Chapter 9
The Impact of Behavioral Factors on Decisions Made by Individual Investors on the Capital Markets

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Abstract Paying attention to the investors' behavioral inclinations is crucial, due to the relatively high incidence of all kinds of anomalies in the capital markets. Identified by researchers anomalies are manifested by excessive or delayed reaction of investors to the price changes and provided information. Understanding the schemes and motives that are used by individual investors on the capital market allow researchers to better characterize the decision-making process and it's determinants. Knowledge about the behavioral inclinations can be used to predict and simulate the behavior of investors on the capital market in the future. The aim of this chapter is to determine the strength and direction of the impact of the behavioral factors on the investors decision-making process on the capital market. The main hypothesis assumes that psychological factors, like behavioral inclinations in preferences and opinion area, have a significant impact on the investor behavior on the capital market, changing their risk tolerance and acceptable rate of return. The first part of chapter presents the principles of construction structural equation models (SEM) and methods of their verification. The second section includes a detailed description of the questionnaire used in the survey and analysis of the results. In the last part behavioral factors characterizing the investors in the Polish capital market, like risk tolerance, inclinations in the opinions and preferences area have been identified. Additionally to verify hypotheses one structural equation model have been specified, estimated, analyzed in subgroup and interpreted.

Keywords Structural equation model • Behavioral finance • Individual investors on capital market in Poland

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K. Nermend, M. Łatuszyńska (eds.), *Neuroeconomic and Behavioral Aspects of Decision Making*, Springer Proceedings in Business and Economics,
DOI 10.1007/978-3-319-62938-4_9

9.1 Introduction

Paying attention to investors' behavioral inclinations is inevitable due to the relatively high incidence of all kinds of anomalies on the capital markets. Anomalies identified by researchers are manifested by investors' excessive or delayed reactions to changing prices and providing information. An explanation of the reasons of these kinds of phenomena seems to be crucial for a better understanding of the capital market, the interpretation of recession, stagnation and the financial market development, and characterize the decision-making process and its determinants.

The aim of this chapter is to determine the strength and direction of the impact of behavioral factors on investors' decision-making process on the capital market. The main hypothesis assumes that psychological factors, such as, for instance, behavioral inclinations in the preferences and opinion areas, change investors' risk tolerance and acceptable rate of return. Following this, the chapter tries to prove that behavioral factors have a significant impact on investors' behavior on the capital market. They change investors' behavior due to fundamental theories of finance.

The first step to achieve the research aim of the chapter was developing a questionnaire using Likert scale, so it was possible to measure unobservable variables such as risk tolerance and behavioral inclinations in preferences and opinion. The data essential for analysis was collected within a survey carried out on a group of individual investors in the Polish capital market. The survey was made by the Association of Individual Investors three times: in 2010, 2011 and 2013.

The second step was the identification of the factors that characterize both the attitude of individual investors and the factors describing the quality of the functioning of the capital market in Poland. Factors such as the level of risk tolerance, capital market quality, opinion and preference behavioral inclinations shown by investors in the investment process were identified. These factors (unobservable variables) reflect the maturity level of the capital market and behavioral tendencies which characterize investors.

Finally, the strength and direction of the impact of these factors on individual investors' reinvestment decisions, investors' satisfaction with the investment and on their risk tolerance was proved using the estimated structural equations model (SEM).

9.2 Using Structural Equation Models in Behavioral Finance: An Overview

The theory of behavioral finance, which assumes the limitation for rational investors attitude, is rapidly developing. The forerunner in this field was a prospect theory (Kahneman and Tversky 1979). The admission of the existence of behavioral inclinations itself which interferes with the investors' decision making process led to the development of behavioral models (LSV, BSV, DHS, HS) and gave an opportunity to present anomalies on the capital market (Thaler 1994; Goldberg and Von Nitzsch 2001; Shleifer 2000; Zielonka 2015; Czerwonka and Gorlewski 2012).

Many of the available studies also consider the impact of institutional investors, especially mutual funds, on the capital market behavior (Lakonishok et al. 1994). Those papers focus on the herding behavior and the phenomenon of the positive feedback among managers. Some probable explanations of this phenomenon include ignoring of the private information available to managers, correlation of the private information held by investors because of the analysis of the same indicators, following 'the stronger' transactions and finally avoiding investments in companies with lower liquidity.

This chapter is focused on using structural equation modeling in finance. The subject matter and foundation of the models were developed for many years in the works of Bollen (1989), Kaplan (2000), Kline (2005). The usage of structural equation modeling is common in psychological and sociological analyses, because of the possibility to seize the unobservable variables. There can still be found relatively not many examples of its application in economics. However, it is becoming increasingly popular.

The works of Wang et al. (2006) and Lin (2011) are worth taking into account as examples of the structural equation modeling usage in finance. In all of these works various behavioral factors were specified and their impact on attitudes and behaviour of investors was defined. In Polish subject literature, studies on the structural equation modeling usage in the area of behavioral finance can be found in works of Osińska et al. (2011). In this study, a significant impact of behavioral inclination on investors' risk tolerance was confirmed.

9.3 Methodology

9.3.1 Structural Equation Model

The Structural Equation Models (SEM) are defined as a set of procedures and statistical tools used to measure the causal relationships in empirical research. The SEM methodology allows the relationships between independent and dependent, measurable (observable) and latent (unobservable) variables to be taken into account. In addition, it makes it possible to estimate potential measurement errors for all observable variables, calculate variances and covariances between variables, as well as identify the direct and indirect effects between them (Joreskog 1973; Wiley 1973).

The SEM methodology consists of a model describing the relationship between latent variables (known as internal) and measurement model for endogenous and exogenous unobservable variables (referred to as 'external'). The external model is a representation of the factor analysis which allows calculating the loads of individual variables affecting the latent factor. The internal model is the path analysis which is used to define a cause-and-effect relationships between variables (Kaplan 2000; Pearl 2000; Bollen and Curran 2006).

The internal model (structural) has the following form:

$$\eta = B\eta + \Gamma\xi + \zeta \tag{9.1}$$

where: $\eta_{m \times 1}$—vector of endogenous latent variables, ξ_{kx1}—vector of exogenous latent variables, B_{mxm}—matrix of regression coefficients for endogenous variables, Γ_{mxk}—matrix of regression coefficients for exogenous variables, ζ_{mx1}—vector of random components.

In the structural model, the following assumptions for a random component are made:

$$\mathrm{E}(\zeta) = 0 \quad \sum\nolimits_{\zeta} = \sigma^2 I \text{ and } \mid I - \mathrm{B} \mid \neq 0 \tag{9.2}$$

The external model (measurement) is given as:

$$y = \Pi_y \eta + \varepsilon \tag{9.3}$$

$$x = \Pi_x \xi + \delta \tag{9.4}$$

where: y_{px1}—vector of observed endogenous variables, x_{qx1}—vector of observed exogenous variables, Π_x, Π_y—matrix of factor loadings, $\varepsilon_{px1}, \delta_{qx1}$—vectors of measurement errors.

For the measurement model, the following assumptions for the random component are made:

$$\mathrm{E}(\varepsilon) = \mathrm{E}(\delta) = 0 \text{ and } Cov(\eta, \varepsilon) = Cov(\xi, \delta) = 0 \tag{9.5}$$

In case of structural equation models, a confirmatory factor analysis is dedicated (Harrnington 2009) and the verification of the variables included in the latent factor is made using α-Cronbach's coefficient (Cortina 1993; Valadkhani et al. 2008). While estimating the structural equation model's parameters, the subject literature particularly recommends using the maximum likelihood method (Joreskog 1973) and the generalized least squares method.

9.3.2 Measures of SEM Model Fit

Most measures of fit SEM models based on a statistic χ^2 defined as:

$$\chi^2 = (n-1)\left[trace\left(S\widehat{\mathrm{E}}^{-1}\right) - p + \ln\left(\widehat{\mathrm{E}}|\right) - \ln\left(|S|\right)\right] \tag{9.6}$$

where: n—means sample size, p—amount of variables, S—covariance matrix for the sample, and $\widehat{\mathrm{E}}$ is an array of recreated S based on the estimated parameters. The use of this statistic directly is justified only if the variable distribution is a multidimensional normal distribution, sample is the right size, and tested hypothesis—true in population.

Critical N is one of the absolute model fit measures and it was first formulated by Hoelter as:

$$CN = \frac{1/2\left(z_{1-\alpha} + \sqrt{2df_h - 1}\right)^2}{T/(N-1)} + 1 \tag{9.7}$$

where $z_{1-\alpha}$ is the critical value read from the normal distribution for the significance level α, T is a statistic χ^2 for estimated model and df_h is the number of degrees of freedom of the estimated model. CN index indicates the maximum sample size at which the estimated model would be acceptable from the point of view of statistics χ^2. The subject literature emphasizes the fact that in the case of a small sample, the value of this statistic may be incorrectly reduced (Konarski 2011).

One of the SEM model fit measures that compare the estimated model to the base model is *Incremental Fix Index* (NFI). It is defined as (Bollen and Curran 2006):

$$NFI = \frac{T_b - T_h}{T_b} \tag{9.8}$$

where: T_h—is a statistic χ^2 for estimated model and T_b—is a statistic χ^2 for base (independent) model. NFI index value should be contained in the range $< 0; 1>$. The model is considered to be well fit, if the value of this statistic is greater than 0.95. This type of indexes tends to favor the more complex models, therefore, in practice, it is often used with modifications which take into account the complexity of the model, for example, index PNFI (Konarski 2011).

Root Mean Square Error of Approximation (RMSEA) is calculated as:

$$RMSEA = \sqrt{\frac{T_h - df_h}{(N-1)df_h}} \tag{9.9}$$

RMSEA index value less than 0.05 means a very good fit of the model to the data, while the case of the statistic greater than 0.10 means a bad fit of the model to the data (Browne and Cudeck 1992). This measure, however, can lead to favoring simpler models.

Since each of these measures have limitations, it seems reasonable to check the multidimensional distribution of variables and additional verification of the estimated model using the bootstrap procedure. To verify whether a multi-dimensional distribution is normal, the test introduced by Mardi (Mardia 1970; Byrne 2010) can be used. In this method a multi-dimensional measure of kurtosis for distribution in the sample is defined as:

$$k = \frac{1}{N}\sum_{i=1}^{N}\left[\left(x_i - \bar{x}\right)S^{-1}\left(x_j - \vec{x}\right)\right]^2 \tag{9.10}$$

where: x_i—vector of variable values for observation i; x_j—vector of variable values for observation j, $\vec{x}$—vector of average values of variables, a S^{-1}—inverse covariance matrix of the variables. According to data available in the literature, the total value of kurtosis should not be greater than 7, and the corresponding t-statistic—greater than 5 (Byrne 2010).

Using the maximum likelihood method or the generalized largest squares method for data with distribution other than normal causes increases in statistics χ^2. It can cause the standard errors undervaluation, which makes that covariance in path or factor analysis will be statistically significant, however, in the population it does not need to be so. That is why an additional quality verification of the estimated model, which would be independent of the variables distribution is needed. One of the methods used for this purpose most frequently is the bootstrap analysis.

9.3.3 Bootstrap Procedure

The bootstrap procedure, which is a statistical method for estimating the distribution of estimation error, was developed for the first time in 1979 by Efron (1979). It is a class of methods for resampling from the original data set. Its idea is based on replacing the unknown distribution of the population with known empirical distribution based on which the standard errors or confidence intervals of parameters are calculated (Efron and Tibshirani 1986).

Let $\sigma(F)$ denote the standard error of the parameter $\widehat{\theta}$ estimated based on a sample P. It can be expressed using the formula:

$$\sigma(F) = \sqrt{S_F^2\left(\widehat{\theta}_P\right)} \tag{9.11}$$

where $S_F^2\left(\widehat{\theta}_P\right)$ is the variance of parameter estimation $\widehat{\theta}$ based on sample P.

The application of the bootstrap procedure to estimate the standard error $\sigma = \sigma\left(\widehat{F}\right)$ uses three following steps (Efron and Tibshirani 1986):

1. Drawing an accordingly large number of bootstrap samples from the original data set labe P lled as: $P_1^*, P_2^*, \ldots\ldots P_B^*$.
2. For each $b = 1, 2, \ldots B$ estimation $\widehat{\theta}_b^* = \widehat{\theta}\left(P_b^*\right)$.

3. Calculation of the standard deviation as:

$$\widehat{\sigma}_B = \sqrt{\frac{\sum_{b=1}^{B}\left(\widehat{\theta}_b^* - \widehat{\theta}^*\right)^2}{B-1}} \tag{9.12}$$

where: $\widehat{\theta}^* = \frac{\sum_{b=1}^{B}\widehat{\theta}_b^*}{B}$, B—sample size.

If $B \to \infty$ then $\widehat{\sigma}_B \to \sigma\left(\widehat{F}\right)$.

Bias measures allow to compare between the estimation of the parameter obtained based on the output data set P with the evaluation of this parameter obtained based on B samples from this set. Thus, they allow making comparisons between the parameter value obtained by using the classical estimation method and multiple resampling.

Bias estimator can be expressed by the formula (Byrne 2010):

$$b\widehat{l}_B^* = \widehat{\theta}_P - \widehat{\theta}^* \tag{9.13}$$

Designation remains as previously.

In the bias analysis applying the bootstrap method, it may be useful to take into account the standard error of the estimator bias $\widehat{\delta}_B^*\left(b\widehat{l}_B^*\right)$ which is counted as (Byrne 2010):

$$\widehat{\delta}_B^*\left(b\widehat{l}_B^*\right) = \widehat{\sigma}_B/\sqrt{B} \tag{9.14}$$

It is assumed that if the standard error of the bias parameter $\widehat{\delta}_B^*\left(b\widehat{l}_B^*\right)$ is greater than bias estimator value itself $b\widehat{l}_B^*$, it can be recognized as statistically insignificant.

9.4 Individual Investors on the Polish Capital Market

9.4.1 Questionnaire

The questionnaire used in this study consisted mostly of questions based on a five-point Likert scale (Oppenheim 1992), which allowed for identification of the unobservable factors such as the quality of capital markets, risk tolerance, ability to use technical and fundamental analysis by investors, their behavioral inclinations in the opinion and preferences areas.

The quality of the market should be understood as general market's characteristics which make its functioning efficient. These include a large number of buyers and sellers, the variety of investment needs, objective and available opinions, information, location, reasonable transaction costs, market integrity, and fairness of all market participants (Maginn et al. 2007). In this study, the market's quality was limited to the subjective assessment of the public information by individual investors.

One of the most frequently described behavioral inclinations in the opinion area is overconfidence. It may be manifested both by frequent changes in the investment portfolio (Barber and Odean 2001; Glaser and Weber 2007), as well as making error calibration (Nofsinger 2011). The literature also points to bias predictions due to the limitation in information access (Kahneman and Tversky 1973) as well as to an excessive tendency to invest in the local market (French and Poterba 1991). These consist in another behavioral inclination—availability heuristic.

In addition, the last investors' investments and ownership effect (behavioral inclinations in the preference area) have a relatively common influence on their decisions related to the capital market. It turns out that after a successful deal, they are willing to invest more than ever before by taking risky decisions (Thaler 1987). On the other hand, the ownership effect means that there is a significant difference between the sales price for which the owner of the goods would agree to sell them, and his purchase price of the same asset (Thaler 1980).

Skill of using technical analysis by the respondents was measured based on questions relating to forecasts of indices and stock prices taking into account their current trend and formation. Because the skill of using fundamental analysis is difficult to measure, the questions in this area measure only the degree of the use of individual fundamental information by respondents (Table 9.1).

9.4.2 The Survey

The survey was carried out in three stages: year 2010 (315 respondents), 2012 (343) and 2013 (366). In each case, a survey was carried out by the Association of Individual Investors, which determines the properties of the sample. It targets and is limited to investors who are members of the Association of Individual Investors (AII), or those who use materials prepared by the Association. Currently, the AII counts about 11,000 members. Thus the sample size was indicated basing on the minimum sample size statistics. In the reported research each sample has a maximum estimate error less than 3% with a confidence level equal to 0.95. Maximum estimate error was calculated using formula for the minimum sample size for fraction:

$$N_{\min} = \frac{N_p(\alpha^{2*}f(1-f))}{N_P e^2 + \alpha^2 f(1-f)} \tag{9.15}$$

where $N_{\min}$ means minimum sample size, N_P—population size, α—confidence level, e—maximum estimate error and $f = 0.5$.

Table 9.1 Questions included in the survey (own study)

Variable	Question
	Market Quality
	1. How would you rate the quality of the public information about the companies which are available on the capital market?
	(Selecting the center square means no advantage of one of the two conflicting assessments; for each row please select exactly one answer)
x_1	Information is incomplete □ □ □ □ □ Information is complete
x_2	Information is useless □ □ □ □ □ Information is useful
x_3	Information is untrue □ □ □ □ □ Information is true
x_4	Information is delayed □ □ □ □ □ Information is prompt
x_5	Information is comparable □ □ □ □ □ Information is uncomparable
x_6	Information is ambiguous □ □ □ □ □ Information is unambiguous
x_7	Information is not available □ □ □ □ □ Information is available
	Risk Tolerance
x_8	8. Do you agree with the statement that you invest in a more risky way than others?
	(1—completely disagree, 5—completely agree)
	□ 1 □ 2 □ 3 □ 4 □ 5
x_9	14. Do you undertake actions that are on the edge of risk while making daily investments?
	(1—never, 5—yes, always)
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{10}	21. Do you take a risk even though it is not necessary when investing?
	(1—no, never, 5—yes, often)
	□ 1 □ 2 □ 3 □ 4 □ 5
	Behavioral Inclination in the Opinion Area
x_{11}, x_{15}	24. How often do you make changes in the portfolio in your selected investment horizon?
	(1—I do not make any changes, 5—I try as often as possible to change the composition of my portfolio)
	□ 1 □ 2 □ 3 □ 4 □ 5
	12. Please estimate the influence of the following factors on your investment decisions: (1—little significance, 3—medium importance while investing, 5—very important)
x_{16}	- Frequency of the occurrence of products/services advertised on television or the Internet
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{17}	- Personal sentiment to the company, for example because of a location in the same region
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{18}	19. Suppose that the value of the WIG20 index is currently at the 2524 level. What do you think of the probability that within a month the WIG20 index value will be outside the range (2056–2992)?
	□ (0%–10%) □ (10%–20%) □ (20%–40%) □ (40%–60%) □ (60%–100%)
	Behavioral Inclination in the Preferences Area

(continued)

Table 9.1 (continued)

Variable	Question
x_{12}, x_{19}	5. You have earned lately a 30% profit on your stock investment. There has been a bull market for six months and there are not any clear signals of the trend change. What percentage of savings would you be willing to further invest?
	□ 10% □ 25% □ 50% □ 75% □ 100%
x_{13}, x_{20}	10. Suppose that you have earned 5000 PLN on investment in shares of 20,000 PLN value each. Market analysts predict further growth and the maintenance of the bull market for at least one year. How do you plan your investments?
	□ You make a review of your portfolio by investing 20,000 PLN and put aside profits for other purposes.
	□ You invest 20,000 PLN along with the gained profits equal to 5000 PLN.
	□ You invest 25,000 and part of your additional revenue (e.g. 5000 PLN)
	□ You invest 25,000 and part of your additional revenue (e.g. 10,000 PLN)
	□ You invest 25,000, the whole of your additional revenue (e.g. 10,000 PLN), and an additional 10,000 PLN (a loan).
x_{14}, x_{21}	16. Suppose you have a stock portfolio worth 10,000 PLN, which earns a profit of 10% per month. According to the market information, investment in company X would provide at least 60% profit in the period of two months. What would be your decision regarding changes in your portfolio?
	□ No changes in the stock portfolio □ Purchase shares of X (3000 PLN)
	□ Purchase shares of X (6000 PLN) □ Purchase shares of X (10,000 PLN)
	□ Purchase shares of X (20,000 PLN) using 10,000 PLN obtained from the loan taken
x_{22}	7. Suppose you own a number of X company shares whose total market value is now 10,000 PLN. From the fundamental analysis and expert knowledge it is known that its value will rise by at least 15% within the coming year. In this situation, today you are able to resell them for a minimum value equal to:
	□ 10,000 □ 10,500 □ 11,000 □ 11,500 □ 12,000
x_{22}	20. From the fundamental analysis and expert opinion it is known that the shares of Y will rise at least by 15% within the coming year. In this situation, today you are able to buy back the company's shares with a market value of 10,000 PLN, for a maximum value equal to:
	□ 10,000 □ 10,500 □ 11,000 □ 11,500 □ 12,000
	The Skill of Using Fundamental Analysis
	2. Evaluate the rate of the importance of the following information for investment decisions:
	(1—little significance, 3—medium importance while investing, 5—very important)
x_{23}	- Macroeconomic information (GDP, foreign exchange rates, commodity prices, interest rates)
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{24}	- The values and changes in the stock indexes (WIG, WIG20, DJIA)
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{25}	- Fundamental information (stock market indices, indicators of financial analysis, Porter's analysis, SWOT)
	□ 1 □ 2 □ 3 □ 4 □ 5
	4. Please, assess your usage of the following indicators of fundamental analysis in the decision process: (1—never used, 3—used sometimes, 5—always used)
	- current assets/current liabilities or other liquidity indicators
	□ 1 □ 2 □ 3 □ 4 □ 5

(continued)

Table 9.1 (continued)

Variable	Question
x_{26}	- turnover ratios of receivables and liabilities of the company
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{27}	- total liabilities/total assets or other debt indicators
	□ 1 □ 2 □ 3 □ 4 □ 5
x_{28}	- net profit/net sales or other profitability indicators
	□ 1 □ 2 □ 3 □ 4 □ 5
	- market price/profit per share or other market value indicators
	□ 1 □ 2 □ 3 □ 4 □ 5
	The Skill of Using Technical Analysis
	3. Based on the signals (information) as specified below, say how, in your opinion, the WIG index will behave in the near future? (−2 means a strong decrease in the WIG index, 0 represents no effect, 2 indicates an increase in the WIG WIG)
	Breaking the levels of support by the falling WIG index
	□ -2 □ -1 □ 0 □ 1 □ 2
	Creating a head and shoulders formation after large increases of the WIG index
	□ -2 □ -1 □ 0 □ 1 □ 2
	The collapse of the main line of the upward trend in the WIG index
	□ -2 □ -1 □ 0 □ 1 □ 2
	The growing WIG index subsequently confirmed the main trend line
	□ -2 □ -1 □ 0 □ 1 □ 2
	After a decline in stock prices—a large excess of demand
	□ -2 □ -1 □ 0 □ 1 □ 2
	A significant increase in the value of the purchase order
	□ -2 □ -1 □ 0 □ 1 □ 2
	Profit Rate
y_8	20. Considering the current situation on the stock market, what return rate on investment would be satisfying for you in the next six months? How do you evaluate the probability of obtaining a satisfying rate of profit?
	satisfying profit rate (. . .. . .%) probability of obtaining this rate (. . .. . .%)
y_7	6. What was your return rate obtained from stock market investments in the last six months? Considering the current situation on the stock market during this period, what return rate would be satisfying for you?
	Obtained profit rate (. . .. . .%) satisfying profit rate (. . .. . .%)

9.4.3 Data Analysis

Most respondents—nearly two-thirds in all stages of the study were living in the city of over 100 thousand residents. In all analyzed years more than 80% of respondents claimed to have higher education and around 70% of respondents had a relatively short practice of investing on the capital market (5 years or less). In a survey conducted in 2013, 284 more than three-quarters of individuals invested primarily on the stock market. Only 16% of investors usually chose the derivatives market, 4%—NewConnect, and less than 2%—Catalyst.

Table 9.2 The usage of particular fundamental analysis indicators in 2013 (%)

Frequency of use	1—never	2—rarely	3—average	4—often	5—always
Liquidity indicators	13.42	16.99	31.51	27.12	10.68
Turnover ratios of receivables and liabilities	16.71	24.38	30.14	21.37	6.03
Debt indicators	9.04	14.52	26.03	35.89	13.97
Profitability indicators	5.21	8.49	17.53	35.89	32.33
Market value indicators	4.38	6.85	19.45	35.62	32.60

Most respondents declared no or low frequency of portfolio changes during the given time horizon. In analyzed years the percentage of investors who did not make any changes in the portfolio in a chosen time horizon significantly increased. In 2010 only 4% respondents chose option 1, and in 2013—33%. The reasons for such a large change in the structure of investors can be explained by the prolonged economic crisis during which investors seemed to represent higher risk aversion (Hoffmann et al. 2012).

About 60% of the respondents admitted that the information derived from technical analysis is important for investment decisions. However, the ability of using technical analysis tools was not on a satisfactory level. In 2013 in this section of the survey nearly 50% answers were correct, while three years earlier—only 40%.

Similar to technical analysis, more than 60% of the respondents admitted that in the decision-making process, fundamental information, which relates to the stock market indicators, financial analysis, SWOT and Porter, was essential. Particularly important for the respondents were indicators of profitability and market value (Table 9.2).

In the study carried out in 2010, the arithmetic average of the return rate achieved by respondents in the last period was 26.6%. Only 3% of respondents admitted to have closed the last time period with at a loss, but in no case this loss exceeded 25% of the contribution. Most responders, nearly 70%, achieved a gain, but lower than 25%. Around 7% of respondents could boast of the rate of profit higher than 50%.

In 2012, the average return rate on investments among the surveyed investors was 14.5% and in 2013 only 13.4%. In the last analyzed year 19% of respondents admitted to end the last period with a loss. Just as in the years 2010 and 2012, also in 2013 the most—of individual investors (around 68%) achieved a profit, but below 25%. Only 2.5% of respondents achieved the return rate over 50% in the last year of the study (Fig. 9.1).

Along with the reduction in the return rate, also investors' satisfactory profit level changed. In 2010, the average desired return rate for investors for the particular period was over 50%. In 2013, the investors' average satisfactory rate of return was only 34%. The decreasing of the expected return rate, as well as the decreasing risk tolerance can also be explained by the prolonged economic crisis (Hoffmann et al. 2012).

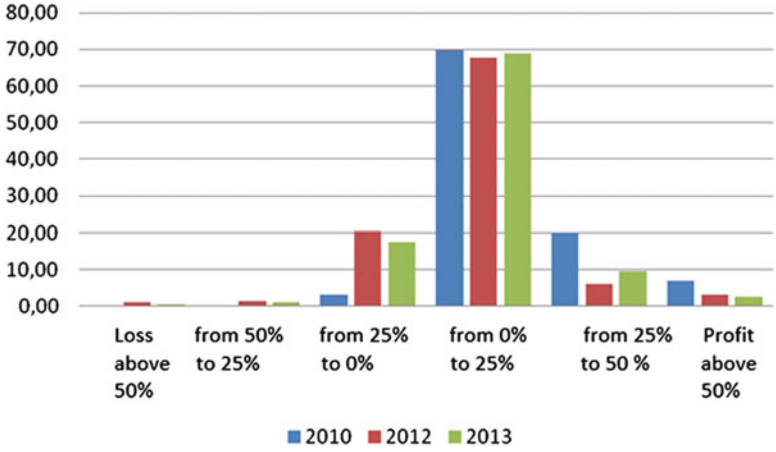

Fig. 9.1 Distribution of the returns obtained from investments in 2010, 2012 and 2013

Table 9.3 The factors, measurable variables and Alfa-Cronbach statistic (own study)

Factor	Description	Measurable variable	Alfa Cronbach statistic
y_1	Capital market quality	x_1, x_2, x_3, x_4, x_5, x_6, x_7	0.75
y_2	Risk tolerance	x_8, x_9, x_{10}	0.71
y_3	Behavioral inclinations	x_{11}, x_{12}, x_{13}, x_{14}	0.49
y_7	Lack of satisfaction with investment		
y_8	Expected return rate		

9.5 Model Solution and Empirical Implications

9.5.1 A Model of Psychological Mechanisms of Investment Behaviors

Table 9.3 includes all defined factors and measurable variables, which correspond to each question of the questionnaire and which create these unobservable factors. Additionally, two endogenous variables are included in the table, which are not latent variables: y_7—lack of satisfaction from investing and y_8—expected return rate. In this study, lack of satisfaction with the investment is defined as the difference between satisfactory and actual obtained return rate during the period. In this understanding, this variable should have the minimum value.

To analyze the mechanisms of decision-making processes by individual investors, the structural equation model was used. The estimation of the model was based on a database containing 1023 observations obtained in all three surveys. The specification, estimation (using maximum likelihood) and verification of the

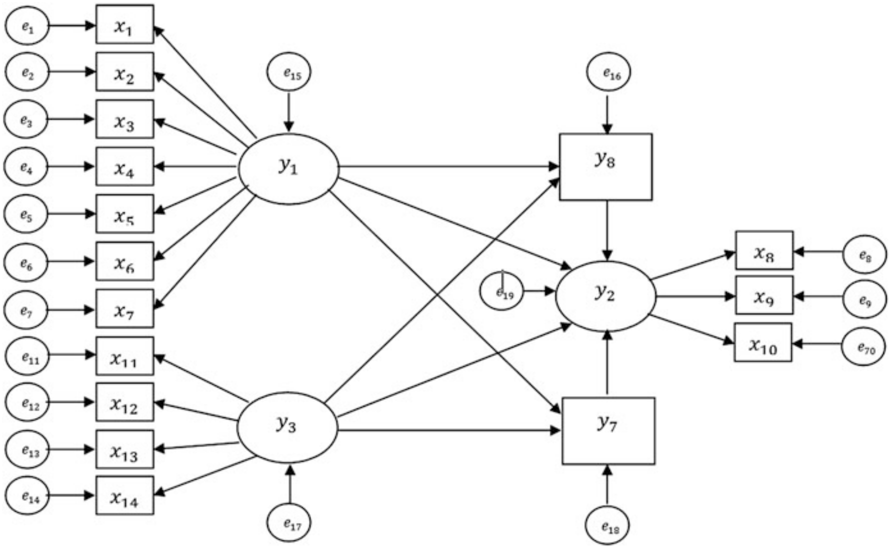

Fig. 9.2 Hypothetical model's scheme (own study)

model (also using the bootstrap procedure) was made using the AMOS v. 17 software. The hypothetical model's scheme is presented in the figure below. The designations are the same as in the table (Fig. 9.2).

The maximum likelihood method requires that all variables included in the model have a multivariate normal distribution. Table 9.4 shows the value of skewness and kurtosis for variables included in the model.

The total value of kurtosis and calculated statistics based on it are significantly higher than the values desired. Thus, the overall assessment of the model's quality is possible only after the assessment of the model's parameters and determining the ranges for parameter's values using the bootstrap procedure.

In order to evaluate the quality of the SEM model, a bootstrap procedure with the maximum likelihood estimator was used. For the confidence intervals' estimation the minimum number of 1000 bootstrap samples is required. Based on the simulations, the additional changes were not noted in the estimation of parameters' standard error or in the limits of confidence intervals between calculations based on 4000 samples and more (the comparison was carried out to make 10,000 samples). Therefore, the quality analysis for the SEM model was based on 4000 samples and the confidence level for the confidence intervals was set at 95%.

Table 9.4 Total value of skewness and kurtosis of variables included in the model (own study)

Variable	Min	Max	Skewness		Kurtosis	
			Parameter estimate	t-statistic	Parameter estimate	t-statistic
y_7	−10.000	297.000	7.140	89.565	80.648	505.792
x_{11}	1.000	5.000	0.279	3.501	0.044	0.276
x_{12}	1.000	5.000	0.318	3.987	−0.943	−5.915
x_{13}	1.000	5.000	0.475	5.961	−0.347	−2.177
x_{14}	0.000	5.000	0.518	6.497	−0.290	−1.818
y_8	0.000	4000.000	25.234	316.516	707.871	4439.505
x_8	1.000	5.000	0.010	0.125	−0.732	−4.593
x_9	1.000	5.000	−0.159	−1.999	−0.563	−3.533
x_{10}	1.000	5.000	−0.064	−0.801	−0.810	−5.081
x_1	1.000	5.000	−0.353	−4.431	−0.387	−2.426
x_2	1.000	5.000	0.045	0.567	−0.612	−3.840
x_3	1.000	5.000	−0.244	−3.058	−0.385	−2.413
x_4	1.000	5.000	0.216	2.707	−0.526	−3.301
x_5	1.000	5.000	−0.375	−4.700	−0.138	−0.865
x_6	1.000	5.000	−0.529	−6.640	−0.029	−0.185
x_7	1.000	5.000	−0.409	−5.130	−0.681	−4.269
Total					798.184	510.914

9.5.2 *Do the Behavioral Factors Have a Significant Impact on Investors' Decisions on the Capital Market? Results of Analysis*

Table 9.5 contains the results of the external model estimated by the maximum likelihood method and Table 9.6—the results of the internal model. The first two columns contain the parameters' estimation and p-value calculated using the maximum likelihood method, and the last one contains the average for each parameter estimate, load estimators, confidence intervals and p-values calculated using the bootstrap procedure. To fully confirm the quality of the estimated model, Table 9.7 contains the measures of the model fit degree.

The results obtained for the external model provided in Table 9.5 indicate that all of the factor loadings are statistically significant. However, the comparison of parameters' estimation obtained with the use of the maximum likelihood with average (bootstrap) indicates the existence of the estimators' loads. First of all, in the case of the internal model, load values for all parameters are higher than adequate load standard errors. Therefore, it was necessary to establish 95% confidence intervals for the parameters. All parameters' estimation obtained using the maximum likelihood method are within the appropriate confidence intervals. According to the *p*-value for *t* statistic and *p*-value for the bootstrap procedure, the parameters β_1, β_5, β_6 and β_8 in the internal model are statistically significant. The IFI index for the estimated model SEM is equal to 0.913, and the value of

Table 9.5 The results of the estimation external model (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$x_1 \leftarrow y_1$	α_1	0.556		0.555	0.034	0.000	0.486	0.616	0.000	0.556
$x_2 \leftarrow y_1$	α_2	0.500	0.000	0.500	0.037	0.000	0.424	0.57	0.000	0.500
$x_3 \leftarrow y_1$	α_3	0.476	0.000	0.476	0.036	0.000	0.404	0.543	0.000	0.476
$x_4 \leftarrow y_1$	α_4	0.569	0.000	0.569	0.028	0.000	0.512	0.620	0.000	0.569
$x_5 \leftarrow y_1$	α_5	0.607	0.000	0.607	0.032	0.000	0.539	0.666	0.001	0.607
$x_6 \leftarrow y_1$	α_6	0.633	0.000	0.633	0.030	0.000	0.569	0.687	0.001	0.633
$x_7 \leftarrow y_1$	α_7	0.456	0.000	0.454	0.037	−0.001	0.381	0.525	0.000	0.456
$x_8 \leftarrow y_2$	α_8	0.610		0.611	0.034	0.000	0.540	0.671	0.001	0.610
$x_9 \leftarrow y_2$	α_9	0.799	0.000	0.798	0.029	−0.001	0.740	0.856	0.000	0.799
$x_{10} \leftarrow y_2$	α_{10}	0.639	0.000	0.638	0.031	−0.001	0.575	0.698	0.000	0.639
$x_{11} \leftarrow y_3$	α_{11}	0.533		0.530	0.046	−0.003	0.435	0.608	0.000	0.533
$x_{12} \leftarrow y_3$	α_{12}	0.605	0.000	0.595	0.063	−0.01	0.490	0.706	0.000	0.605
$x_{13} \leftarrow y_3$	α_{13}	0.421	0.000	0.411	0.051	−0.01	0.330	0.511	0.000	0.421
$x_{14} \leftarrow y_3$	α_{14}	0.253	0.000	0.255	0.053	0.002	0.150	0.356	0.000	0.253

Table 9.6 The results of the internal model (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	−0.135	0.059	0.022	0.087	0.066	−0.001	−0.275	−0.019	0.021
$y_1 \rightarrow y_3$	β_2	0.088	0.059	0.137	0.085	0.066	−0.003	−0.043	0.219	0.181
$y_1 \rightarrow y_8$	β_3	−1.223	1.388	0.378	−1.390	1.773	−0.167	−4.787	1.823	0.446
$y_1 \rightarrow y_7$	β_4	−6.294	10.286	0.541	−6.633	5.272	−0.339	−17.534	2.812	0.178
$y_3 \rightarrow y_2$	β_5	0.508	0.074	0.000	0.537	0.170	0.029	0.349	0.770	0.001
$y_3 \rightarrow y_8$	β_6	5.680	1.686	0.000	7.234	8.088	1.554	1.544	10.332	0.003
$y_3 \rightarrow y_7$	β_7	9.975	12.020	0.407	12.993	21.989	3.018	−18.940	39.683	0.511
$y_2 \rightarrow y_8$	β_8	3.086	1.243	0.013	2.389	4.146	−0.697	−0.050	6.461	0.052
$y_2 \rightarrow y_7$	β_9	7.642	9.146	0.403	5.981	12.662	−1.661	−8.230	28.607	0.287

Table 9.7 Measures of the degree of fit of the SEM model (own study)

Model	NFI	PNFI	RMSEA	CMIN/DF	Hoelter 0.05
Estimated	0.913	0.705	0.045	3.067	416
Saturated	1	0.000	–	–	–
Independent	0.000	0.000	0.128	17.642	70

RMSEA is at the level of 0.045, which proves correct fitting the model to the empirical data.

According to the results contained in Table 9.6, behavioral inclinations of investors have a statistically significant impact on their risk tolerance (β_5) and the expected return rate (β_6). It confirms the results obtained by Long, Shleifer, Summers and Waldmann in 1990. Additionally, if the public information provided by the company is of higher quality, the willingness to take the risks by the investors is lower (β_1).

For further verification of the hypotheses established at the beginning of the chapter, the author decided to analyze the results of the estimated model in subgroups. In the first case the first group of investors contained market participants, who never or rarely used the fundamental information in the investment process. In the second group there were investors who used the fundamental analysis regularly (Tables 9.8 and 9.9).

Both in the first and the second group of respondents the behavioral inclinations have statistically significant influence on risk tolerance (β5). In addition, in the group of investors for which fundamental information is not significant, behavioral inclinations have not only an indirect impact on the expected return rate—β8, but also a direct effect on the lack of satisfaction with the investment—β7. The behavioral inclinations in this group are influenced by the growth of the difference between the expected and the real return rate obtained. The results support the hypothesis that the influence of behavioral inclinations of rational investors, who use the fundamental analysis on investment decisions is smaller.

In another split of the respondents in the first group, the investors who use the tools of technical analysis below average were included, while the second group was included investors who use them efficiently (Tables 9.10 and 9.11).

In both groups of respondents behavioral inclinations are statistically significant for risk tolerance (β5). In addition, in the group of investors, who do not have the skills to use technical analysis, the behavioral inclinations have statistically significant influence on the expected rate of return (β6). The standardized size of this impact is 0.229. In the second group behavioral inclinations have no direct impact on both the lack of satisfaction with the investment as well as the expected return rate. There is only indirect influence of these values by risk tolerance. The total standardized impact of behavioral inclinations in this group on the expected return rate is only 0.062 and is significantly lower than in the first group.

Subsequently, the respondents were divided according to their experience gained while investing on the capital market. Investors were split, as earlier, into two groups. The first group contained investors who had been active on the capital market up to five years, the second—investors with more than five-year experience (Tables 9.12 and 9.13).

Table 9.8 The internal model results for investors who never or rarely used the fundamental information in the investment process (Group 1) (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	−0.122	0.086	0.157	−0.133	0.104	−0.011	−0.342	0.066	0.210
$y_1 \rightarrow y_3$	β_2	0.141	0.105	0.179	0.134	0.116	−0.007	−0.094	0.369	0.211
$y_1 \rightarrow y_8$	β_3	−3.363	2.350	0.152	−3.977	2.518	−0.615	−8.410	1.09	0.144
$y_1 \rightarrow y_7$	β_4	−5.383	5.277	0.308	−8.558	12.286	−3.175	−38.689	5.194	0.339
$y_3 \rightarrow y_2$	β_5	0.424	0.100	0.000	0.543	0.276	0.119	0.201	1.077	0.002
$y_3 \rightarrow y_8$	β_6	3.013	2.567	0.241	6.541	9.621	3.529	−4.665	29.747	0.455
$y_3 \rightarrow y_7$	β_7	21.401	6.424	0.000	43.686	63.133	22.285	2.533	187.009	0.020
$y_2 \rightarrow y_8$	β_8	6.433	2.659	0.016	4.032	8.002	−2.402	−13.24	17.135	0.270
$y_2 \rightarrow y_7$	β_9	0.329	5.902	0.956	−14.866	42.679	−15.194	−108.509	12.514	0.901
		IFI = 0.890								
		RMSEA = 0.053								
		CFMIN/DF = 2.027								

Table 9.9 The internal model results for investors who use fundamental analysis regularly (Group 2) (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	−0.154	0.079	0.050	−0.158	0.093	−0.003	−0.334	0.029	0.093
$y_1 \rightarrow y_3$	β_2	0.034	0.071	0.633	0.033	0.084	0.000	−0.130	0.201	0.678
$y_1 \rightarrow y_8$	β_3	0.303	1.700	0.858	0.075	3.546	−0.229	−5.227	4.733	0.897
$y_1 \rightarrow y_7$	β_4	−8.908	16.334	0.586	−9.169	9.461	−0.261	−32.478	5.751	0.229
$y_3 \rightarrow y_2$	β_5	0.565	0.104	0.000	0.625	0.287	0.06	0.341	1.363	0.001
$y_3 \rightarrow y_8$	β_6	8.955	2.251	0.000	13.008	22.925	4.054	3.681	17.804	0.001
$y_3 \rightarrow y_7$	β_7	4.002	19.391	0.836	8.674	33.465	4.672	−51.357	58.56	0.928
$y_2 \rightarrow y_8$	β_8	1.252	1.378	0.363	−0.277	9.655	−1.529	−4.672	4.207	0.382
$y_2 \rightarrow y_7$	β_9	9.366	13.046	0.473	7.213	16.064	−2.153	−13.77	38.276	0.297
		IFI = 0.907								
		RMSEA = 0.046								
		CFMIN/DF = 2.384								

Table 9.10 The internal model results for investors who use the tools of technical analysis below average (Group 1) (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	−0.035	0.077	0.653	−0.036	0.086	−0.001	−0.209	0.130	0.660
$y_1 \rightarrow y_3$	β_2	0.085	0.084	0.312	0.083	0.094	−0.002	−0.107	0.269	0.360
$y_1 \rightarrow y_8$	β_3	−1.084	2.481	0.662	−1.127	2.891	−0.043	−6.800	4.731	0.690
$y_1 \rightarrow y_7$	β_4	−11.869	20.364	0.560	−12.286	10.200	−0.417	−38.044	3.512	0.135
$y_3 \rightarrow y_2$	β_5	0.513	0.106	0.000	0.532	0.152	0.019	0.307	0.846	0.000
$y_3 \rightarrow y_8$	β_6	10.619	3.327	0.001	11.967	6.683	1.349	3.685	19.887	0.001
$y_3 \rightarrow y_7$	β_7	23.102	25.096	0.357	24.711	25.951	1.610	−28.247	66.269	0.358
$y_2 \rightarrow y_8$	β_8	5.166	2.387	0.030	4.593	3.885	−0.573	−0.245	11.980	0.060
$y_2 \rightarrow y_7$	β_9	9.173	19.255	0.634	8.337	16.117	−0.836	−14.076	48.065	0.434
		IFI = 0.905								
		RMSEA = 0.046								
		CFMIN/DF = 2.124								

Table 9.11 The internal model results for investors who use the tools of technical analysis efficiently (Group 2) (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	−0.229	0.088	0.009	−0.238	0.115	−0.009	−0.483	−0.022	0.030
$y_1 \rightarrow y_3$	β_2	0.097	0.08	0.228	0.093	0.096	−0.004	−0.087	0.292	0.271
$y_1 \rightarrow y_8$	β_3	−1.431	1.208	0.236	−2.686	6.484	−1.255	−11.729	2.412	0.375
$y_1 \rightarrow y_7$	β_4	−0.354	3.744	0.925	−3.935	20.972	−3.58	−31.467	15.558	0.943
$y_3 \rightarrow y_2$	β_5	0.504	0.104	0.000	0.642	0.424	0.138	0.25	1.858	0.001
$y_3 \rightarrow y_8$	β_6	1.617	1.361	0.235	8.647	31.341	7.031	−3.077	75.890	0.455
$y_3 \rightarrow y_7$	β_7	3.004	4.212	0.476	23.373	111.88	20.369	−16.035	308.179	0.713
$y_2 \rightarrow y_8$	β_8	1.117	1.023	0.275	−2.633	16.737	−3.75	−45.445	4.162	0.532
$y_2 \rightarrow y_7$	β_9	4.387	3.19	0.169	−6.722	60.416	−11.109	−153.05	22.126	0.531
		IFI = 0.813								
		RMSEA = 0.073								
		CFMIN/DF = 3.591								

Table 9.12 The internal model results for investors who had been active on the capital market up to five years (Group 1) (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	−0.130	0.093	0.163	−0.133	0.107	−0.003	−0.365	0.063	0.169
$y_1 \rightarrow y_3$	β_2	0.213	0.118	0.071	0.195	0.128	−0.018	−0.035	0.465	0.093
$y_1 \rightarrow y_8$	β_3	−2.339	3.041	0.442	−2.596	3.572	−0.257	−8.967	4.283	0.473
$y_1 \rightarrow y_7$	β_4	−15.443	9.106	0.090	−16.2	11.81	−0.756	−43.586	2.224	0.083
$y_3 \rightarrow y_2$	β_5	0.320	0.092	0.000	0.445	0.413	0.124	0.117	1.706	0.006
$y_3 \rightarrow y_8$	β_6	6.420	2.857	0.025	10.733	21.32	4.314	−0.036	35.216	0.051
$y_3 \rightarrow y_7$	β_7	24.062	8.781	0.006	38.791	69.679	14.729	−4.771	154.549	0.115
$y_2 \rightarrow y_8$	β_8	5.923	2.38	0.013	4.203	8.74	−1.72	−8.625	13.091	0.130
$y_2 \rightarrow y_7$	β_9	6.631	6.959	0.341	−0.16	28.674	−6.792	−44.810	26.424	0.428
		IFI = 0.856								
		RMSEA = 0.058								
		CFMIN/DF = 2.544								

Table 9.13 The internal model results for investors who had been active on the capital market more than five years (Group 2) (own study)

		MLM			Bootstrap					
Dependence	Parameter	Parameter estimation	Standard dev.	p-value	Average	Standard dev.	Load (b*)	Low limit	High limit	p-value
$y_1 \rightarrow y_2$	β_1	0.053	0.219	0.809	0.058	0.334	0.005	−0.442	0.953	0.777
$y_1 \rightarrow y_3$	β_2	−0.178	0.120	0.137	−0.184	0.173	−0.006	−0.562	0.120	0.232
$y_1 \rightarrow y_8$	β_3	4.950	6.391	0.439	5.903	12.136	0.953	−18.198	27.944	0.620
$y_1 \rightarrow y_7$	β_4	7.777	15.545	0.617	10.12	32.768	2.343	−39.48	89.723	0.682
$y_3 \rightarrow y_2$	β_5	1.990	0.517	0.000	1.987	0.84	−0.003	1.170	5.153	0.000
$y_3 \rightarrow y_8$	β_6	60.536	20.479	0.003	65.123	44.874	4.586	17.892	217.521	0.000
$y_3 \rightarrow y_7$	β_7	153.128	67.315	0.023	171.196	128.916	18.067	54.656	756.59	0.000
$y_2 \rightarrow y_8$	β_8	−18.066	8.006	0.024	−52.387	18.539	26.999	−93.654	−1.610	0.021
$y_2 \rightarrow y_7$	β_9	−52.387	26.999	0.052	−56.818	51.267	−4.431	−309.796	−12.583	0.002
		IFI = 0.856								
		RMSEA = 0.058								
		CFMIN/DF = 2.544								

Again, the impact of behavioral inclinations on risk tolerance (β5) is statistically significant in both groups of investors. Additionally, in both groups the impact of behavioral inclinations on the expected rate of return (β6) and the lack of satisfaction with the investment (β7) is significant. However, Parameter β6 of the second group of respondents has a much higher confidence factor. This suggests a stronger inclination behavioral impact on the expected return rate for investors with more experience in the capital market. This can be explained by the increase in self-confidence along with the acquired experience.

Lastly, the respondents were divided due to the level of education. In the first group there were investors with at most secondary education. In the second—with higher education. In this case, there are no significant differences between estimated parameters.

9.6 Conclusions

Based on the survey carried out in the years 2010, 2012 and 2013 among individual investors investing on the Polish capital market, unobservable variables like risk tolerance, behavioral inclinations in the opinion and preferences areas, market quality and ability to the use of fundamental and technical analysis were identified. According to the hypotheses, the strength and direction of the influence of the aforementioned mentioned factors on the decision-making process of individual investors on the capital market in Poland were measured using SEM models. In particular, the main hypothesis according to which psychological factors, which are behavioral inclinations in the opinion and preferences areas, have a significant impact on the behavior of investors on the capital market, changing their risk tolerance and a satisfactory rate of return was confirmed.

It also shows the differences in influence of behavioral inclinations between investors who properly use the fundamental or technical analysis, and those who do not have this ability. A detailed analysis was carried out by dividing the investors to the separate groups based on their experience in investing on the capital market or education level. It has been shown that investors' experience on the capital market increases their self-confidence so that they can have more risk tolerance. In addition, good quality of information provided by the company reduces investors' risk tolerance significantly. The value and significance of the parameters of the models obtained by maximum likelihood was confirmed by bootstrap procedure.

Analysis of the survey's results allows for the assessment of the changes in the behavior of individual investors on the Polish capital market each year. The results of SEM model estimation allow on the other hand to perform numerous simulations to assess the impact of changes in the quality of information, in ability to use technical or fundamental analysis and in behavioral inclinations on risk tolerance, expected return rate and satisfaction of investing.

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