DETERMINANTS OF BRAZILIAN INVESTORS' RISK TOLERANCE

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ABSTRACT

This study analyzes the risk appetite dynamics of high-income Brazilian investors between 2021 and 2024. Using a confidential dataset of 774 investors, we investigated how individual characteristics (age, profession, retirement status) and external events (elections, stock market performance, and interest rate) affect risk appetite. We found inconclusive patterns for age, but the results showed that equity allocation is higher among those in quantitative professions and among retirees. Moreover, investors invested comparatively less in equity when previous fixed income rates were higher, when stock markets performed poorer, and around the Brazilian presidential elections of 2022. These findings are important for brokers, investment funds, and policymakers, as they should consider these determinants in the fluctuations that occur in investor preferences.

Keywords: Risk appetite, Portfolio management, Investor characteristics, Presidential elections.

1 INTRODUCTION

Risk preference is a critical attribute when deciding which assets to invest in. Risk is often measured as the variance of expected returns, due to uncertainties in the economy, liquidity, interest rates, inflation and other systemic or specific factors. More conventional theories, such as those of Stigler and Becker (1977), argue that risk preference can be considered as stable. However, several modern studies show that, besides cross-sectional differences, an individual's risk aversion is subject to fluctuations. Guiso et al. (2018), for instance, conducted a study with 1,686 customers of an Italian bank and concluded that, after the 2008 crisis, investors decreased their tolerance to risk.

Analyzing risk preference is essential to understanding investor behavior, especially in periods of political and economic uncertainty. Determinants of risk aversion are important inputs for the formulation of economic policies and for the decision-making of wealth managers and individual investors. Hence, we investigate cross-sectional and longitudinal determinants of the risk tolerance of high-income investors in Brazil, verifying their portfolio of fixed and

variable income investments between 2021 and 2024. Particularly, we analyze whether individual characteristics, such as age and profession, and external events, such as elections and stock market performance, explain portfolio patterns, and study the intensity with which adjustments are made with respect to those determinants.

After performing regressions with panel data with 6,968 observations of 774 individuals, we surprisingly found that retired individuals showed a higher appetite for risk. Furthermore, investors invested comparatively less in equity when previous fixed income rates were higher, when stock markets performed poorer, and around the Brazilian presidential elections of 2022. Moreover, as expected, we found that those who work in quantitative areas invest more in equity.

Our results are in line with the assumption of fluctuating risk preferences, affected by personal characteristics and by variations in market and political conditions. They are particularly important for two types of entities: brokerage firms and managers when recommending investment alternatives to clients, and governments and regulators when promoting certain markets.

We present relevant literature and our research hypotheses in the next section and then we describe data and methodology. After that, we present and analyze the results and make final comments.

2 LITERATURE AND HYPOTHESES

Stigler and Becker (1977) opened a debate that has lasted for decades in the area of personal finance. In their work, the authors argue that consumer preferences are stable over time and that the differences observed in consumer behavior can be explained not by changes in preferences, but rather by differences in budget constraints and prices. The literature on risk preference is thriving. Schildberg-Hörisch (2018), contrasting the ideas of Stigler and Becker (1977), concluded that risk aversion depends on three main variables: life cycle (individual age), temporary fluctuations, and external shocks. In short, as people age, they tend to be more conservative, while events along the way can increase or decrease momentary risk tolerance.

Milan and Eid Jr. (2017) evaluated the change in investors' risk preference in response to terrorist attacks. Applying fixed effects models to panel data containing monthly movements of investment funds since 1984, they verified whether investors withdrew resources from risky funds and invested in conservative funds. Between 1970 and 2010, there were 1,206 attacks in the US, resulting in a negative flow of capital to stocks (variable income) and an increase in the

demand for bonds issued by the US government. These results support the thesis that risk aversion is not stable.

Cunha and Lobão (2022), an important reference for our work, analyzed changes in the portfolios of private investors (high income) after the 2008 financial crisis. Using confidential questionnaires from a Swiss bank, it was possible to capture the risk preferences of clients. Initially, in 2007, half of the portfolios were composed of conservative assets. After the crisis, there was a significant migration from risky alternatives to those assets, with lower volatility.

Almeida (2021) analyzed the change in risk aversion among Brazilians by social class between 2018 and 2021, seeking to identify impacts caused by the COVID-19 pandemic. Using a database with 6,189 people who responded to an ANBIMA (Brazilian Association of Financial and Capital Market Entities) questionnaire about the use of financial products in investment portfolios, he concluded that there was a significant increase in portfolio diversification and greater concern for liquidity, especially in the upper classes.

Milan and Eid Jr. (2017) developed a regression model to explain the composition of the portfolios of 500 Brazilian investors, testing hypotheses about individual characteristics and their impact on investments. The model revealed that investors with higher levels of education and who are married tend to have more diversified portfolios. Unlike North Americans, Brazilians do not increase diversification with the growth of total investments, allocating to similar assets. Factors such as age, gender, marital status and total investments explained the level of risk. The study showed that young, male and single individuals are less risk averse, while larger investment amounts lead to greater risk exposure.

Our first hypothesis relates age to risk aversion. Following Schildberg-Hörisch's (2018) study about investors from Germany and the USA, we conjecture that age determines higher risk aversion among Brazilian investors.

H1: Younger people have less risk aversion.

Skagerlund et al. (2018) show that numeracy, the ability to understand and manipulate numbers, is a crucial component of financial literacy and is closely linked to the ability to deal with risk. Professions in the exact sciences, which require a higher level of numeracy, probably contribute to a greater propensity to take risks, as these professionals develop analytical skills and confidence in interpreting probabilities, calculations, and financial results. In addition, the study suggests that numeracy facilitates rational decision-making, even in complex contexts, reducing anxiety about numbers and increasing the willingness to assess and accept calculated risks. Milan and Eid Jr. (2017) and Skagerlund et al. (2018) reached to similar conclusions. Hence, our hypothesis is that the propensity to take risks is greater among individuals who work

in quantitative areas, such as engineering and accounting. These professions tend to require greater affinity with numbers, influencing individuals' propensity for risk.

H2: People with professions in quantitative areas have lower risk aversion.

Bragança (2009) explained the relationship between human capital, financial wealth and risk aversion. According to the author, human capital represents the ability to generate future income, being higher for non-retired people, who still have years of work ahead of them. The security provided by the expectation of future income increases their propensity to take more risks with their financial wealth, since losses can be at least partially recovered with future income. Retirees, on the other hand, may no longer have the ability to increase future income. They tend to prefer more predictable income sources for day-to-day expenses. This makes them more dependent on their accumulated financial wealth and, as a result, more averse to risky investments, since it is more difficult to compensate for financial losses through new income. Thus, due to lower human capital, retirees should prefer to keep their wealth in safer assets.

H3: Retirees have greater risk aversion.

Haubert et al. (2014) sought to understand the risk aversion of 130 students from Lisbon. The study collected data through a questionnaire, concluding that students are less prone to risk when they win and more prone to risk when they lose. In this context, we test hypotheses about the impact of stock market and fixed income returns on the portfolio composition of Brazilian investors.

H4: Higher past stock market returns are associated with greater risk aversion;

H5: Higher past fixed income returns are associated with greater risk aversion.

Political events also impact the market and, consequently, investment decisions. Jacob Júnior and Souza (2020) conducted a case study on how stock prices were affect by Jair Bolsonaro's victory in the 2018 presidential elections. They collected prices of the stocks of Banco do Brasil, Itaú, Bradesco and Santander, the four largest listed Brazilian financial institutions. At the end of the chosen period, 25 days before and after the result of the second round, prices were above the expected levels, indicating increased market optimism. We aim to investigate whether the political transition arising from the 2022 election, which Luiz Inácio Lula da Silva won over Jair Bolsonaro, led to changes in investors' risk appetite.

H6: Risk aversion changed during Brazil’s 2022 presidential election.

The next section describes the data and explains how these six hypotheses are tested.

3 METHOD

We had access to a confidential database provided by an investment firm that manages the assets of high-income clients, i.e., those with a declared net worth equal to or greater than R$ 5 million (around 1 million dollars). The sample consists of monthly time series of 774 clients, 558 males and 216 females, between February 2021 and March 2024. Each observation refers to a single client i, in a given period t. Our dependent variable to represent risk aversion is the net worth ("NW") of the client i allocated to variable income ("vi") assets (stocks and derivatives), which we reference as $NW_{i,t}^{vi}$. As a second measure, we included the monthly variation in this portion ($\%NW_{i,t}^{vi}$). Portions higher than 100% or equal or lower than 0% are discarded because they may represent measurement errors or residuals. Due to the same reason, absolute changes in this portfolio by more than 100% were removed from the sample.

As individual-level determinants, we included the client's age, in years, and the dummy variables $quant\_prof_i$, an indicator of professional activity in quantitative areas, and $retired_{i,t}$, indicating retirement status. As professions in quantitative areas, we considered Systems Analyst, Accountant and Engineer.

The test of hypotheses H4 and H5 requires proxies for stock market and fixed income returns. Hence, we also added $stock_{t-1}$, which is the return of the Ibovespa (Bovespa Index, Brazilian's most popular stock index) between last month and the month before, and $interest_{t-1}$, the return of the CDI (Interbank Deposit Certificate, Brazilian's most popular fixed income index) between last month and the month before. Finally, in order to test H6, we included the variable $election_t$, indicating the month of October 2022, when Luiz Inácio Lula da Silva was elected as the new president of Brazil, a position held until then by Jair Messias Bolsonaro.

The regression of $NW_{i,t}^{vi}$ included a lagged component as a regressor, since some persistence in the risk aversion is expected. In fact, the Durbin-Watson test indicates positive autocorrelation in the model of $NW_{i,t}^{vi}$ without its lagged component. The resulting models are described in Equations 1 and 2, which represent Model 1 and Model 2.

$$\begin{aligned} NW_{i,t}^{vi} = {} & \beta_0 + \beta_1 election_t + \beta_2 age_{i,t} + \beta_3 quant\_prof_i \\ & + \beta_4 retired_{i,t} + \beta_5 interest_{t-1} + \beta_6 stock_{t-1} \\ & + \beta_7 NW_{i,t-1}^{vi} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

$$\%NW_{i,t}^{vi} = \beta_0 + \beta_1 election_t + \beta_2 age_{i,t} + \beta_3 quant\_prof_i + \beta_4 retired_{i,t} + \beta_5 interest_{t-1} + \beta_6 stock_{t-1} + \varepsilon_{i,t} \quad (2)$$

4 RESULTS

As previously mentioned, the sample includes 774 clients, with an average age of 48 years, 216 females and 558 males. Table 1 shows the descriptive statistics of the variables used in the analysis.

Table 1: Descriptive statistics

Variable	Average	Std. Dev.	Min	Max
$NW_{i,t}^{vi}$	30.686%	32.317%	0.001%	100.000%
$NW_{i,t-1}^{vi}$	31.449%	32.528%	0.001%	100.000%
$\%NW_{i,t}^{vi}$	-1.711%	20.393%	-99.993%	99.876%
$interest_{t-1}$	0.951%	0.181%	0.130%	1.170%
$stock_{t-1}$	1.402%	5.552%	-11.500%	12.540%
$age_{i,t}$	47.88	14.42	18.00	94.00
$quant\_prof_i$	0.14	0.35	0.00	1.00
$retired_{i,t}$	0.03	0.18	0.00	1.00
$election_t$	0.01	0.11	0.00	1.00

Note: not all variables have 6,968 observations.

The average percentage of the net worth allocated to variable income investments in our sample is 30,686%. It changes by -1.711%, on average, with a standard deviation of 20.393%. This high deviation may be the result of sudden changes in exposure due to external events or to the volatility of the assets.

Mean returns of fixed income investments and of the stock index are 0.951% and 1.402%, respectively, with standard deviations of 0.181% and 5.552%, respectively. The average client is 47,88 years old. Only 14% of the clients work in quantitative fields and only 3% are retired.

Figure 1 shows the distribution of the percentage of the net worth in variable income investments. Most of the portfolios have between 0% and 35% in this asset class. 2,113 clients invest at most 6%, while 2,599 allocate between 6% and 35%. Only 618 clients allocate more than 94%.

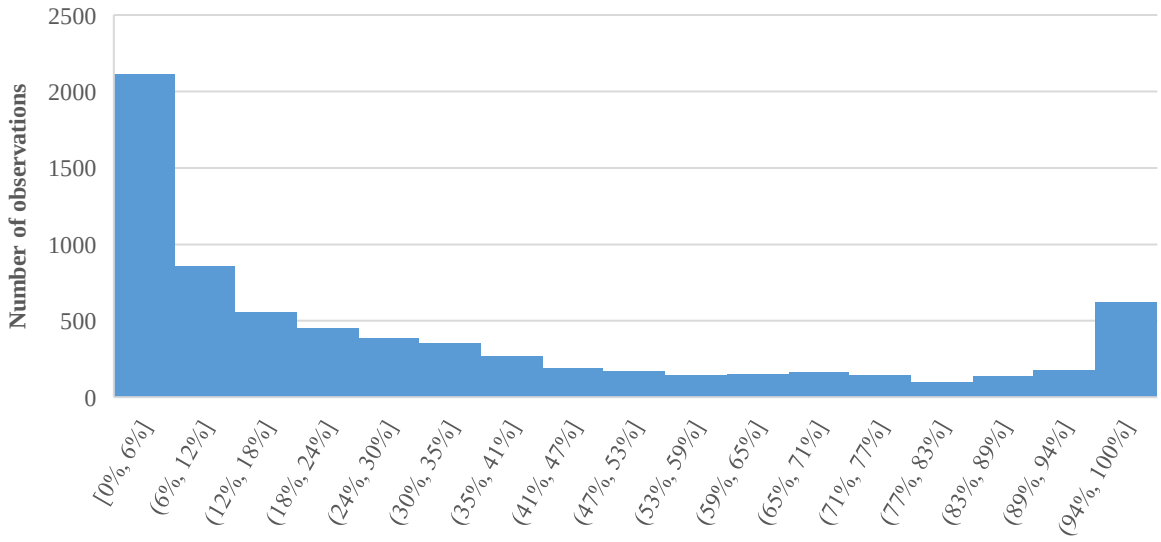

Figure 1: Histogram of the variable $NW_{i,t}^{vi}$

Figure 2 presents the distribution of the change in this portion, which is much more symmetrical. Most of the observations (3,075) are concentrated around the mean, between -4% and 4%.

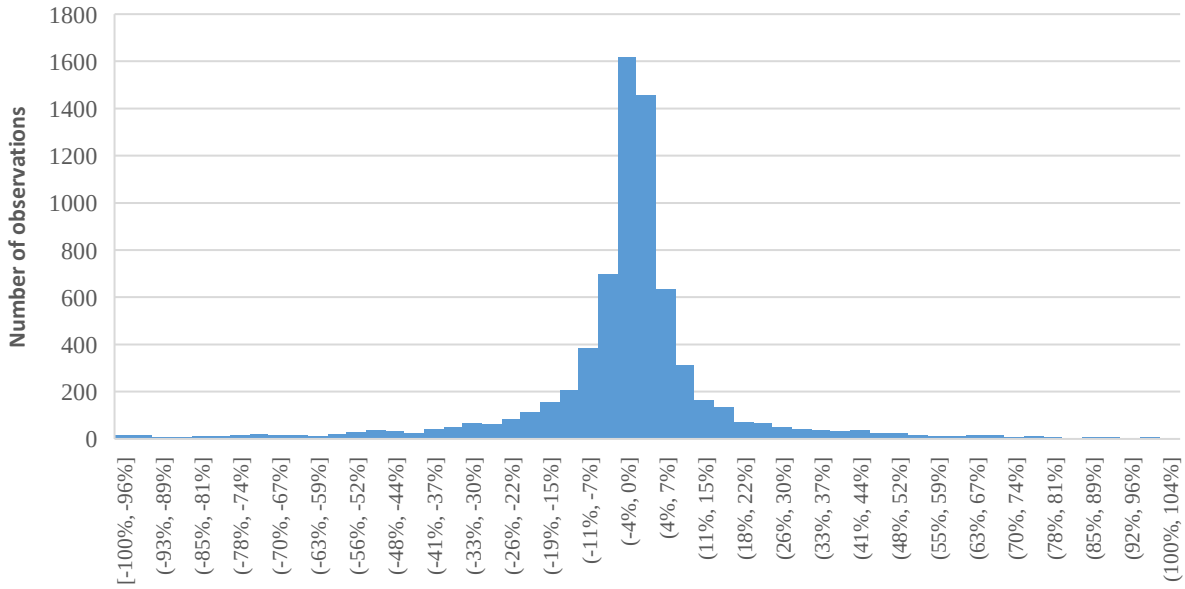

Figure 2: Histogram of the variable $\%NW_{i,t}^{vi}$

Figure 3 shows the relationship between the average annual return and the average annual standard deviation of the investments. Monthly returns were calculated multiplying the portions in fixed and variable income to the returns of CDI and Ibovespa, respectively, and them summing the results. Based on that, the average return for each year and its standard deviation were obtained for each client. The sample was then divided into three terciles, classifying clients according to risk aversion profiles: low, medium and high.

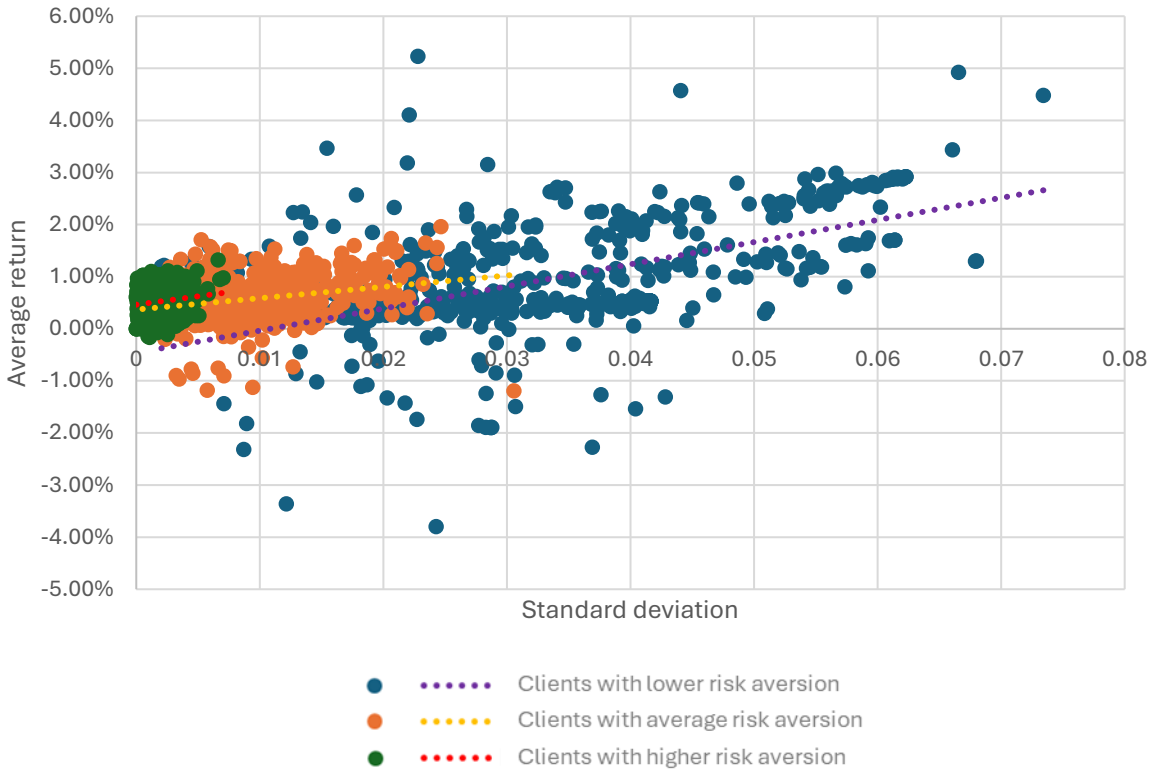

Figure 3: Average return and standard deviation of customer grouped by their risk aversion

All terciles present a positive relationship between returns and standard deviation. Portfolios of clients with lower risk aversion have greater dispersion. They are prone to greater volatility (higher standard deviation), but also accomplish higher average annual returns. However, they are also more exposed to negative returns in adverse scenarios. Medium-risk aversion clients position themselves at intermediate levels of risk and return. The trend line for this group reflects a more gradual increase in average return with risk.

Higher risk-aversion clients, on the other hand, prioritize stability, focusing on low levels of volatility and modest returns, showing that they avoid risk in exchange for predictability. This dynamic reinforces that, while potential return increases with risk, different aversion profiles shape investors' choices. Low-risk aversion investors are willing to take more risks in search of high returns, while more conservative investors prefer to protect their capital, even accepting reduced returns.

The correlation between the variables, presented in Table 2, evidences the high autocorrelation of the dependent variables ($\boldsymbol{NW_{i,t}^{vi}}$ has a correlation of 98% with its lagged component, $\boldsymbol{NW_{i,t-1}^{vi}}$). The other correlations are not high enough to raise multicollinearity problems.

Table 2: Correlation matrix

Variable	1	2	3	4	5	6	7	8	9
(1) $\boldsymbol{NW_{i,t}^{vi}}$	1.00								
(2) $\boldsymbol{NW_{i,t-1}^{vi}}$	0.98	1.00							
(3) $\%\boldsymbol{NW_{i,t}^{vi}}$	0.10	-0.03	1.00						
(4) $\boldsymbol{interest_{t-1}}$	-0.03	-0.05	0.03	1.00					
(5) $\boldsymbol{stock_{t-1}}$	0.01	0.02	-0.02	-0.01	1.00				
(6) $\boldsymbol{age_{i,t}}$	-0.01	-0.01	0.01	-0.05	0.00	1.00			
(7) $\boldsymbol{quant\_prof_i}$	0.02	0.01	0.03	0.06	0.01	0.02	1.00		
(8) $\boldsymbol{retired_{i,t}}$	-0.07	-0.07	0.01	0.01	0.01	0.29	-0.07	1.00	
(9) $\boldsymbol{election_t}$	0.00	0.00	-0.04	0.07	-0.02	0.01	0.00	0.00	1.00

The results of the model estimations are presented in Table 3. The results for Model 1, represented by Equation 1, confirms the high autocorrelation of the risk tolerance over time. Its lagged component presented a statistically significant coefficient of 0.75.

Table 3: Regression results

	Dependent variable:	
	Model 1: $\boldsymbol{NW_{i,t}^{vi}}$	**Model 2:** $\%\boldsymbol{NW_{i,t}^{vi}}$
$\boldsymbol{NW_{i,t-1}^{vi}}$	0.75***	
	(0.03)	
$\boldsymbol{interest_{t-1}}$	-1.57**	2.51
	(0.79)	(1.89)
$\boldsymbol{stock_{t-1}}$	-0.02	-0.10***
	(0.01)	(0.04)
$\boldsymbol{age_{i,t}}$	-0.01***	0.02***
	(0.00)	(0.01)
$\boldsymbol{quant\_prof_i}$	-0.01*	-0.01
	(0.01)	(0.02)
$\boldsymbol{retired_{i,t}}$	0.08***	0.10***
	(0.00)	(0.00)
$\boldsymbol{election_t}$	0.00	-0.07**
	(0.01)	(0.04)
$\boldsymbol{const.}$	0.38***	-0.94***
	(0.11)	(0.28)
$Prob. > F$	0.00	0.00
R^2	0.5881	0.006

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. Standard errors are shown in brackets. Models 1 and 2 are represented by Equations 1 and 2.

As in the work of Schildberg-Hörisch (2018), in which young people are more prone to risk, our results indicate that they have, on average, a larger portion of their portfolio in variable income investments ($\boldsymbol{age_{i,t}}$ enters significantly negative in Model 1). However, the significant and positive coefficient of $\boldsymbol{age_{i,t}}$ in Model 2 indicates that older investors reduced a lesser portion (in percentage terms) of their balance in variable income over time. Thus, results for H1 are not conclusive.

The variable $\boldsymbol{quant\_prof_i}$, which indicates whether the investor works in more quantitative fields, showed a negative and statistically significant coefficient only in Model 1, and only at the 10% level. This result suggests that these investors have, on average, a slightly smaller portion of their assets allocated to variable income investments, which may reflect a more cautious approach. Thus, based on our data, we cannot state that working in areas that demand more financial or quantitative skills affects the portion of investments in variable income. Results for H2 are also not conclusive.

Surprisingly, the results showed that retirees have a higher portion of their wealth invested in variable income, both in terms of level and variation. In both models, the variable $\boldsymbol{retired_{i,t}}$ had a positive and statistically significant coefficient, at the 1% level. This finding is contrary to H3 and to Bragança's (2009) statement that retired people tend to make more conservative decisions.

The coefficient of the variable $\boldsymbol{stock_{t-1}}$ was not indistinguishable from zero in Model 1, indicating that past stock market returns are not associated with the investor's risk tolerance, different from what we conjecture in H4. However, in Model 2, its coefficient was negative and statistically significant at the 1% level, indicating that positive returns on the Ibovespa are associated with higher reductions (increases) in the weight of variable (fixed) income investments. This finding suggests that, after periods of bullish market activity, investors tend to take profits and reduce their exposure, reflecting a momentary aversion to risk. Therefore, we can partially validate H4, since past stock market returns appear to influence risk aversion in terms of variation, but not in terms of levels, in the weight of variable income investments.

The variable $\boldsymbol{interest_{t-1}}$ presented a negative and statistically significant coefficient at the 5% level in Model 1, indicating that an increase in fixed income returns is associated with a lower allocation to variable income. Hence, investors tend to reduce their exposure to risky assets (higher risk aversion) in periods of higher interest rates. This behavior is in line with H5. In Model 2, on the other hand, the coefficient of the same variable was not significant. Thus, the interest rate significantly affects the level of the portfolio weight in variable income investments, but not the relative changes in allocation. Thus, H5 is only partially validated.

Jacob Júnior and Souza (2019) found that stock returns are higher than expected around the 2018 presidential elections in Brazil. Similarly, we verified whether the investors' risk appetite fluctuates around the 2022 presidential elections. The coefficient of $\boldsymbol{election_t}$ was negative and statistically significant in Model 2, at the 5% level, but insignificant in Model 1. Hence, investors did a higher-than-average percentage reduction in their exposure to variable income investments around the election, but the portfolio weight of this asset class was not significantly different from other periods, on average. We conclude that the election momentarily affected risk appetite in terms of the size of the percentage adjustments, but this effect could not be evidenced in terms of how much the investment in variable income represents of the total portfolio, partially validating H6.

5 FINAL COMMENTS

This study analyzed the dynamics of risk appetite among high-income Brazilian investors between 2021 and 2024, with the aim of understanding how individual and external factors influence the composition of portfolios. The results indicated that profession and retirement status are important in explaining the risk profile of these investors. In addition, political and economic events, such as elections and the performance of stock and fixed income markets, showed momentary or lasting relationships in the allocation behavior in variable income assets.

Our findings indicate that the risk aversion behavior of investors is complex and sensitive to different influences, making it necessary to observe both individual and cyclical factors. As expected, we evidenced that professionals in quantitative areas tend to allocate a larger portion to risky assets. Surprisingly, we found that retirees have a greater propensity for risk than expected, probably due to greater experience or financial stability.

Our study has some limitations. For instance, the attrition in the database (the loss of participants over time) can introduce selection bias, because the departure of individuals may not be random; for example, if clients with specific characteristics (such as greater risk aversion after losses) are more prone to leave the sample, the remaining sample may become less representative and influence the results, compromising the validity of the conclusions. In the sample, there were both entries and exits of clients throughout the period analyzed. Some individuals were observed for only two months, while others remained in the database for up to 38 months, with an average of nine observations per individual, totaling 6,968 observations.

This phenomenon can introduce selection bias, especially if the clients who left had different characteristics than those who remained. Thus, the remaining sample may not fully represent the behavior of all high-income investors originally included, limiting the generalizability of the conclusions and requiring caution in interpreting the results.

In addition, since the investors in the sample chose to become clients of the firm in question, there is a possible self-selection bias, due to the fact that this decision may be linked to particular characteristics, such as a specific risk profile or investment preferences. The analysis also considers only investors aged 18 or over, since minors do not have legal autonomy to make full financial decisions, characterizing a pre-selection bias. Furthermore, the sample is restricted to high-income investors managed by a single firm, without including investors from other firms or who act independently, introducing an exclusion bias. These biases should be considered when interpreting the results, as they may influence the representativeness and generalizability of the study's conclusions.

Our dependent variable, the portion allocated to variable income investments, have limitations as indicators of risk appetite, being influenced by the client's financial movements, such as new contributions, withdrawals or changes in the available balance, which may not reflect real changes in the risk profile. Moreover, the client may have investments managed by other institutions or even real assets, such as real estate, which were not accounted for. Future studies can address these limitations, considering the cash flows in the client's account, adjusting the metrics to discount the impact of inflows and outflows, as well as using surveys or considering other data sources, in order to obtain a more accurate proxy for the investor's actual risk tolerance.

Moreover, future studies can conduct additional analyses to understand the characteristics of participants who left the base over time, or the allocation to each specific type of variable income investment, both in Brazil and abroad. This approach would allow a more comprehensive analysis, considering that many high-income investors seek geographic and industry diversification, and also provide a more detailed view of how individual and external factors affect allocation across different asset classes.

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