

Behavioral distortions of individual investors in the decision-making process¹

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Abstract. The primary aim of this study was to assess the extent and dispersion of dispositional optimism and a positive orientation among individual investors in Poland. An ancillary objective was to scrutinize the correlation between dispositional optimism and positive orientation with factors such as gender, age, education, place of residence, and experience. To examine psychological variables such as dispositional optimism, positive orientation, and risk propensity, the authors used psychological tests: the Life Orientation Test (LOT-R), the Positive Orientation Scale (P- Scale), and the risk-related questionnaire inspired by the Kahneman and Tversky studies. The findings revealed that individual investors in Poland generally displayed a mixed outlook of dispositional optimism and positive orientation. Moreover, the study demonstrated that factors such as age, experience, and consistency in decision-making played a role in shaping the level of optimism among these investors. Unlike most studies that solely focus on measuring the errors resulting from excessive dispositional optimism, this paper offers insights into recognizing and understanding optimistic tendencies in the context of investment behavior.

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1. INTRODUCTION

In the financial markets, the process of making investment decisions is conditioned by many factors, including psychological factors, which play an essential role, apart from economic factors. The development of behavioral finance is evidence of the perception of emotions as an essential factor influencing the decisions of investors (Żurawik, 2012).

Emotions occur in all areas of investor behavior. Emotions are related to violent feelings (fear, surprise), feelings (pride, envy), disposition (pessimism, optimism), etc. (Żurawik, 2012). One of the most widely recognized findings in the field of behavioral aspects of investing is that people tend to be excessively hopeful when it comes to their expectations of future results (Weinstein, 1983). Decision makers tend to be overly optimistic and confident about their chances of success, and they tend to consider their self-interested judgments to be fair (Solek, 2014). Optimism is an important personality feature that influences the perception of reality and decision-making processes (Kozubikova et al., 2017).

A number of different phenomena are typically subsumed under the umbrella term "optimistic." Shepperd et al. (2013) highlight the distinction between unrealistic comparative optimism and unrealistic absolute optimism. In accordance with the aforementioned definition, individuals evaluate their prospects to be superior to those of other analogous individuals (or a distinct reference group). This implies that they anticipate positive outcomes to be more probable and adverse outcomes to be less probable in themselves than in others. In contrast, the latter definition indicates that individuals tend to assess risk in an unrealistically positive manner when compared to an objective criterion, such as actuarial risk assessment or actual outcomes (e.g., a grade at the end of their studies). It is essential to differentiate these forms of optimistic attitudes from dispositional optimism. Dispositional optimism is defined as a general tendency to expect positive future outcomes and plays an important role in the behavioural process of self-regulation. As shown in the extensive literature, dispositional optimism is a powerful personal trait influencing several aspects of the psychosocial functioning of an individual (Steca et al., 2015). This expectation does not have to be unrealistic, and the Life Orientation Test measures an overall positive perspective that does not include predictions about specific life events (Jefferson et al., 2017). Dispositional optimism is a characteristic that can manifest in different degrees. It is possible that nature has endowed us with a fundamental level of optimism, and individuals may exhibit varying intensities of this trait for a variety of reasons. Another factor to consider is how people differ in terms of displaying optimism in certain areas while lacking it in others (Czerw, 2010). The authors of the study investigated dispositional optimism among individual investors.

Positive orientation is a new construct posed at the core of positive evaluations about oneself, life, and the future (Caprara et al., 2012). The concept of positive orientation emerged from a generalisation of the findings of empirical studies. These studies demonstrated a reproducible correlation between self-esteem, life satisfaction, and optimism, which collectively formed a single factor in the results of factor analyses. The aforementioned analyses permitted the formulation of the hypothesis that a standard underlying latent variable exists. A positive orientation may be defined as an underlying tendency to notice and attach importance to positive aspects of life, experiences, and the self. It is mainly responsible for adaptive functioning, as it signifies a natural inclination towards favourable self-appraisal, high satisfaction with life, and high evaluation of the chances of achieving goals (Łaguna et al., 2011). When comparing optimism and positive orientation, optimism is a personality trait characterized by the tendency to expect positive outcomes in the future. In contrast, positive orientation is a broader outlook that emphasizes positivity in the past, present, and future. Despite these differences, both concepts share common ground as positive aspects of the human mental state (Hashimoto & Koyasu, 2012).

While optimists tend to focus on the good outcomes, pessimists focus on the harmful outcomes of risk. The tendency to focus on good or bad outcomes of risk, in turn, affects both the self-reported

willingness to take risk and actual risk-taking behavior. This suggests that dispositional optimism affects risk-taking mainly by shifting attention to specific outcomes rather than causing misperception of probabilities (Dohmen et al., 2023). Similarly, individual differences in positive orientation may serve to offset risk-avoidance tendencies (Caprara et al., 2012)

The concept of optimism is the subject of study at a number of different levels. In the majority of cases, optimism is examined in the field of economics or finance as an unrealistic forecast of future events, that is to say, the discrepancy between a predicted outcome and the actual outcome. In contrast, there is a paucity of research on dispositional optimism among participants in capital markets, understood as a character trait examined by psychological tests. Puri and Robinson (2007) reached similar conclusions, noting that the primary obstacle to collecting large-scale economic evidence on optimism is measurement. They observed that direct psychometric tests of optimism are not conducted as part of large-scale economic research. The authors identified a research gap regarding the study of dispositional optimism among participants in capital markets, including individual investors, and recommended the use of psychological tests.

The primary objective of this study aimed to gauge the extent and dispersion of dispositional optimism and positive orientation among private investors in Poland. Furthermore, an auxiliary aim was to investigate the interplay between dispositional optimism and positive orientation, considering variables such as gender, age, education, place of residence, and experience.

The article is comprised of the following sections: introduction, literature review, description of methodology, own research and discussion, and conclusion.

Undoubtedly, the presented study's significant contribution to the research on heuristics is that it attempted to identify potential optimists based on their characteristics. This allows for taking action to reduce the potential effects of excessive optimism among investors, for example, by including additional discounts in forecasts made by such people. At this stage of the study, it is difficult to speak of a precise model for using such an approach in decision-making processes. However, the authors indicate a certain spectrum of possibilities in this area.

2. LITERATURE REVIEW

Research on optimism among managing directors was conducted, for example, by Malmendier and Tate (2008), Lin et al. (2005), and Hilary et al. (2016). From their research, it can be concluded that there is excessive optimism among managing directors. Among professionals (stock market analysts), Mola and Guidolin (2009) found that stock market analysts are overly optimistic in their recommendations for companies included in investment fund portfolios compared to those outside such portfolios. Ertimur et al. (2011) observed that initial recommendations are less optimistic than subsequent "corrective" ones. Hu et al. (2021) discovered that analysts' profit forecasts are more optimistic when controlling shareholders have pledged their shares for loans. Chu and Zhai (2021) noted that analysts tend to downplay negative information and exaggerate positive information, particularly for companies with a high insolvency risk. However, Radke (2023a) found that while analysts are generally optimistic, the LOT-R psychological test does not indicate such optimism. Positive orientation, as measured by the P-scale test, was also at an average level.

In examining individual investors, De Bond (1993) found that they tended to be overly optimistic when they predicted profits from their own portfolios, while the predictions were more realistic when predicting the future level of the stock index. Iqbal (2015) found that optimism influences investor decision-making, suggesting that investors rely on their beliefs and personal judgment. Riaz and Iqbal (2015) examined the effects of four behavioural distortions, overconfidence, optimism, self-control, and the illusion of control,

on investment decisions using a survey. The results confirm the influence of 3 out of 4 distortions, such as confidence, optimism, and self-control, on investment decisions; the research did not confirm the influence of the illusion of control. Gakhar (2019) surveyed 117 investors in India. His research shows that 68.40% of the surveyed investors were optimistic. The findings of the Benetton and Compiani (2020) study indicate that younger investors with lower incomes and those who have recently entered the cryptocurrency market exhibit a greater degree of optimism regarding the future price movements of these assets. This observation suggests that investor optimism may be influenced by factors such as age, economic status, and the timing of entry into the market. Neseem et al. (2021) analysed the Chinese, Japanese, and U.S. markets, finding that the COVID-19 pandemic led to negative investor sentiment. The uncertainty surrounding the outbreak, along with economic and social restrictions and concerns about the future, diminished investor optimism and prompted many to pull back from stock market investments.

Optimism can be related to a positive orientation (Łaguna et al., 2011). Furthermore, apart from assessing the prevalence of optimism and a positive orientation among individuals in the fields of psychology, economics, and finance, an inquiry was conducted to explore how socio-demographic factors might affect the degree of optimism. The research by Czerw (2009), Glaesmer et al. (2012), Schou-Berdal et al. (2017), and Hinz et al. (2017) shows that optimism is influenced by age. This is in contrast to the findings of Stach (2006) and Radke (2023b), who observed no correlation between age and optimism. Studies by Czerw (2009), Glaesmer et al. (2012), and Schou-Berdal et al. (2017) show that gender does not influence the level of optimism. The influence of gender on the level of optimism was found by Stach (2006), Prosad et al. (2015), Hinz et al. (2017), Joo and KakabDurri (2017), and Dawson (2023). Stach (2006), Schou-Berdal et al. (2017), and Joo and KakabDurri (2017) illustrated the impact of educational attainment on the degree of optimism in their research. Radke (2023b) demonstrated that no such relationship existed between the variables. In a study conducted by Prosard et al. (2015), it was found that experience has a positive effect on optimism. However, Radke (2023b) found no such relationship. Other socio-demographic features that influence the level of optimism are a place of residence (Schou-Berdal et al., 2017), marital status (Ates et al., 2016), and forms of employment (Joo & KakabDurri, 2017).

The current study examines the relationship between risk appetite dispositional optimism and positive orientation by checking whether risk-tolerant people have more optimistic beliefs about the future (Weinstock & Sonsino, 2014). It is also possible that dispositional optimism affects risk-taking behavior primarily by directing attention to specific outcomes rather than by leading to an inaccurate perception of probability (Dohmen et al., 2023). There is a clear connection between character traits and approach to risk and the way a given person makes decisions. (Solek, 2014).

3. METHODOLOGY

3.1. Research goal and hypotheses

The primary objective of this study aimed to gauge the extent and dispersion of dispositional optimism and positive orientation among private investors in Poland. Furthermore, an auxiliary aim was to investigate the interplay between dispositional optimism and positive orientation, considering variables such as gender, age, education, place of residence, and experience. The following hypotheses guided the research:

- H1: Individual investors in Poland show a high level of dispositional optimism and positive orientation.
- H2: The level of dispositional optimism and positive orientation of individual investors depends on socio-demographic variables such as investment experience, place of residence, education, gender, age, and propensity to risk.

3.2. Participants

The study was conducted from August to November 2020. In order to verify the adopted hypotheses, the quantitative method was used. A survey tool was used, and 1,057 active individual investors in Poland were surveyed. The questionnaire consisted of the Life Orientation Test (LOT-R) questionnaire, the Positive Orientation Scale (P-Scale) questionnaire, the risk-related questionnaire, and the metric, which included questions about the socio-demographic characteristics of the sample, such as gender, age, investment experience, education, place of residence.

3.3. Detailed description of the questionnaires

The LOT-R test is the most widely used optimism measurement tool (Hinz et al., 2017; Lai & Yue, 2000; Schou-Bredal et al., 2017; Steca et al., 2015), and has become the gold standard for measuring dispositional optimism (Cano-García et al., 2015). The overall score ranges from 0 to 24 points, and the higher it is, the higher the level of optimism (Jurczyński, 2001; Schou-Bredal et al., 2017). Walsh et al. (2015) proposed that the minimum score that could be calculated was 0 (representing extreme pessimism), and the maximum was 24 (representing extreme optimism). Kreis et al. (2015), Chakraborty (2016), and Marotta et al. (2019) proposed a sub-scale that converts points obtained from the LOT-R test into the level of optimism. The scale is as follows: from 0 to 13 points - low level of optimism; from 14 to 18 points - medium level of optimism; from 19 to 24 points - high level of optimism.

Caprara et al. (2012) developed the P-Scale as a direct P-Scale measure. Higher scores indicate a higher P-Scale (Tian et al., 2018). The range of scores is 8 to 40 points.

Despite the LOT-R and P-Scale questionnaire and the questions about the sociological and demographic features of the participants, the authors also asked about the approach to risk and games of chance. Three questions were asked on that subject. All of them were inspired by the Kahneman and Tversky studies about the utility function, and they referred to 3 different decision types: profitable, loss, and neutral. Both choice options in every question result in the same outcomes in the sense of Neuman-Morgenstern (utility = probability * value) (Neumann & Morgenstern, 1944).

3.4. Methodology

To investigate the distribution of results from the LOT-R and P-Scale questionnaire among individual investors in Poland, the authors used descriptive statistics, such as average, median, modal value, standard deviation, and precondition. Then, they performed a deepened analysis of the compounds between individual variables.

Variables used in the study are:

- LOT- R points - The number of points obtained by the respondent in the LOT-R test. The result can be from 0 to 24 points.
- LOT optimist - This is a binary variable separating respondents into two groups: optimists and non-optimists, based on the result obtained from the Lot-R test. A respondent is considered an optimist when his LOT-R result is at least 14 points.
- P-Scale points - The number of points obtained by the respondent in the P-Scale test. The result can range from 8 to 40 points.
- P-Scale optimist - This is a binary variable separating respondents into two groups: optimists and non-optimists, based on the result obtained from the P-Scale test. A respondent is considered an optimist when his P-Scale result is at least 29 points.

- Risk_attitude - this is a 3-degree variable determined based on the respondent's subjective assessment of his risk approach. The variable can take a value of 1 when the participant is used to an increased risk level, 2 when it is a neutral risk, and three if risk aversion is demonstrated.
- Consistency - This is a derivative variable determined by the authors of the study based on the participant's response to 3 similar questions regarding participation in a random game with a simple character. The "CONSISTANCE" variable is binary and takes a value of 1 for participants who choose a coherent answer in all of them: certainty or randomness in the following questions.
- Gambling_type - This is a binary variable dividing respondents into two groups depending on how someone responded to questions related to random games, where there were possible choices of specific and random solutions with an equal value, according to the utility function. The value one was assigned to participants who have always chosen a gambling random option, 0 are the other participants who responded differently.
- Gender is another binary variable. 0 is assigned to a female respondent and 1 to a male respondent.
- Age - it is the age of the participants divided into subgroups. It is variable, with values from 1 to 5 depending on the respondent's age group: 1 for "18-24," 2 for "25-34," 3 for "35-44," 4 for "45-60," and 5 for "61 and over."
- Exp [Years of experience] - this variable represents the participant's experience in investing.

Variable value	Years of experience
1	"0-5"
2	"6-10"
3	"11-15"
4	"16-20"
5	"21-25"
6	"26-30"

- Education_lvl [Education]— is a representation of the respondent's formal education confirmed by completion of a given type of school or obtaining an academic degree. The variable can take five values tapping with a table.

Variable value	Education
1	Basic, professional
2	Secondary education
3	Higher (bachelor or engineer)
4	Master's degree
5	Doctor or professor title

- Place of residence—a variable representing the place of residence. By tapping with a table, the variable can take 6 values.

Variable value	Place of residence
1	Village
2	A city of up to 20,000 residents
3	A city between 20,000 and 50,000 inhabitants
4	A city between 50,000 and 100,000 inhabitants
5	City between 100 thousand and 500 thousand inhabitants
6	A city with over 500,000 inhabitants

First, the study analyzed the distribution of individual variables. This study is especially interested in the distribution of the P-Scale and LOT-R points among the investors.

The second part of the study is focused on the correlation analysis between the proposed datasets. The Pearson Product Moment Correlation (PPMC), which shows the linear relationship between two sets of data, was used.

Additionally, the investigation incorporates the utilization of the logit model. Regarding the deliberations, the variable indicating the presence of a clearly defined optimist was established in the following manner:

For LOT-R test:

$$y_i = \begin{cases} 1, & \text{if LOT - score} < 13 \\ 0, & \text{if LOT - score} \geq 13 \end{cases}$$

For P-Scale test:

$$y_i = \begin{cases} 1, & \text{if P - Scale - score} < 28 \\ 0, & \text{if P - Scale - score} \geq 28 \end{cases}$$

In the context of this research, the objective is to identify specific attributes within the examined variables that enable us to evaluate whether an investor can be categorized as a potential optimist or not. This is an interesting issue because the phenomenon of optimism and excessive optimism is very often tested in finance, and those phenomena have significantly affected the approach to the calculation and forecasting of individual market participants. Rarely, however, does research refer to the issue of detecting optimists based on relatively easy ways to obtain data on them. In the case of optimistic detection possibilities, it would be easier to analyze subsequent analyses, for example, by considering adjustments for assessments and forecasts they perform.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. LOT- R

The average LOT-R results for the entire sample of 1,057 individual investors in Poland were 15.72 points (SD: 2.589); the median was 16 points. Table 1 shows the distribution of points from the LOT-R test and the sub-scale indicating the level of dispositional optimism (low, medium, high).

A comparison of the mean point score on the LOT-R test for individual investors (15.72 points) with the scores achieved by stock market analysts in Poland (14.38 points; Radke, 2023a) and for the normalization sample for Poland (14.55 points; Jurczyński, 2001) reveals that individual investors exhibited a higher level of dispositional optimism than the other two groups. Conversely, when the points were converted into a dispositional optimism sub-scale, all three groups exhibited a moderate level of dispositional optimism. In their 2003 study, Felton et al. examined the role of dispositional optimism in investment risk-taking behavior among a sample of 66 students. The authors used the LOT-R test to examine dispositional optimism. The findings of the study indicated that the mean score of the student cohort was 15.95 points, which differed by 0.23 points from that of individual investors in Poland.

Table 1

Profile of the sample of individual investors drawn for results of the LOT-R test for point values and the following ranges: low, medium, and high levels of dispositional optimism (n = 1,057)

Points	Frequency	Sub-scale	Frequency
1	0.00%	Low dispositional optimism	20.06%
2	0.00%		
3	0.00%		
4	0.00%		
5	0.00%		
6	0.00%		
7	0.19%		
8	0.28%		
9	1.14%		
10	1.99%		
11	2.37%		
12	4.92%		
13	9.18%		
14	9.84%	Moderate dispositional optimism	65.85%
15	12.11%		
16	17.88%		
17	14.76%		
18	11.26%	High dispositional optimism	14.10%
19	8.42%		
20	4.26%		
21	1.04%		
22	0.28%		
23	0.09%		
24	0.00%		

Source: own compilation

4.2. P- Scale

The average results from the P-Scale questionnaire for the entire sample of 1,057 individual investors in Poland were 31.79 points (SD: 2.818); the median for the result was 32 points. The distribution of points from the P-scale test is shown in Table 2.

Table 2

Profile of the sample of individual investors drawn from results of the Scale test (n = 1057)

Points	Frequency
8	0.00%
9	0.00%
10	0.00%
11	0.00%
12	0.00%
13	0.00%
14	0.00%
15	0.00%
16	0.00%
17	0.09%
18	0.00%
19	0.19%
20	0.28%
21	0.38%
22	0.28%

23	0.19%
24	0.38%
25	1.14%
26	1.23%
27	2.84%
28	3.97%
29	4.45%
30	4.82%
31	11.54%
32	22.33%
33	19.96%
34	11.83%
35	8.14%
36	3.69%
37	0.76%
38	0.95%
39	0.57%
40	0.00%

Source: own compilation

A comparison of the mean point score on the P-Scale test for individual investors (31.78 points) with the scores achieved by stock market analysts in Poland (29.49 points; Radke, 2023a) and for the normalization sample for Poland (29.30 points; Laguna et al., 2011) reveals that individual investors exhibited a higher level of positive orientation than the other two groups.

4.3. Risk

To the question “What is your attitude to risk?”, 69.3% of individual investors invest within the optimal risk level; 27.4% of the respondents invest in low-risk conditions. The lowest number of individual investors - investments in high-risk conditions - was 3.2% of the respondents. This is illustrated in Table 3.

Table 3

Distribution of attitude to risk (n = 1057)

Answer	Frequency
I invest in conditions of an increased level of risk	3.22%
I invest within the optimal risk level	69.35%
I invest under low-risk conditions	27.44%

Source: own compilation

For the second question, you have the amount of PLN 10,000 at your disposal. Then you were offered a choice between the following options A and B: 94.5% of individual investors chose to participate in the lottery: win PLN 10,000 with a 50% probability or a PLN 0 win with a 50% probability. A negligible part of the respondents, only 5.5%, chose the second option, i.e., keeping PLN 5,000 at the end of the game. The results are presented in Table 4.

Table 4

Distribution of answers for savings (n = 1057)

Answer	Frequency
Save PLN 5,000 and game over	5.49%
Participation in the lottery: - win 10.000 PLN with a 50% probability - Win PLN 0 with a probability of 50%	94.51%

Source: own compilation

To the third question, you have PLN 10,000 at your disposal. Then, you were offered a choice between options A and B: 91.2% of individual investors chose to participate in a lottery: a loss of PLN 10,000 with a probability of 50% or a loss of PLN 0 with a probability of 50%. The second answer, i.e., the behavior of PLN 5,000 and the end of the game, was chosen by 8.8% of investors. The results are presented in Table 5

Table 5

Distribution of answers for losses (n = 1057)

Answer	Frequency
Some loss of PLN 5,000 and game over	8.80%
Participation in the lottery: - loss of PLN 10,000 with a probability of 50% - loss of PLN 0 with a probability of 50%	91.20%

Source: own compilation

For the fourth question in the following lottery, please choose between options A and B: 60.9% of individual investors chose to participate in the lottery: profit of PLN 100 with 50% probability or loss of PLN 100 with 50% probability. The second answer, i.e., a specific payment of PLN 0 and the end of the game, was chosen by 39.1% of investors. The results are presented in Table 6.

Table 6

Distribution of answers to the question In the following lottery. (n = 1057)

Answer	Frequency
Specific payment of PLN 0 and game over	39.07%
Participation in the lottery: - profit of PLN 100 with a probability of 50% - loss of PLN 100 with a probability of 50%	60.93%

Source: own compilation

4.4. Correlations

Table 7 presents the correlations between all the variables included in the study. Due to the article's subject, the most interesting relations are those concerning the P-Scale and LOT points obtained by each participant.

First of all, it should be noted that there is a significant correlation between the LOT-R and P-Scale. The same conclusions are drawn from the research of Hashimoto and Koyasu (2012), who also demonstrated a correlation between dispositional optimism and positive orientation. Correlation (P-Scale; LOT) is around 0.3, which is not a very high number considering the similarity of both surveys. This is definitely proof that those questionnaires should not be understood as exchangeable in further analysis. This conclusion potentially opens a new discussion about the type of test for optimism that should be used in the studies about overoptimism in finance (forecasting, valuation, etc.). From the authors' point of view, the different characteristics and backgrounds for diverse economic and financial tasks may probably lead to results that different types of psychological tests are best to assess if someone is likely to be over-optimistic in a particular task.

As shown in table 7, the proposed correlation analysis between the P-Scale and LOT-R points with participants' characteristics has not shown any strong and significant correlation. There is a relevant link between P-Scale and LOT-R points and gender (men tend to be slightly more optimistic), but the relation is definitely weak. Similar conclusions were reached by Stach (2006), Prosad et al. (2015), Hinz et al. (2017), Joo and Kakab-Durri (2017), and Dawson (2023), while studies by Czerw (2009), Glaesmer et al. (2012), and Schou-Berdal et al. (2017) present opposing findings. As in the earlier study by Stach (2006) and Radke (2023b), the effect of age on dispositional optimism was not confirmed. This result differs from that

obtained in the study by Czerw (2009), Glaesmer et al. (2012), Schou-Berdal et al. (2017), and Hinz et al. (2017). Furthermore, experience and education do not appear to influence dispositional optimism levels. This finding aligns with the results of Radke's (2023b) study, but contrasts with those of Stach (2006), Prosad et al. (2015), Schou-Berdal et al. (2017), and Joo and KakabDurri (2017). Prior research has indicated that place of residence may impact dispositional optimism levels (Schou-Berdal et al., 2017). However, our findings did not support this hypothesis.

Table 7

Correlations between analyzed variables

	LOT-R Pts.	P-Scale Pts.	Risk attitude	Gender	Age	Exp	Education lvl	Place of residence	Gambling Type
LOT-R Pts.	100.00%	30.28% Yes p = 0.000	-0.99% No p = 0.747	2.73% Yes p = 0.000	-6.17% No p = 0.044	5.75% No p = 0.061	-3.38% No p = 0.2728	-1.62% No p = 0.599	-8.43% No p = 0.006
P-Scale Pts.	x	100.00%	-17.07% Yes p = 0.000	10.32% Yes p = 0.000	4.69% No p = 0.127	6.34% No p = 0.039	2.65% No p = 0.389	3.39% No p = 0.2705	12.08% No p = 0.000
Risk attitude	x	x	100.00%	-8.70% Yes p = 0.004	-1.09% No p = 0.722	-20.14% Yes p = 0.000	-4.24% No p = 0.168	-5.72% No p = 0.063	-4.40% Yes p = 0.153
Gender	x	x	x	100.00%	-0.33% No p = 0.914	2.40% No p = 0.435	-0.04% No p = 0.988	5.41% No p = 0.0787	4.96% Yes p = 0.107
Age	x	x	x	x	100.00%	54.33% Yes p = 0.000	0.77% No p = 0.801	6.17% No p = 0.597	-11.05% No p = 0.000
Exp	x	x	x	x	x	100.00%	-2.13% No p = 0.489	11.80% Yes p = 0.000	-6.54% No p = 0.033
Education lvl	x	x	x	x	x	x	100.00%	-3.38% No p = 0.272	-0.99% Yes p = 0.747
Place of residence	x	x	x	x	x	x	X	100.00%	-6.44% No p = 0.036
Gambling Type	x	x	x	x	x	x	X	x	100.00%

Source: own compilation

What also should be noted is that people who stated they see themselves as low-optimists obtained significantly higher scores on the P-Scale test, which is very interesting and can be proof that self-declarations can be misleading. There is probably a significant distortion in general self-awareness dependent on short-term moods and recent events that people cannot filter from their assessment in these types of questions. Also, it should be stated that the “risk attitude” variable has not been proven to have a significant correlation with the LOT-R test. This is at odds with the findings of Dohmen et al. (2023) and Davson (2023). This also shows that those two tests can give very different results when identifying the optimists in the group.

4.5. Econometric modeling

In the third part of the study, the authors proposed a logit model describing the probability of identifying an optimist among investors using the variables defined in the study. The model has been estimated in two variants, depending on the type of test determining the optimist. The first estimation was based on the P-scale test and the independent variables. The dependent variable has been defined as binary in reference to the P-Scale points obtained by each participant and the survey interpretation. The final form of the model is presented in the table 8.

Table 8

Logit estimation of the occurrence of optimists based on P-Scale survey points (n = 1057)

Variable	Coefficient	Standard error	z	Value p	
Const	-0.308693	0.396312	-0.7789	0.4360	
Consistency	0.764636	0.176104	4.342	<0.0001	***
Gambling_type	0.715313	0.253218	2.825	0.0047	***
Gender	0.585116	0.237854	2.460	0.0139	**
Age	0.144803	0.0758563	1.909	0.0563	*
The arithmetic mean of the dependent variable	0.845790		The standard deviation of a dependent variable	0.361321	
McFadden R2	0.045816		Adjusted R2	0.034813	
Number of 'correct prediction' cases = 891 (84.3%)					

Source: own compilation

The proposed model obtained 84.3% efficacy in predicting if a person is an optimist. That is a satisfying result, especially considering the fact that the analyzed descriptive variables are pretty general in terms of a complicated subject like human behavior in the context of finance. Nevertheless, the model is an opportunity to describe a potential optimist in terms of demographic and sociologic background. It can be concluded that people who consistently choose the same type of solutions to stochastic problems are more likely to be optimists. The effect is even more substantial if their preferred solution is a game of chance rather than a known result. According to the model, statistically, we can assume that investors who are older men are more likely to be investing optimists. It is also assumed that they will be more likely to make risky decisions. This is a similar conclusion to Nadeem (2019).

The second version of the proposed model is different due to the definition of the optimist based on the LOT-R test. As described earlier, P-Scale and LOT are quite different in their approach and the phenomena that they measure. This was also proved in the correlation analysis, which showed a rather weak link between the results in both tests in the survey.

The model shown below is less precise in detecting a potential optimist in the group. The number of correct predictions is around 70%, while the SOP-based model is more than 84%.

Table 9

Logit estimation of the occurrence of optimists based on LOT-R survey points (n =1057)

Variable	Coefficient	Standard error	z	Value p	
Const	0.967834	0.302671	3.198	0.0014	***
Consistency	-0.248773	0.146868	-1.694	0.0903	*
Gambling_type	0.488650	0.221356	2.208	0.0273	**
Age	-0.230580	0.0702988	-3.280	0.0010	***
Exp	0.118939	0.0543052	2.190	0.0285	**
The arithmetic mean of the dependent variable	0.701041		The standard deviation of a dependent variable	0.458019	
McFadden R2	0.014174		Adjusted R2	0.006419	
Number of 'correct prediction' cases = 743 (70.3%)					

Source: own compilation

According to the LOT-R optimist model, people who are less consistent in choosing answers to stochastic problems tend to be more optimistic. The model also provides an opposite interpretation of the age and optimism relation, in which younger people seem to be more optimistic generally. That interpretation can be very intuitive and convergent with common sense. Younger people are generally seen as being optimistic due to their lack of experience and probable lower awareness of the potential negative consequences of making mistakes. That does not have to be the case and should not be considered as a rule, but that is a general understanding of the relationship between age and optimism. From the author's point of view, the difference in interpretation of the influence of age on the optimism level in both models can be explained by putting optimism in a broader and narrower context - the P-Scale test measures our level of positivity in the context of our actions. With more experience and older age, people may be more optimistic about the results of the activities and choices that they make, so this is the narrower context, which is focused on particular tasks in some areas. The broader context proposed in the second model shows a more general attitude that is not focused so much on the specific task.

The described differences in understanding optimism and its relation to age do not exclude the possibility of adding the positive correlation of optimism and experience to the equation. That is because the participants' age did not correlate with their market experience. In the proposed LOT logit model, experience and attitudes towards gambling positively affect the chances of identifying optimists in a group of investors.

Nevertheless, the second version of the model, which is based on the LOT-R survey, is less coherent and, as a result, more concerning as a prediction tool.

5. CONCLUSION

The point results obtained by individual investors in Poland in the LOT-R test show an average level of dispositional optimism. The mean score was 15.72, and the median was 16 points out of 24. Converting the discrete point measure into an interval measure pertaining to optimism levels reveals that the majority of investors, amounting to 65.8%, exhibited a moderate level of dispositional optimism. Only 14.1% of the respondents showed a high level of dispositional optimism. Similar results were achieved by the sample examined in the P-Scale test, which examined the positive orientation. The mean score was 31.79, and the median was 32 out of 40 possible points from the test. The results do not confirm the presence of a high level of optimism and positive orientation. In reference to the second hypothesis, results obtained in the study have shown that nearly all of the test variables were not significantly correlated to the number of points on the P-Scale and LOT-R tests. The exception is the gender of the participant, according to which men tend to be slightly more optimistic than women, but still, this relation is weak. This means that the

studied variables were not determinants of the level of dispositional optimism, and the stated hypothesis is verified negatively.

The "gambling_type" variable defined by the study's authors is an important factor in the econometric models described in the study. They illustrate the co-directional relationship between the tendency to risky behavior and being optimistic, according to the P-Scale and LOT-R scales. This conclusion, on the one hand, seems to be natural. However, in referring to the fact that often taking risks in random decisions is not an objective and calculated process, according to the authors, this conclusion did not have to be confirmed.

However, if the analysis from assessing the points from the test to a binary problem would be different, the situation changes. Suppose a segregation of investors into two groups on the basis of their P-Scale and LOT-R test results is possible. In that case, the proposed independent variables start to determine an affiliation to one of the groups significantly. Results from the logit modeling allowed us to draw conclusions about the relationship between the tested variables and being an optimist. That led to a conclusion about the positive verification of the third thesis. One can conclude that features like age, experience, or consistency of choices are significant indicators of optimist among investors and analysts.

The findings obtained from the conducted study align with the ongoing research focusing on heuristics and their significance within the context of the stock market. There is a large number of optimists in a group of people active in the market. It is also known that over-optimism may result in making ineffective decisions, wrong allocations of capital, mistaken evaluations, etc. This is why it is important to try to propose tools that will help to identify optimists in decision-making groups. Analysis can lead to factors that identify optimists in the group, as well as finding links between levels of optimism and the potential errors in assessments that they may determine. A study of this nature has the potential to enhance the objectivity of the investment process, ultimately resulting in improved and more effective allocation of capital resources.

The suggested analysis makes a substantial contribution to the broadening of insights into stock market investors. The research presented in this context distinguishes itself by its distinctive nature, primarily due to the absence of any analogous study conducted over an extended timeframe in the Polish market utilizing variables put forth in this investigation. As a result, conducting a direct comparison of the findings with similar surveys in the Polish market is unfeasible. Furthermore, the analytical approach adopted to tackle this subject matter is relatively rare in the existing literature. Most studies within this domain rely on case studies or descriptive methodologies. Consequently, this research aspires to enrich the quantitative exploration of optimism among investors.

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