels of risk, the investor is remunerated at the pure rate (risk-free), defined by the basic interest rate of the economy (Selic). Risky assets must remunerate the basic rate plus the risk premium.

However, it was observed that investors with a risk-averse profile have chosen to invest in savings accounts, whose remuneration has been shown to be lower than assets linked to the Selic rate or 100% of the CDI, and has not been able to keep up with inflation during the period. Through a discussion from a behavioral perspective, it was observed how agents, on average, were influenced by cognitive biases – among them, loss aversion, status quo, confirmation and excess of options – which limited them from making more efficient investment decisions that would allow an increase in the profitability of the portfolio without necessarily increasing the level of risk. Important decisions, such as those related to investments, must be made in a considered and well-founded manner, in order to avoid hasty and biased choices.

The integration of classical finance theory with behavioral finance concepts offers a more comprehensive and effective understanding of the investment decision-making process. Although these approaches may seem divergent at first glance, their greatest value lies precisely in their complementarity. Together, they offer a more complete perspective, allowing investors to recognize both the objective rationales and the psychological factors that influence their choices. New theoretical work has incorporated concepts from prospect theory into more traditional models of economic behavior, and a growing body of empirical work has tested the predictions of these new theories (Barberis, 2013).

Despite the significant contributions of this study, it is essential to recognize some limitations that may impact the results presented. First, the absence of interviews or questionnaires that test investors' biases and heuristics may limit a deeper understanding of the reasons underlying the inefficient investment choices observed. Specifically, the specific reasons why many investors opted for savings accounts were not empirically tested, even in the face of evidence that this type of investment is not the most efficient in terms of profitability. Studies such as those by Khalaf (2023) and Cao (2021) used questionnaires to test various biases for investors at an international level, although focused on the stock market, offering an empirical perspective that could be adapted to the Brazilian context.

It is therefore suggested that future studies include targeted questionnaires, focusing on understanding the motivations and reasons that lead investors with a risk-averse profile to

choose their assets. This would allow for a more detailed analysis of the behavioral biases at play, offering a more comprehensive and enriching view of the choices made by Brazilian investors, expanding the relevance and applicability of the results.

References

AINIA, N. S. N; LUTFI, L. The influence of risk perception, risk tolerance, overconfidence, and loss aversion towards investment decision making. Journal of Economics, Business, & Accountancy Ventura, v.21, n.3, 401-413, 2019.

ANBIMA. Raio-X do Investidor Brasileiro - 5ª edição. São Paulo, 2022. Disponível em: < https://www.anbima.com.br/pt_br/especial/raio-x-do-investidor-2022.htm >
Aguirre, R. A.; Aguirre, A. A. Behavioral finance: Evolution from the classical theory and remarks. Journal of Economic Surveys, 38(2), 452-475, 2024.

ALQURAAN, T., ALQISIE, A., & AL SHORAFA, A. Do behavioral finance factors influence stock investment decisions of individual investors? (Evidences from Saudi Stock Market). Journal of American Science, 12(9), 72-82, 2016.

BANCO CENTRAL DO BRASIL. Remuneração dos Depósitos de Poupança. Disponível em: < https://www.bcb.gov.br/estatisticas/remuneradepositospoupanca> Acesso em: 01/05/2023.

BARBERIS, N; THALER, RICHARD. A survey of behavioral finance. Handbook of the Economics of Finance, v. 1, p. 1053-1128, 2003.

BARBERIS, N. Thirty years of prospect theory in economics: A review and assessment. Journal of economic perspectives, v. 27, n. 1, p. 173-196, 2013.

BERNARD, C., CHEN, J. S., VANDUFFEL, S. Rationalizing investors' choices. Journal of Mathematical Economics, 59, 10-23, 2015.

BLANCHARD, O. Mercados Financeiros II: o modelo IS-LM ampliado. Macroeconomia: 7ª edição. São Paulo: Pearson Education do Brasil, cap.6, 2017.
BLOOM, N. The impact of uncertainty shocks. Econometrica, Wiley Online Library, v. 77, n. 3, p. 623–685, 2009.

DE BORTOLI, Daiane et al. Personality traits and investor profile analysis: A behavioral finance study. PloS one, v. 14, n. 3, p. e0214062, 2019.

CAO, M. M., NGUYEN, N.-T., & TRAN, T.-T. Behavioral factors on individual investors' decision making and investment performance: A survey from the Vietnam Stock Market. The Journal of Asian Finance, Economics and Business, 8(3), 845–853, 2021.

CHU, W; IM, M; JANG, H. Overconfidence and emotion regulation failure: How overconfidence leads to the disposition effect in consumer investment behaviour. Journal of Financial Services Marketing, v. 17, p. 96-116, 2012.

DEWAN, P; DHARNI, K. Herding behaviour in investment decision making: a review. Journal of Economics, Management and Trade, v. 24, n. 2, p. 1-12, 2019.

FAMA, E. Efficient capital markets: A review of theory and empirical work. Journal of Finance 25, p.383-417, 1970.

GAL, D; RUCKER, D. The loss of loss aversion: Will it loom larger than its gain? Journal of Consumer Psychology, v. 28, n. 3, p. 497-516, 2018.

HADDOW, A; HARE, C; HOOLEY, J; SHAKIR, T. Macroeconomic uncertainty: what is it, how can we measure it and why does it matter? Bank of England Quarterly Bulletin, Q2, 2013.

HEATON, J; LUCAS, D. Market Frictions, Savings Behavior, and Portfolio Choice. Macroeconomic Dynamics, v.1, p.76–101, 1997.

IYENGAR, S.; LEPPER, M. When choice is demotivating: Can one desire too much of a good thing? Journal of personality and social psychology, v. 79, n. 6, p. 995, 2000.

KAHNEMAN, D.; TVERSKY, A. Julgamento Sob Incerteza: Heurísticas e Vieses. Science, v. 185 n. 4157, Sep. 1974.

KAHNEMAN, D; TVERSKY, A. Prospect theory: an analysis of decision under risk. Econometrica: Journal of the Econometric Society, V. 47, N. 2, p. 263-291, 1979.

KHALAF, B. An empirical investigation on investor psychological biases. Corporate and Business Strategy Review, v. 4, n. 2, p. 8-14, 2023.

KUMAR, S; GOYAL, N. Behavioral biases in investment decision making – a systematic literature review. Qualitative Research in Financial Markets, v. 7, n.1, p.88-108, 2015.

LIAN, C., MA, Y; WANG, C. Low interest rates and risk-taking: Evidence from individual investment decisions. The Review of Financial Studies, v.32, n.6, p.2107-2148, 2019.

MANKIEW, N. G. Principles of Economics. Cengage Learning, 2017.

MARKOWITZ, H. Portfolio selection. The Journal of Finance, 7(1), p.77–91, 1952.

MASSAFERA, F; CANDIDO, M. Uma Análise Dos Títulos Públicos No Brasil: Risco E Retorno. Revista Economia e Políticas Públicas, v. 10, n. 2, 2022.

MCCANNON, B. C., ASAAD, C. T; WILSON, M. Financial competence, overconfidence, and trusting investments: Results from an experiment. Journal of Economics and Finance, 40, 590-606, 2016.

NETO, A. A. (2021). Mercado financeiro. Atlas, 5ª edição.

PARK, J. et al. Confirmation bias, overconfidence, and investment performance: Evidence from stock message boards. McCombs research paper series no. IROM-07-10, 2010.

RAMIAH, V; XU, X; MOOSA, I. Neoclassical finance, behavioral finance and noise traders: A review and assessment of the literature. International Review of Financial Analysis, v. 41, p. 89-100, 2015.

RUBIK, E. M., & COSTA, K. V. A. Algumas relações entre a SELIC-over e o CDI. Ciências Sociais Aplicadas em Revista, v.8, n.15, 2008.

SAHI, S; ARORA, A. Individual investor biases: A segmentation analysis. Qualitative Research in Financial Markets, 2012.

SAMUELSON, W; ZECKHAUSER, R. Status quo bias in decision making. Journal of risk and uncertainty, v. 1, p. 7-59, 1988.

SATTAR, M; TOSEEF, M; SATTAR, M; Behavioral Finance Biases in Investment Decision Making. International Journal of Accounting, Finance and Risk Management. Vol. 5, No. 2, 2020, pp. 69-75.

SERRA COSTA, J. F., DE SOUZA, I. F. B., de PINHO PAIVA, M. G; RAMOS, C. Y. R. Escolha do investimento mais adequado ao perfil conservador utilizando método de análise hierárquica. Produto & Produção, v.21, n.1, 2020.

SHARPE, W. F. Capital asset prices: A theory of market equilibrium under conditions of risk. The journal of finance, v.19, n.3, p.425-442, 1964.

SILVA, A. Metodologia da Pesquisa Aplicada à Contabilidade. São Paulo: Editora Atlas, 2003.

VARIAN, H. Intermediate Microeconomics: A Modern Approach. W. W. Norton & Company, 1987.

VICEIRA, L. M. Optimal Portfolio Choice for Long-Horizon Investors with Nontradable Labor Income. The Journal of Finance, v.56, n. 2, 2001.

Von Neumann, J., & Morgenstern, O. Theory of games and economic behavior: 60th anniversary commemorative edition. In Theory of games and economic behavior. Princeton University Press, 2007.

YEN, G; LEE, C. Efficient Market Hypothesis (EMH): Past, Present and Future. Review of Pacific Basin Financial Markets and Policies. V. 11, No. 2, p.305–329, 2008.