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THE APPLICATION OF CLASSIFICATION AND REGRESSION TREES IN THE ANALYSIS OF SAVING AND CREDIT DECISIONS MADE BY HOUSEHOLDS

Summary: The study analyses the behaviour presented by natural persons in situations which require making decisions about savings or taking loans. The objective of the article is to identify the factors determining the choice of a given option and to indicate both the advantages and disadvantages resulting from a particular attitude. The following research tools were applied: the CART method (*Classification and Regression Trees*) and the descriptive method. The empirical data originate from surveys carried out by the CAWI method (*Computer Assisted Web Interview*) performed on a sample of 1000 Poles. The obtained results indicate that debt aversion, holding credits and the level of income earned, represent the main factors determining an individual tendency to make decisions regarding saving. In the case of credit decisions, the most important factors are the level of debt aversion, monthly net income level of a household and being in possession of savings.

Keywords: personal finance, Classification and Regression Trees, financial decision, credits, savings.

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1. Introduction

The turbulent environment, the unclear market of financial services, more and more complicated products and unfair practices on the part of financial institutions result in the fact that undertaking optimal financial decisions by individuals is becoming more and more difficult. In this context the importance of education and financial awareness keeps increasing and influencing the effective management of personal finance. The significance of the initiatives carried out in this area is determined by the serious consequences resulting from making particular choices. Each financial decision, referring to either saving or taking out a loan is associated with certain advantages and disadvantages.

The presented study analyses the behaviour of natural persons in situations which require undertaking decisions about savings and/or loans. The objective of the

article is to identify the factors determining the choice of a given option and to indicate both the advantages and disadvantages resulting from presenting a particular attitude. The following research tools were applied: the CART method (*Classification and Regression Trees*), the descriptive method, literature references analysis and the critique method. The necessary empirical data were collected based on surveys carried out in 2013, the applied CAWI method (Computer Assisted Web Interview), performed on a sample of 1000 Poles aged 15 and over.[1]

The respondents were asked to solve problems requiring their decisions related to either making savings or taking a credit. By means of presenting them with an appropriate set of questions, it was possible to find out their preferences referring to such issues as e.g. aversion to debt and foresight.

The knowledge of the factors exerting the most significant impact on saving and credit- focused decisions, facilitated the selection of characteristics typical for individuals included in groups which should become the main target of educational activities aimed at upgrading overall financial awareness. The researched knowledge can be used by financial institutions for the purposes of constructing appropriate products and services, suitable for and tailored to the needs of clients.

2. The essence of financial decisions

Behaviour is understood as a specific, physical and possible to observe action, as well as the associated mental processes, motives and the underlying reasons for it. Any type of behaviour refers to the mental and physical actions presented by individuals and groups in terms of purchase orientation, usage, maintenance and the elimination of a product, or production, from the public market sector and from households. It allows functioning and achieving individual goals such as satisfaction and wealth, also considering short and long-term results, as well as their individual and social consequences [Antonides, van Raaij 2003, p. 24].

Consumer behaviour in financial markets can be analyzed from different angles. One of the methods for behavioural analysis is the decision-making perspective. As

[1] The structure of the sample was adjusted using analytical balance corresponding to the structure of Polish Internet users representing the group 15+ in terms of the key characteristics related to the studied problem and based on random-quota sampling. The weight was constructed by applying the following socio-demographic variables: gender, age, education and the place of residence size, as well as those related to the broadly understood lifestyle. The sample structure, in terms of major socio-demographic characteristics, is as follows: gender (women – 64%; men – 36%), age (15-18 age group – 8.4%; 19-24 age group – 21.7%, 25-34 age group – 30.7%; 35-49 age group – 22.7%; 50 and older – 16.5%), education (tertiary – 46.1%; secondary – 39.7%; other – 14.2%), location of residence (village – 27.1%; town up to 100 000 residents – 25.8%; town from 100 000 to 500 000 residents – 26.2%; town over 500 000 residents – 20.9%). An invitation to participate in the study was shown on websites having an overall monthly reach of over 70% of Polish Internet users.

S. Smyczek points out, a decision made stands for a choice of a particular action selected from a set of various options, however, making a particular choice is accompanied by a certain risk, since the result achieved after the choice has been made is not certain [Smyczek 2012, p. 71]. Decisions made in conditions of uncertainty are characterized by the unpredictability of the effects resulting from the actions considered. In conditions of uncertainty, similarly to those of risk, every action leads to one out of many results. The decision-maker, however, is not able to assign a probability to that result which will actually appear [Tyszka 2010, p. 27].

From the traditional perspective, the decision-making process related to the purchase of financial services by a consumer consists of four stages: the perception of a financial need, investigating and evaluating the possibilities for meeting this need, making the purchase and the feeling of being experienced after the purchase has been made [Smyczek 2012, p. 72]. Referring to the first stage, it has to be emphasized that every financial need can be met by taking advantage of different financial services and, therefore, a particular service can meet numerous and diverse needs.

One of the frequently quoted, in literature references, approaches to financial needs is the one suggested by D. A. Yorke. He distinguished the following five basic, and listed below, financial needs shown by consumers [Yorke 1982]:

1) the need of access to financial means (e.g. by using ATM cards, charge cards or cheques);

2) the need to secure financial means – physical protection of the means, e.g. against theft and depreciation;

3) the need to transfer financial means – related to the possibility of transferring funds at a distance;

4) the need for payment deferral (met by credits and loans);

5) the need for being provided with financial consultancy.

Consumer behaviour in financial markets can be subject to different classifications. From the perspective of the institutional system criterion, such behaviour can be analyzed in terms of two institutional systems – in the market or outside it. In the first case two types of markets are distinguished – the main (traditional) financial market and the alternative one [Smyczek 2012, p. 65].

The classification of financial behaviour following an objective criterion, on the other hand, allows for analyzing them based on three areas [Smyczek 2007, pp. 32-33]:

- in the market of financial services (using the services of financial institutions, e.g. banks, insurance companies, brokerage houses);
- in a household (managing financial means, taking advantage of financial services);
- in the remaining situations (making decisions about using services offered by an institution outside the financial market, e.g. casinos, bookmakers or the financial relations between a consumer and the state mainly related to paying taxes).

Having considered the rationality of both decisions and behaviour, one can distinguish rational, habitual or impulsive behaviour, as well as that determined by the social context [Swoboda 2004, p. 103]. Rational behaviour requires from an individual to get involved in searching for, analyzing and processing information and thus express the desire to make an optimal decision. Financial habitual behaviour patterns are not based on searching for information. An individual acts in the same way as he/she used to in the past. Impulsive behaviour is characterized by situations in which the decision-maker follows an impulse and skips the phase of searching for the data about a product. The last of the possible behaviour types related to financial behaviour covers the decisions made based on the defined standards and social values characteristic for a particular environment.

3. CART – Classification and Regression Trees Method

Classification and regression trees represent data mining tools used in the construction of predictive and descriptive models. They are applied in the classification of objects when a dependent variable is found in the set of analyzed variables and the variables subject to analysis (dependent and independent variable) can be measured both in weak scales (nominal and ordinal) and strong scales (interval and quotient) [*Metody statystycznej*... 2004, pp. 56-59]. Classification trees are constructed when the dependent variable is expressed in either a nominal or ordinal scale, or regression trees when the level of this variable measure is at least of an interval character. The purpose of building a predictive model is to make either a qualitative or quantitative prediction, while in the case of a descriptive model construction it is the description and presentation of patterns in the surveyed population [Łapczyński 2003, p. 93].

Classification and regression trees are constructed as a result of compiling local models built in particular subspaces of *m*-dimensional space with $\mathbf{X^m}$ variables. The space is sequentially divided into R_k subspaces (segments) until *Y* dependent variable reaches, in each of them the minimal diversification level measured by an adequate loss function [*Analiza danych*... 2011, p. 185]. This is a multistage process in the course of which a different independent variable can be applied in each subsequent step. All the predictors are analyzed at each step and the selected one has to ensure the best node partitioning, i.e. resulting in the most homogenous subsets.

The recursive partitioning method was already used in statistics in the 1960s by Morgan and Sonquist [Morgan, Sonquist 1963], however, its application for the purposes of discriminative analysis and regression was presented twenty years later by Breiman, Friedman, Olshen and Stone in their book entitled *Classification and regression Trees* (CART) [Breiman et al. 1984]. The reason for such naming of the method is the graph taking the form of a tree which best presents the process of recursive partitioning.

Classification and regression trees represent a graphic model version of [Gatnar 2008, pp. 37-39]:

$$Y = f(x_i) = \sum_{k=1}^{K} \alpha_k I(x_i \in R_k), \tag{1}$$

where:
Y − dependent variable,
R_k (k = 1,…, K, wherein K – number of segments) – represent subspaces (space segments) of $\mathbf{X^m}$ explanatory variables (X_1, X_2,…, X_m, where m – the number of explanatory variables),
$x_i = [x_{i1}, x_{i2}, \ldots, x_{im}]$ – observations from a recognizable set,
α_k – model parameters,
I – indicator function.

The method for defining I indicator function depends on the nature of explanatory variables (X_1, X_2,…, X_m). When these variables are metric then each of R_k segments is defined by its boundaries of $\mathbf{X^m}$ space in the following way:

$$I(x_i \in R_k) = \prod_{j=1}^{m} I(v_{kj}^{(d)} \leq x_{ij} \leq v_{kj}^{(g)}), \tag{2}$$

where:
$v_{kj}^{(d)}$ – upper section limit in j-th space dimension,
$v_{kj}^{(g)}$ – lower section limit in j-th space dimension.

If $X_1, X_2,\ldots, X_m$ variables are of a qualitative nature (non-metric), then R_k subspace can be defined as:

$$\boldsymbol{I}\,(x_i \in R_k) = \prod_{j=1}^{m} \boldsymbol{I}(x_j \in B_{kj}), \tag{3}$$

where B_{kj} stands for the subset of X_j variable category, i.e. $B_{kj} \subseteq V_j$.

If Y dependent variable in model (1) is a nominal one then the model is called a discriminatory one and is represented by a classification tree. The α_k parameters underlying this model are specified in line with the majorization principle [*Metody statystycznej*... 2004, p. 107]:

$$\alpha_k = \arg\max_l \{p(l|k)\}, \tag{4}$$

where $p(l|k)$ stands for the probability that R_k segment observation belongs to l class.

The starting point for each tree is the entire set of observations divided into two or more subsets. In the first case this refers to binary trees, while in the second to optional ones. The set under partitioning is called the parent node, whereas its subsets represent child nodes. In the course of the second partitioning stage the child node, which is subject to further partitioning, becomes the parent node for the second stage while the node which remains unchanged becomes the end node, called a leaf. The size of the tree is determined by the number of leaves, while its depth is represented

by the number of edges between the top and the most distant tree [Łapczyński 2003, p. 93].

In the case of models taking the form of classification and regression trees, the problem of regularization occurs, i.e. the choice of such model form which provides for its universal character and thus does not depend on the learning data set content. In other words, a compromise has to be found between the prediction complexity and accuracy [*Analiza danych*... 2011, p. 191].

Pruning is one of the methods applied most often for this purpose. This procedure results in the reduction of the tree size by removing some of its fragments in order to reduce the description of trees (with an insignificant increase of the classification error). This allows for comparing an extended model and one with a reduced number of nodes, since sometimes the tree quality does not depend on the prediction accuracy, but on the usefulness of the generated rules. The difference between (α_0) − the entire tree classification error and (α_1) – is the classification error of a tree with a removed branch. After the first pruning stage this α_1 is selected for which the difference is the smallest. In the next step α_1 is already regarded as an out-tree and its error is compared with the error of α_2 tree. This particular α_2 tree is selected in cases in which the difference in classification errors between α_2 and α_1 is the smallest [Łapczyński 2003, p. 95].

The second important advantage of the algorithm is the parallel presentation of the redistribution cost (error rate calculated with reference to the learning data set) against the error rate calculated based on the test set (the latter value may result from the simple validation, cross-validation or multiple cross-validation). The technique called cross-validation divides the training data into the subset used for the tree construction, and next the classification error is estimated for the remaining validation subset. Such partitioning is repeatedly performed for different subsets and the classification error rate is averaged to obtain a cross-validation of how well a given size tree functions with new and unknown data. The size of the tree which presents the smallest cross-validation of the classification error is chosen as the correct size for the ultimate tree model [Hand, Mannila, Smyth 2005, pp. 188-189].

The following measures can be applied for the assessment of $\mathbf{X^m}$ explanatory variables regarding space partitioning quality for the nonparametric dependent variable: classification error, Gini index, the measure of entropy, χ^2 statistics.[2]

In the presented article, the CART procedure was used to determine the classification tree[3]. The calculations were performed using the Statistica 9.0 programme following the assumptions presented in Table 1.

---

[2] More about the methods for determining measures and their properties to be used in the assessment of variables space partitioning in [Gatnar 2001].

[3] This method was applied by P. Anioła and Z. Gołaś to analyse the saving strategies of households in Poland [Anioła, Gołaś 2012].

Table 1. The assumption used in the CART procedure

Specification	Assumptions
Costs of misclassification	Equal
Fit measures (partitioning rule)	Gini index
Stopping rule	If misclassified
Minimum number	200
Maximum number of the tree levels (depth)	10
Maximum number of nodes	1000
Error estimation	10-fold test validation

Source: authors' compilation.

The dependent variables used for the classification of savings (Y_1) and credit (Y_2) decisions were coded based on the responses made by the respondents answering three selected questions. The hypothetical situations presented to the respondents required making financial decisions in the area of savings and credits. The first question (Q1) required a choice between using the savings made to pay for the child's education and borrowing money (from different sources) when faced with the need to buy a car. The first option was chosen by 48% of Polish Internet users aged 15+, whereas the second one was ticked off by 52% of respondents. The second question (Q2) presented a situation which required from respondents imagining that he/she has been married for five years and is currently awaiting the birth of a child. Together with the spouse he/she rents a bedsitter and has the amount of PLN 30.000 in savings to purchase his/her own apartment. He/she comes across a chance to purchase a property worth PLN 150.000, having assumed that the respondent's household is safe to lend to, the decision has to be made whether to purchase the apartment and take out a mortgage, using also the saved-up funds, or to continue saving money and postponing the decision about the purchase for years to come, since he/she is concerned about incurring debt. The majority of respondents made the decision to apply for a credit (57%). In the case of the third question (Q3) the respondent had to decide how he/she would react if faced with financing higher expenses connected with Christmas. The choice was between making a decision about saving small amounts of money for this purpose starting from summer holidays (61% responses), or covering the additional Christmas expenses with a credit card, consumer credit or some other form of loan and thus making a credit decision (39% responses).

Independent variables of an economic, psychological and socio-demographic nature were selected for the analysis. After verifying their variability degree (V_x variation coefficient above 30%) the candidates for explanatory variables were selected. The correlation significance was analyzed based on the methods of Q-Yule, Phi, C-Pearson and V-Cramer. Finally, four variables were adopted for further studies which presented the strongest relation with the explanatory variable, and si-

multaneously the weakest relation between one another. They were the following predictors:

- X_1 – being in possession of savings (nonparametric binary variable, where 1 – the person in possession of actual savings, 0 – does not have any savings);
- X_2 – the level of aversion towards debt (nonparametric multi-category ordered variable, where 3 – the person presents a very strong debt aversion; 2 – the person presents strong debt aversion; 1 – the person presents weak debt aversion; 0 – the person does not present debt aversion)[4];
- X_3 – having credit/loans (nonparametric binary variable, where 1 – the person has an actual loan/credit, 0 – the person does not have a loan/credit);
- X_4 – the level of net household income (nonparametric multi-category ordered interval variable – from category 1 for an interval < PLN 0-500) to category 11 for an interval <10.000 and more).

Whereas the X_1, X_3 and X_4 predictors are quite obvious, the second explanatory variable requires some comments. It was coded based on the responses given by respondents who answered three questions. Two of them presented different hypothetical situations referring to achieving an intended goal by taking advantage of a loan/credit or not. While answering the third question the respondent was asked to imagine that he/she is paying off a mortgage and wins PLN 10.000 in a lottery. If it is assumed that he/she still has to pay off PLN 150.000, the respondent was asked to indicate the way of using the unexpected income, as well as specify whether he/she will use the funds to pay the debt off, or put the money in bank deposit/invest the money or spend it on current expenses. If he/she ticks off the first variant (55% responses), it can be assumed that the option of taking a loan represents a mental burden for him/her, associated with discomfort and the urge to pay it off as soon as possible. Those respondents who decided to make this particular choice can be classified as individuals showing debt aversion.

4. Saving decisions – determinants of the willingness to make saving decisions, advantages and disadvantages

As a result of the CART method application, the sequences of four classification trees were obtained. In the next stage, based on the analysis of a diagram presenting the cross-validation costs level and the level of redistribution costs, at the background of tree complexity, the best two trees were selected (based on the smallest difference between the cost of cross-validation and redistribution). Next, both trees were

[4] The particular categories were determined based on the answers provided to three questions regarding the saving and credit decisions and allowing to evaluate the level of respondents' aversion to indebtedness. A respondent who chose, in all three questions, the response variants allowing to avoid taking a loan presents a very strong aversion to debt (category 3), whereas a person who decided to take a debt in each question did not show any aversion towards indebtedness (category 0).

evaluated in terms of their complexity and also the number and significance of the predictors used in partitioning. The usefulness of the generated rule was also of major significance. Finally, the best classification tree was considered the one characterized by four partitioned nodes and five end ones (Figure 1). In this case the resubstitution cost was 0.25 and the error rate, following 10-fold cross-validation, was 0.26. The ranking of the predictors' significance indicated that debt aversion has the highest impact on the dependent variable (1.00), next in line was having loans (0.36) and the monthly net household income level (0.20).

The risk level indicator and classification tables were used to evaluate the model quality. The risk was estimated at the level of 0.268, which means that the category predictable by the model (the willingness to make saving decisions) is wrong for about 27% of cases (the risk of misclassification). The results collected in the classification table turned out to be convergent with the estimated risk level. The model classified almost 75% of cases correctly and the classification correctness for households willing to make saving decisions exceeded 80%. This demonstrates that the obtained model is well adjusted to the data.

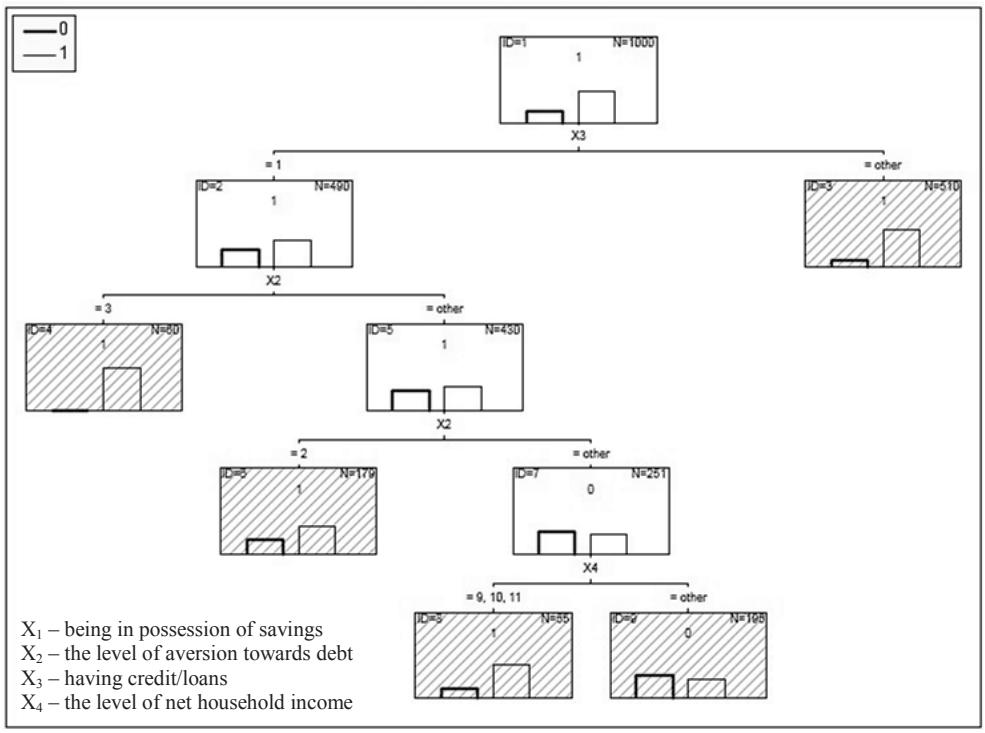

Figure 1. Classification tree – saving decisions

Source: author's compilation.

Moving on to the analysis of data illustrated by the classification tree (Figure 1), attention should be paid to the credit variable (X_3) since it was the first variable which allowed to partition the entire surveyed group into those who represent actual credit holders and those who do not have any credit commitments. It turns out that, regardless of the remaining characteristics, the vast majority of respondents who do not have any actual loans (510 people), made saving decisions – 86%.

On the other hand, the analysis of financial decisions made by those holding credits shows that the aversion to debt (X_2) indicated by respondents is the major differentiation parameter characteristic for this group. The majority of respondents presenting the highest aversion level – 3 and those with 2 aversion level, made saving decisions. In the group of respondents showing the strongest debt aversion only 1 out of 60 did not make saving decisions, whereas in the group of respondents characterized by strong aversion the relevant level was 69%.

In the case of people with weak or no debt aversion, the net level of household income was the main determinant influencing the choices made (X_4). Those who declared their monthly income above PLN 7000 were mainly classified as individuals preferring saving decisions (77.8%). The respondents covered by the other income groups are more willing to make credit decisions (55%).

The fact that those who do not hold any actual credits made saving decisions and thus avoided debts reveals their definite preferences regarding the style of their own budget management. In the case of the hypothetical situations presented in the survey questions, the method of personal finance management turned out to confirm their actual financial behaviour. Placing respondents in hypothetical situations offers the possibility of disclosing their willingness to make savings or taking out a loan owing to the elimination of real factors such as the level of obtained income or creditworthiness.

The dominating form of loan among those presenting debt aversion at level 2 or 3 was credit card debt (68%) and mortgage (24%). As far as the first form of loan is concerned, for many individuals (especially those who repay their debt within an interest free period) using credit cards has become common practice and does not raise major concerns or aversion. A mortgage, on the other hand, is nowadays recognized as an unavoidable form of debt. Nevertheless, those representing the analyzed class, if only such an opportunity arises, prefer to make saving decisions as the primary ones.

The final group of people making saving decisions covers the respondents who already have loans. A low level of debt aversion, or its total absence, eliminates concerns regarding credit commitments. In spite of that, however, in hypothetical situations requiring a financial decision to be made, they decide about their savings management. The level of their income turns out to be the crucial factor here. The respondents declaring the highest net household income level (more than PLN 7000) can afford to make savings without major sacrifices. This is manifested in their lifestyle comfort improvement and higher sense of security.

The individuals presenting a willingness to make saving decisions can thus expect the following advantages:

- as a result of safe and well planned investments, savings allow for multiplying the accumulated capital;
- postponing the sometimes excessive consumption in time allows for life quality improvement in the future, also including the retirement period;
- saving 'for a rainy day' provides a sense of security and allows to cover unpredictable expenses;
- patience and persistence in accumulating financial means is rewarded by the possibility of purchasing a particular good without incurring additional costs associated with a possible credit (the settlement of overall purchase costs is more favourable);
- the accumulated savings can be passed over to children or grandchildren by way of inheritance and thus support them in the future.

The advantages resulting from saving money are very visible in the form of both economic profit – multiplying capital and avoiding additional costs related to servicing a credit, as well as psychological – the sense of security in the future (retirement) and also in cases of unforeseen negative circumstances (e.g. illness).

Additionally, the decisions about saving are not free from disadvantages. A thrifty person reduces their current consumption in favour of the deferred. This may result in a certain discomfort related to the sense of lower life quality and having to make constant sacrifices. Additionally, the individuals making saving decisions have to take into account the deferred purchase of the desired good. A person presenting such a profile also has to be patient since 'making dreams come true' at the moment they appear will turn out to be impossible.

5. Credit decisions − determinants of the willingness to make credit decisions, advantages and disadvantages

The CART method allowed to obtain the sequences of three classification trees of which the best had to be selected. For this reason the analysis of the diagram presenting the cross-validation cost level and the level of redistribution costs against the background of tree complexity was performed and the worst tree was rejected. Next, the remaining models were evaluated in terms of their complexity as well as the number and significance of the predictors used in partitioning. Finally, the classification tree with five partitioned nodes and six end ones (Figure 2) was considered the best. The redistribution cost in its case was 0.30 and the error rate, following 10-fold cross-validation, was 0.33. The conducted ranking of the predictors' significance indicated that the dependent variable (Y_2) is most affected by debt aversion (1.00), followed by the monthly net income of a household (0.70) and being in possession of savings (0.21).

The risk level indicator and classification tables were used to evaluate the model quality. The risk was estimated at the level of 0.35, which means that the category predictable by the model (the willingness to make credit decisions) is wrong in about 35% of cases (the risk of misclassification). The results collected in the classification table turned out to be slightly better against the estimated risk level. The model classified 70% of cases correctly, which demonstrated its sufficient adjustment to the data.

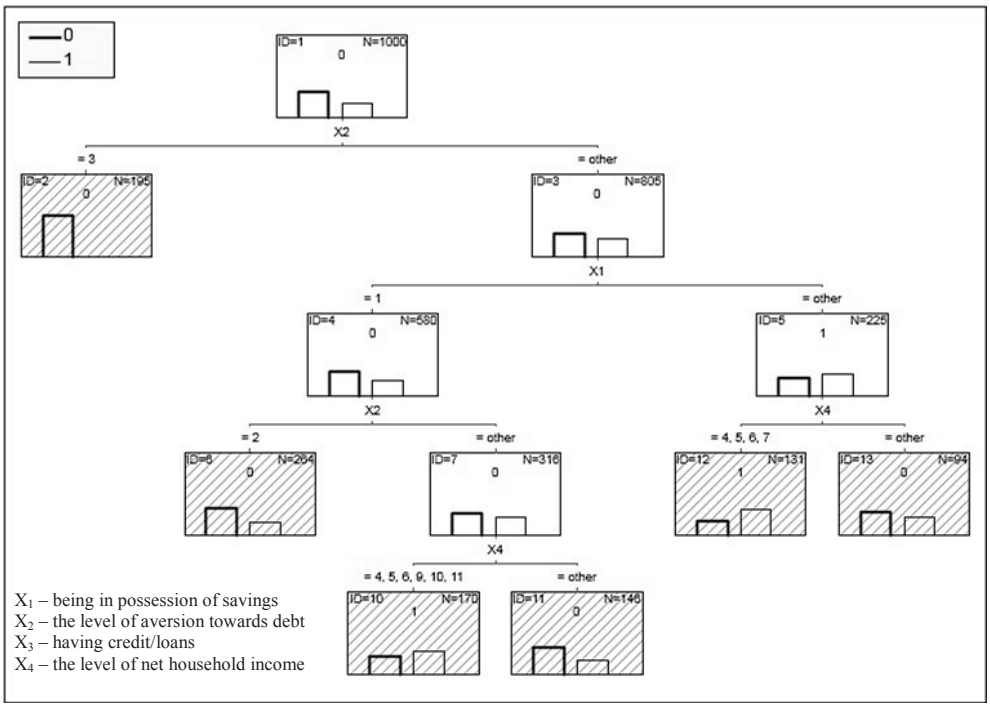

Figure 2. Classification tree – credit decisions

Source: author's compilation.

As the result of the conducted analysis debt aversion (X2), was identified as the parameter exerting the greatest impact on the willingness to make credit decisions. Regardless of the remaining characteristics, the respondents manifesting the highest aversion level (3) were classified as individuals who do not make credit decisions. Therefore, strong debt aversion is of primary significance. This class covered 19.5% of the respondents.

In other cases (aversion lower than 3), the fact of being or not being in possession of savings (X_1) and the level of net monthly income in a household (X_4) represent the differentiating parameters in qualifying an individual to a particular class. The vast

majority of respondents presenting level 2 aversion and being in actual possession of some savings do not make credit-oriented financial decisions (almost 70% of them). However, if they have savings and their aversion level is very low (1), or non-existent (0) the undertaken decision is determined by the income level. The majority of respondents who declared that it is in the range from PLN 2001 to PLN 5000 and more than PLN 7000, make positive credit decisions (about 60%). Those covered by the remaining income groups are much less willing to incur debt (only 30%).

Among the respondents declaring the absence of any savings who do not present the highest debt aversion and declare a monthly net income of their households in the range from PLN 2001 to PLN 6000, credit decisions are made by about 65% of this class members. Those whose monthly net income was either below PLN 2000 or above PLN 6000 avoid taking credits (about 40%).

Based on the conducted analyses, two classes of people making credit decisions were distinguished (illustrated by leaves labelled 1 and meaning success on the classification tree – Figure 2). They differ in terms of both their economic and psychological characteristics.

The first group of individuals taking credit-oriented financial decisions covers respondents characterized by weak aversion or its absence (level 1 and 0), is in the possession of savings and the declared household level of net monthly income ranges between PLN 2001 – PLN 5000 and more than 7000. It seems that the described characteristics clearly determine the respondents' behaviour in both the analyzed decision-making situations. The obtained income allows for the assumption that those individuals are creditworthy and the absence of debt aversion results in the fact that they will make a credit decision in order to carry out their plans.

The second group covers individuals with a strong debt aversion (level 2) who do not have savings, whose monthly net income ranges from PLN 2001 to PLN 6000. Contrary to the first group, the financial behaviour of those individuals is not so obvious and thus encourages discussion. It seems that being far from the highest level of income and the absence of savings accompanied by a relatively strong debt aversion, this should not enhance credit decisions.

The vast majority of those covered by the analyzed group and placed in the situation of having to buy a car (Q1) either financed by a credit or financial means collected to pay for their child education, made positive credit decisions (69%). This proves that the individuals who in fact are not in the possession of savings, if put in the hypothetical situation of having some savings at their disposal, refrained from investing them.

The factor of economic nature can have a decisive influence on the undertaken financial decision. It seems that the level of income earned by the respondents included in the analyzed group, and especially those for whom this level is close to the lower limit of the specified range (about 30%), may become the factor reducing

saving possibilities. The response to the survey question can, however, confirm that these households reveal the need for having savings. Sometimes they follow the misconception that making savings is a luxury and only the richest can afford it.

Having considered the possible impact of the psychological factor, attention should be paid to the occurrence of the mental accounting phenomenon. This term was introduced by R. H. Thaler and means the "set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities" [Thaler 1999, p. 183]. Mental accounting is based on creating special accounts in one's mind. Mental accounts refer to income sources (e.g. regular transfers of salaries vs. bonuses), consumer items (e.g. basic goods vs. luxury goods) and saving patterns (fixed account and interim account) [Gou et al. 2013]. Fixed accounts refer to savings aimed at long-term goals, such as retirement savings, and are characterized by the fact that people are not willing to spend them on current consumption. Savings accumulated to pay for one's children education represent this type of financial means. Hence, as the result of mental accounting people do not invest the savings at their disposal, but rather make a credit decision. Such individuals behave as if money was not substitutive.

The awareness of the benefits and threats represents a crucial factor while making saving or credit-oriented financial decisions. The potential advantages resulting from making credit decisions are as follows:

- speeded up consumption facilitates current life quality improvement, many Poles evaluate their neighbours and friends from the perspective of their possessions, e.g. where they spend their holidays, not paying much attention to the financing sources of such expenditure, since nowadays being indebted is perceived by society as a sort of standard, while several decades ago having debts was synonymous with failure;
- responsible use of a credit card or an overdraft facility allows to improve household budget liquidity;
- credit allows to gain financial means for investment, accumulating which would otherwise be very time consuming;
- having even small bank credits and their timely repayment establishes a positive credit history of an individual and thus increases the probability of obtaining another credit facility.

The potential threats related to adopting such an attitude concentrate around the argument that accelerated consumption incurs credit servicing costs. Their level depends on the credit type and determines the level of debts servicing risk. Debt burden is accompanied by the risk of higher credit costs or the provided collateral loss and, moreover, the risk of excessive debt which can result in financial exclusion. Credit cards allow for carefree spending and additionally their large number results in lower creditworthiness. Individuals without any registered income, or earning it in

the grey economy, those listed in the Credit Information Bureau (CIB) who cannot take advantage of bank credit, become the clients of shadowy banking sector[5] (e.g. Provident). Irresponsible debt management, taking out more loans − frequently to repay the previous loans – results in a debt loop and the drastic deterioration of the quality of life.

On the basis of observations of individual behavior, the researchers have suggested the so-called financial behavior pyramid [Antonides, van Raaij 2003; Pass 1999]. This behavior hierarchy gives information on the rules controlling people's financial behavior. In most cases the basic motive for decision-making is managing the budget and cash. Due to the nature of such activities, managing cash flow is of primary significance.

Only after satisfying such a need as another kind of financial behavior, a process of saving money as a buffer as well as the need for protection against negative events that may occur and may have non-beneficial effects on the financial situation of individuals (traffic accident, sudden illness or job loss), can be noticed. This is the most common type of savings. Relating to saving decisions the prevention motive has core significance (cf. [*Stan wiedzy finansowej*… 2009, Swacha-Lech 2013]). For the researched people the most important thing is to keep their standard of living at the same level. Next, they pay attention to saving money for particular aim (savings aimed to purchase specific goods or credit).

In most cases, only after satisfying the three aforementioned kinds of needs, do the individuals start to manage their wealth. This multiplying wealth process appears to be the most advanced level of financial behavior.

This article analyses the people's examined behavior in hypothetical situations requiring taking a saving or credit decision. In the case of each of the analyzed situations, a stated decision problem could be solved by using savings or credits. People who prefer using their savings and avoiding being in debt at the same time, are those who, on the scale ranging between fear and greed – the two opposing attitudes describing financial behavior − are placed much closer to fear. The decisions of individuals preferring loans are placed a lot closer to the attitude determined by greed, in which the main influence on the choices is effected by short-sightedness and the present-biased preferences.

6. Final remarks

The article presents an analysis of the respondents' behaviour in situations which require making financial decisions of either a saving or credit nature. As a result of the conducted studies it was observed that debt aversion, having loans to repay and

[5] The Financial Stability Board (FSB) defined shadow banking as the "system of credit intermediation which covers units or activities operating outside the regulated banking system" [*Shadow Banking*… 2011].

the level of obtained income represent the major factors determining individual willingness to make saving decisions. In the case of a credit decision, the most significant are debt aversion, monthly net income of a household and having savings.

Additionally, the advantages and disadvantages resulting from the adoption of a particular attitude were discussed. The ability to identify them is indispensable in making an optimal financial decision in particular circumstances. It is worth emphasizing that the personal finance management style is subject to transformations depending on a different life situation and cannot be clearly evaluated as a positive or a negative one. The nature of the threats identified in the article refers to, in particular, the group exposed to risk and made up of people who are not characterized by thriftiness and still present a willingness to make credit decisions. They should be aware of the consequences resulting from the choices made since they carry the risk of debt servicing, excessive indebtedness which, ultimately, can even result in both financial and social exclusion. Therefore the problem of raising financial awareness is becoming particularly crucial here. An important role, in this context, is played by the state and financial institutions. The activities undertaken by the state should concentrate on educating both the youth and adults by teaching them basic skills in personal finance management (school curricula, courses, training) and by organizing social information campaigns. Financial institutions should participate in establishing social financial awareness by means of initiatives as part of the CRS (Corporate Social Responsibility) concept. These can take the form of courses, games, workshops for students of all ages, training and special websites, addressed to adults, presenting issues related to making savings or taking out loans.

Educational initiatives raising financial awareness represent a component of the activities aimed at consumer protection and also covering the construction of adequate legal solutions. It is best when all these activities are carried out simultaneously, since only then do they bring about the best results, not only for particular households but also for the entire financial market. Effective consumer protection, accompanied by substantive financial knowledge, represents the primary condition supporting confidence in the financial market which is indispensable for its stability and sustainable development.

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WYKORZYSTANIE DRZEW KLASYFIKACYJNYCH DO ANALIZY DECYZJI OSZCZĘDNOŚCIOWYCH I KREDYTOWYCH GOSPODARSTW DOMOWYCH

Streszczenie: W opracowaniu dokonano analizy zachowań osób fizycznych postawionych w sytuacjach wymagających podjęcia decyzji oszczędnościowych lub kredytowych. Celem artykułu stała się identyfikacja czynników determinujących wybór danej opcji oraz wskazanie korzyści i wad płynących z przyjęcia określonej postawy. Wykorzystane metody badawcze to: metoda CART (*Classification and Regression Trees*) i metoda opisowa. Dane empiryczne pochodzą z badań ankietowych zrealizowanych metodą CAWI (*Computer Assisted Web Interview*) na próbie 1000 Polaków. Uzyskane wyniki wskazują, że awersja do zadłużania się, posiadanie kredytów i poziom osiąganych dochodów to główne czynniki determinujące skłonność jednostek do podejmowania decyzji oszczędnościowych. W przypadku decyzji kredytowych największe znaczenie mają: poziom awersji do zadłużania się, miesięczna wysokość dochodów netto gospodarstwa domowego i posiadanie oszczędności.

Słowa kluczowe: finanse osobiste, drzewa klasyfikacyjne i regresyjne, decyzje finansowe, kredyty, oszczędności.