# RATIONAL CHOICE THEORY AND ADDICTION BEHAVIOR

## TEORIJA RACIONALNOG IZBORA I OVISNIČKO PONAŠANJE

TRŽIŠTE

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**Ključne riječi**:

*teorija racionalnog izbora, koeficijent averzije prema riziku, stopa preferencije prema vremenu, teorija racionalne ovisnosti, ovisnost o nikotinu*

**Key words**:

*rational choice theory, risk aversion coefficient, time preference rate, theory of rational addiction, nicotine addiction.*

### SAŽETAK

Teorija racionalnog izbora pretpostavlja da se pri odlučivanju o konzumaciji ili nekonzumaciji određenih proizvoda potrošači koriste analizom radi procjene vrijednosti individualnih pokazatelja preferencija. Iz te perspektive postoje preferencije vezane uz rizik i vrijeme. Prve pokazuju averziju prema riziku i izražavaju se koeficijentom averzije prema riziku, dok druge mjere stupanj preferencije za sadašnje zadovoljstvo u odnosu prema istom zadovoljstvu u budućnosti. Stupanj preferencije za sadašnje zadovoljstvo u odnosu na isto zadovoljstvo u budućnosti izražen je stopom preferencije vremena. Od pušača koji pokazuju nisku stopu preferencije prema vremenu i visoku stopu razine koeficijenta averzije može se očekivati uspješnost u prestanku pušenja. Cilj je rada proučavanje pušača iz perspektive teorije racionalnog izbora kako bi se otkrili čimbenici

### ABSTRACT

The rational choice theory assumes that, when deciding whether to consume some goods or not, consumers use analysis in order to estimate the values of individual preference indicators. From this point of view, there are risk and time preferences. The former show aversion to a risk and are expressed through the risk aversion co-efficient, while the latter measure the degree of preference for present satisfaction in relation to the same satisfaction in the future. The degree of preference for present satisfaction regarding the same satisfaction in the future is expressed by the time preference rate. Smokers with a low time preference rate and high risk aversion coefficient level can be expected to be successful in cessation. The aim of this paper is to study smokers from the perspective of rational choice theory, in order to detect factors influencing their

koji utječu na njihovo ponašanje. Istraživanjem je ustanovljeno da su značajni čimbenici ponašanja pušača sljedeći: spol, dob, obrazovanje, koeficijent averzije prema riziku i stopa vremenske preferencije. Analiza ponašanja pušača, uz uvažavanje odgovarajućih ograničenja i mogućnosti, dobro je razvijen alat za istraživanje i interpretaciju stvarnosti.

behavior. The study (investigation) found that the significant factors for smokers' behavior are: gender, age, education, risk aversion coefficient, and the time preference rate. Analysis of smokers' behavior, with appropriate limits and qualifications, is a well-developed and highly effective tool for exploring and interpreting reality.

# 1. INTRODUCTION

For a long time, it was believed that economic analysis should only be applied to economic phenomena – to the factors of production and their allocation, explicit markets, factors income, their distribution, and consumption. Everything else was outside the explanatory domain of rational choice theory (Begović, 2004, p. 76).

For a long time, the analysis of addictive behavior was reserved for other non-economic sciences, primarily sociology and psychology. The usual sociological standpoint is that addictive behavior should be treated as unwise, compulsive, destructive, and, of course, irrational. However, for the proponents of rational choice theory, addictive behavior is just like any other economic behavior – economically rational (Tomer, 2001, p. 243).

This paper has two main purposes. The first is to explain why addictive behavior is not rational. The other is to develop a socio-economic model of addictive behavior as an alternative to the economic theory of rational addiction.

Explanations and models applicable to economic concepts are developed based on the knowledge of a variety of behavioral disciplines, especially psychology. The appropriate structure presented in this paper was made in the hope that this interdisciplinary approach would help us see addiction behavior in its true light. The structure of this paper is as follows. Section Two reviews the basic features of rational choice theory. Section Three introduces the concept of addiction in the theory of rational addiction. Section Four explains the socio-economic model of addictive behavior. Section Five is devoted to the reconsideration of basic rational choice assumptions, which include the results of research studies and the statistical testing. The closing section of this paper focuses on the analysis of smokers' preferences with the aim of discovering some new facts about human behavior.

# 2. RATIONAL CHOICE THEORY

The perception of limited resources as a universal property of economic activities, and subjective evaluations of benefits and investments has turned the economic science into practical guidelines that require people to follow rational economic behavior. Similar to all other sciences, economics provides various interpretations of rational economic behavior and, on the basis of these findings, forms conclusions, depending on the theoretical prism through which it observes facts linked to the adoption and enforcement of rational economic decisions.

Until the 20th century, there had been a relatively small number of theories of rational decision-making. This changed radically in the 20th century, when the first models of rational behavior emerged, first in the theory of operational research and then in rational choice theory. Rational choice theory concerns rational human behavior. In rational choice theory, the principle of rationality is characterized by subjectivity and constraint. The following is a brief description of subjectivity as a universal characteristic of rationality.

In comparison with the neoclassical direction, rational choice theory fundamentally changed the paradigm of rationality. Rational choice theorists renounced the useless "demarcation" between rationality and irrationality and focused on the subjective determination of rationality. If children prefer to watch TV instead of studying, they act subjectively and rationally, although they might have a different opinion in 10 years' time (Šveri, 1997, p. 40).

For Downs, all activity actors are target oriented and always rational. "The monk deliberately chooses as his target the achievement of the state of mythical perception of objective reality. To accomplish that, one needs to free one's mind of all logical thoughts and conscious goal setting. From an economic point of view, this liberation is completely rational, though it can be

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treated as irrational and ultimately too irrational from the perspective of some non-economic definitions of rationality" (Downs, 1957, p. 5).

In order to discover the rules that people use in their rational economic behavior, neoclassical theory does not pay enough attention to some important elements and, thus, has two fundamental shortcomings. Firstly, it assumes that expenditure to obtain information equals zero or nearly zero. Secondly, neoclassical theory ignores legal transaction costs. Famous philosophers, such as Max Weber (1978) and Joseph A. Schumpeter, presumably did not pay attention to such considerations. According to Weber's typology (Šveri, 1997, p. 40), only conscious focus on the ultimate goal and conscious choice of the means of its realization are considered to be rational. Therefore, he makes a distinction between "traditionally rational" behavior (stimulated by rationally selected goals that are realized by rational means) on the one hand, and "traditionally irrational" behavior (that is based on habit and routine) and "affective behavior" (that is caused by affects and emotions) on the other hand (Stojanović 2007, p. 134). Nevertheless, both "traditionally irrational" behavior and partly "affective behavior" can be rational (Weber, 1978, p. 24).

If the analysis includes time constraints, it becomes clear that, in some trivial situations, it is often more rational to make a decision immediately, and then to behave irrationally if there is no reason for rational behavior. No matter whether we talk about eating with a fork and knife or with chopsticks, combing our hair or tidying our room in the morning, these are all cases where traditional behavior is rational. Just as Weber (1978), Schumpeter remained doubtful regarding the principle of rationality. For example, Schumpeter made regular use of the term "field of rationality" to explain entrepreneurs' behavior. However, he did not pay attention to terms such as "rationality" in the circumstances in which information may be incomplete and behavior irrational and variable (Šveri, 1997, p. 40).

Rational choice theory resolved all rationality definition flaws and brought the rationality prin-

ciple to its logical end, recognizing the important role that time, transaction costs, and other factors have in everyday life.

Carl Menger, John R. Commons, Ronald H. Coase and Friedrich A. Hayek were the first to include transaction costs in economic analysis (Šveri, 1997, p. 43). In addition, Frank Knight and John M. Keynes analyzed some aspects of uncertainty (Knight, 2002, p. 50). Herbert A. Simon (1957) was the first to formulate the general principle of bounded rationality that is applicable to all social sciences. He strongly denied the unrealistic assumptions of neoclassicists and elaborated on the concept of rationality in conditions of uncertainty and the abnormal distribution of information (Simon, 1957, p. 279).

The next important step was made by George J. Stigler (1961). According to Stigler, a subject (consciously or unconsciously) maximizes the amount of information collected, so the ultimate gain of additional information equals its final expenditure (Stigler, 1961, p. 69). In "A Treatise on the Family", Gary S. Becker (1991) concluded that collecting information about potential partners stops when marginal costs equal marginal revenue (Becker, 1991, p. 325).

Simon, Stigler and Becker's research showed that theorists of rational choices had reviewed different spheres of social life on which they focused their attention, on the assumption of limited resources (Šveri, 1997, p. 43). In order to better understand the limitation factors, we can rely on Williamson's interpretation of rationality. Williamson distinguishes three levels of rationality (Williamson, 2006, p. 40):

o In the narrow sense, rationality is defined as a purposeful activity of the subject focused on the realization of goals that are consistent with its internal hierarchy of preferences. Such goal realization ensures the stakeholders' maximum benefit level. Therefore, in the narrow sense, rationality is also referred to in literature as the principle of maximization. The most important representatives of this rationality are

neoclassicists and supporters of the Chicago School.

o Rationality can also be formulated in a less strict form. The most consistent advocate of this form of rationality is Simon (Williamson, 2006, p. 41). He notes that we do not have a lifetime to spend on decision-making, so people generally do not maximize, but determine the level of personal satisfaction.

o Rationality can be observed in an organic form. We can consider the example of the conception of "an invisible hand". After Adam Smith, the organic schools and different evolutionary directions actively represented the organic form of this rationality. From the perspective of organic rationality, the maximization of individual and collective satisfaction is realized by trial and error (Williamson, 2006, p. 42). Such a view is based on the belief that personal and social rationality can be improved by developing a culture of individualism and market behavior of all members of social classes (Josifidis & Lošonc, 2012).

The first and the third principle of rationality are very similar, and a famous French proverb aptly applies to them – "extremes touch each other" ("les extremes se touchent"). In contemporary literature devoted to rational choice, organic and strict forms of rationality always coexist side by side.

# 3. THEORY OF RATIONAL ADDICTION

Most of us think of addictive behavior as unwise, excessive, overindulgent, compulsive, destructive, and, of course, irrational. In examining addiction behavior, crucial unnecessary desires have a crucial (decisive) role (Ruden, 1997, p. 105). In the throes of unnecessary desires, people are not able to consider information, consult their preferences, and make decisions that are in their best interests. These people can be rational when excessive desires are not present.

Daniel Kahneman's work has taken into account the following reasons for addiction behavior. The first is the loss of aversion, when losses loom larger than corresponding gains (Kahneman, 1994, p. 22). The second involves framing effects, which show that equivalent lotteries presented in different ways are valued differently (Kahneman, 1994, p. 22). Kahneman also finds evidence that addicts have 1) an inability to accurately predict their future utility from using goods, 2) an inability to predict changes in their tastes, and 3) an inability to accurately evaluate how much utility they have gained from one experience (Kahneman, 1994, pp. 22-32). In addition, it is believed that there would be greater inefficiency in the consumption of addictive goods than in the consumption of food supplies.

The broader message of previous analysis of rational addiction suggests that addicts are something more than the standard rational economic man. In order to better understand what addiction is to people, it is necessary to have a broader and quite different approach to economic behavior.

# 4. SOCIO-ECONOMIC MODEL OF ADDICTION BEHAVIOR

Noting the important appearances and discarding less important features in a given context, the model demonstrates the importance of different types of capital (personal, social and consumer) to make and implement decisions about the consumption of addictive goods.

## 4.1. Personal capital

The core of the socio-economic model of addictive behavior is the idea that addiction is characterized by a significant internal imbalance that will affect one's ability to perfect oneself and the environment. When the degree of internal imbalance exceeds a certain limit, and the individual finds an addictive good to which a person is bound in order to restore a sense of balance and control, it is

likely that their personality will change under the influence of the consumption of psychoactive substances. In the fifties, the professional journals of Western Europe and North America began to publish the results of case-control studies, which indicated a higher level of distress in the academic population. A high level of psychoactive substance abuse was later identified in these young subjects. This can explain why the young experiment with substances that can cause addiction in the long term, without thinking about the dangerous possibility of becoming addicts.

According to Daniel J. Goleman, different patterns of addictive behavior lead to the consumption of various substances (Goleman, 1994, pp. 254-255). There are two types of alcoholics. Chronically high levels of anxiety were observed in the first type. The other involved a high level of agitation, impulsiveness and apathy. People with this pattern of behavior turn to alcohol to escape their fears and slight agitation. Such emotional and spiritual imbalances and other types of internal imbalances can cause addiction. These include: lack of proper nutrition, excessive levels of histamine etc.

## 4.2. Social capital

Social capital, in the form of a tangle of social connections and relationships, is not something that is given and which exists independently of our will, but it is rather a product of conscious human behavior (individual or collective), that is directed towards establishing or reproducing social relationships that individuals and groups can use in order to achieve goals (Bourdieu, 2012, p. 251). A special dimension of interpersonal relationships is made of instrumental and social choices. Instrumental choices are characterized by respect for people and their abilities. Social choices are motivated by one's desire to help people in need (Sokolovska, 2011, p. 226).

In their theoretical and empirical studies of nicotine dependence, Sandra Japuntich, Adam M. Leventhal, Megan E. Piper, Daniel M. Bolt, Linda J. Rob-

erts, Michael C. Fiore, and Timothy B. Baker (2011) dealt extensively with the impact of social capital in social networks (or groups) on smoking cessation. They discovered that it was less likely for those participants who had a higher proportion of smokers in their social network to abstain during a six-month follow-up period. Moreover, there was a higher lapse risk (Japuntich et al., 2011, p. 290).

## 4.3. Consumer capital

George J. Stigler and Gary S. Becker (1977) proposed the theory of rational addiction, which was improved by Gary S. Becker and Kevin M. Murphy (1988). In this theory, "a person is potentially addicted to [some good] *c* if an increase in his current consumption of *c* increases his future consumption of *c*" (Green, 2002, p. 28). The key feature of these models is that the utility of the consumer at any given time depends not only on consumption in the period but also on "consumption capital". Consumer capital is, basically, the consumer's ability to enjoy a certain good, which crucially depends on previous consumption, and perhaps some other factors.

If previous consumption increases the ongoing ability to enjoy, the addiction is *beneficial*. For example, this may be the case with listening to classical music. Scientific research shows that listening to classical music has a positive effect on the ability to enjoy it (Green, 2002, p. 29). If previous consumption reduces the ongoing ability to enjoy, then the addiction is *harmful*. This is the case with substances like heroin and other substances that are usually thought to be addictive. If the consumption of heroin is higher in the present, the enjoyment of any quantity of the substance will be less in the future.

## 5. STUDY OF NICOTINE ADDICTION

The aim of this research is to find, on the basis of collected data, whether economic, demo-

graphic and contextual variables can influence smoking cessation. By using a mathematical model, we had the special intention to determine whether current smokers are more rational than ex-smokers.

The model of rational choice assumes that, when deciding whether to smoke cigarettes or not, people use analysis in order to estimate the indicator values of individual preferences. From that perspective, there are risk and time preferences. The former shows aversion to a risk and is expressed through the coefficient of risk aversion (indicator of risk preferences). For the higher coefficient of risk aversion, risk aversion is greater. The latter measures the degree of preference for present satisfaction in relation to the same satisfaction in the future (Stojanović, 2010, p. 68). The degree of preference for present satisfaction regarding the same satisfaction in the future is expressed as the rate of time preference.

In order to determine the risk aversion coefficient and the time preference rate of the respondents, we used Ida and Goto's list of alternatives for the measurement of risk and time preferences (Ida, Goto, Takahashi & Nishimura, 2008, p. 6):

Alternative 1: Reward: 100,000 Winning probability: 100%, Time delay: Now
Alternative 2: Reward: 150,000 Winning probability: 90%, Time delay: One month
Alternative 3: Reward: 200,000 Winning probability: 80%, Time delay: Six months
Alternative 4: Reward: 250,000 Winning probability: 60%, Time delay: One year
Alternative 5: Reward: 300,000 Winning probability: 40%, Time delay: Five years

The risk aversion coefficient equals winning probability. The time delay is used to determine the time preference rate. If the 100,000 reward that the individual gets for a year is worth 250,000 (Alternative 4), the time preference rate will be 150% in this case (Miki, Yokoyama, Sumitani, Kusaka, Warita, Matsumoto, Wang, Wilce, Bedi, Itoh, & Takeuchi, 2008).

Besides the list of alternatives for the measurement of risk and time preferences, Ida and Goto's work emphasized the connection between the risk aversion coefficient and the time preference rate on the one hand, and successful cessation at the initial and final phases of the study on the other (Ida et al., 2008, p. 4). In both phases, smokers used the same technique to quit smoking and filled in a questionnaire that, among other things, contained a conjoint analysis to measure the risk aversion coefficient and the time preference rate. Results showed that there are two groups of respondents (smokers): 1) respondents with a high risk coefficient and a low time preference rate and 2) respondents with a low risk aversion coefficient and a high time preference rate. In the initial phase of the study, persons successful in quitting had a greater risk aversion (higher risk aversion coefficient). In the final phase, the same persons were more patient (lower time preference rate) and had a higher aversion to risk than persons who failed to quit. Therefore, the results of Ida and Goto's research clearly indicated that we can predict a successful cessation on the basis of the risk aversion coefficient and the time preference rate (Ida et al., 2008, p. 4). Japanese scientists also discovered that people successful in quitting became more patient between the initial and final phases of the study and that people who failed to quit became more impatient. We can expect that smokers who have achieved a low time preference rate and a high level of the risk aversion coefficient will be successful in cessation. All this suggests that these parameters are not only important predictors for successful cessation, but also factors of individual rationality.

Taking into account these findings, the rational choice model assumes that people will use the risk aversion coefficient and the time preference rate to calculate the utility of alternatives. Let the utility of alternative *i* be *Vi*. In the rational choice model, the utility of the alternative is calculated on the basis of the equation of discounted and expected utility (Ida et al., 2008, p.7-8):

Discounted utility:
$$\exp(-TIME*\text{timedelay}_i)*\text{utility}(\text{reward}_i), \qquad (1)$$

where parameter *TIME* denotes the time preference rate.

Expected utility:
$$probability_i * utility(reward_i). \qquad (2)$$

Accordingly, rewriting *Vi*, we obtain:
$$Vi\ (reward_i, probability_i, timedelay_i) =$$
$$= \exp(TIME*timedelay_i) * probability_i *$$
$$* utility(reward_i). \qquad (3)$$

At this point, we simply specify the functional form of utility as the *RISK*-th power of reward. Such a utility function is called the constant relatively risk-averse form, where the coefficient of the relative risk aversion is denoted by 1-*RISK*. By taking logarithms of both sides, we obtain:

$$\ln Vi\ (reward_i, probability_i, timedelay_i) =$$
$$= -TIME*timedelay_i + \ln probability_i +$$
$$+ RISK*\ln reward_i. \qquad (4)$$

Formula (4) was used in the survey to measure the net utility or rationality of current and former smokers.

Although the mathematical rational choice model is principally distinguished by its greater clarity and consistency than other techniques in social sciences, the rational choice model is to a certain extent "deficient" when it comes to conveying all of the complexity of reality. This model lacks analysis of the impact of nicotine dependence and demographic and contextual variables on smokers. Sandra Japuntich and her colleagues analyzed the effects of these factors on the behavior of smokers (Japuntich et al., 2011, p. 286).

Daily smoking data was collected with a smoking calendar using timeline follow-back. The maximum amount of time for recall was six weeks. Seven-day point-prevalence abstinence was assessed during a six-month follow-up call, and biochemically confirmed (Japuntich et al., 2011, p. 287). The three milestone variables were computed using smoking calendar data: 1) the initial abstinence variable, 2) the lapse variable, and 3) the relapse variable. The initial abstinence variable indicated whether participants reported smoking zero cigarettes on at least one day in the first 14 days of the study. The lapse variable, coded for those who achieved initial abstinence, was the number of days between the first day when participants smoked zero cigarettes, and the first day when they smoked any amount (Japuntich et al., 2011, p. 287). Finally, the relapse variable, computed for participants who lapsed, was smoking. If participants did not reach a milestone (e.g., lapse/relapse), their milestone variable indicated the number of days from their last milestone until the end of the follow-up (Japuntich et al., 2011, p. 289). If they withdrew from the study before reaching a milestone, their milestone variable indicated the number of days from their last milestone until their withdrawal date.

Besides nicotine addiction, the survey conducted by Sandra Japuntich et al. (2011) found that demographic and contextual variables were significant predictors of short-term and initial abstinence, lapse and lapse-relapse transition. The results also showed that contextual and demographic variables tend to reduce initial abstinence probability.

## 5.1. Research hypotheses

Following the theoretical framework, five hypotheses were set, as follows:

**Hypothesis 1**: Persons successful in smoking cessation have a greater risk aversion coefficient than persons unsuccessful in smoking cessation.
**Hypothesis 2**: Persons successful in smoking cessation have a lower time preference rate than persons unsuccessful in smoking cessation.
**Hypothesis 3**: Ex-smokers are more rational than current smokers.
**Hypothesis 4**: Middle-aged smokers have the highest daily consumption of cigarettes, and they will be the most motivated to quit smoking.
**Hypothesis 5**: Women stop smoking to the same extent as men do.

For the purposes of this research, we selected: two economics variables, three demographic variables and one contextual variable (economic variables: time preference rate, risk aversion coefficient; demographic variables: gender, education, age; contextual variable: daily smoking). The variables used in this research can be conditionally divided into independent and dependent ones.

Independent: smoking cessation with two categories (current smokers or persons who have not quit smoking and ex-smokers or persons successful in smoking cessation, or nonsmokers), age (the young, the middle-aged and the elderly), sex (male and female).

Dependent: risk aversion coefficient, time preference rate, rationality (net utility), cigarettes per day.

## 5.2. Research instruments

For the analysis of the relationships between these variables and smoking cessation, we used the following instruments: questionnaire, Fagerstrom's Test for Nicotine Dependence and the rational choice model.

The questionnaire has 23 questions. Most questions (14) are closed questions (multiple choice questions). Questions asked at the beginning of the questionnaire (the first seven) concern the personal data of respondents. The following 16 are asked in order to discover: the smoking habits of the respondents, their knowledge about tobacco and its harmful effects, and if they have direct experience with some of tobacco's harmful effects.

In order to provide the information base for the questionnaire, we used the following research studies: 1) Japuntich et al. (2011), "Smoker Characteristics and Smoking-Cessation Milestones", 2) Ida et al. (2008), "Can Economic-Psychological Parameters Predict Successful Smoking Cessation?" and 3) Marković-Denčić, Knežević, Radović, Kisin and Šeparović (2007), "Smoking Prevalence in the Institute of Public Health in Serbia".

Parts of the research conducted by S. Japuntich et al. (2011) which we applied in our paper are: Smoking-Cessation Milestones, Risk Factors for Cessation Failure, and Predicted Relationships. We used the results of Ida and Goto's research on the correlation between economic parameters and successful cessation to measure the utility or rationality of the participants. In preparing the questionnaire, we also used the paper written by Ljiljana Marković-Denčić et al., which examined the following characteristics of smokers: the period of smoking, passive smoking in the family and the workplace, and the desire to quit smoking.

In order to check whether the questions in the questionnaire were clear, we conducted a pilot piece of research showing that respondents had understood the questions and responded in a proper way.

Fagerström's Test of Nicotine Dependence measures the degree of nicotine dependence. It consists of six questions. The maximum number of points is 10 (Table 1).

**Table 1:** Level of dependence on nicotine

| Results on Fagerström's Test of Nicotine Dependence | The level of dependence on nicotine |
|---|---|
| 0-2 | Very low dependence |
| 3-4 | Low dependence |
| 5 | Medium dependence |
| 6-7 | High dependence |
| 8-10 | Very high dependence |

The core of the rational choice model consists of the risk aversion coefficient and the time preference rate. The risk aversion coefficient negatively depends on the time preference rate (Figure 1). If a respondent with a high risk aversion coefficient chooses alternative 1 from the list of alternatives to measure risk and time preferences (the risk aversion coefficient is 100%), they will be rewarded at the same moment (the time preference rate is 0%).

**Figure 1:** Inverse proportion between the risk aversion coefficient and the time preference rate



Time preference rate

Risk aversion coefficient
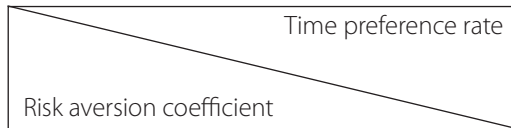
The results of Ida and Goto's research clearly indicated that individuals successful in smoking cessation were more patient than those who failed to achieve smoking cessation (Ida et al., 2008, p. 11). This means that individuals successful in smoking cessation exhibit higher values of the risk aversion coefficient. Therefore, since the risk aversion coefficient negatively depends on the time preference rate, it can be concluded that individuals successful in smoking cessation have a lower time preference rate. Thus, the time preference rate is an indicator of patience or impatience. The higher it is, the higher a smoker's impatience is.

In order to obtain a more realistic picture of the weight of variables, we prepared databases and performed factor analysis of variance (ANOVA) in the SPSS (computer program used for statistical analysis).

## 5.3. Sample

The sample consists of 487 respondents, who are citizens of the city of Niš, Republic of Serbia. We surveyed current smokers and non-smokers – former smokers. The research was carried out during the period from April to July 2013.

The key steps in the formation of a simple random sample are:

o Defining the population (large set). The subject of this research is the smoking habits of the population of Brzi Brod (Medijana municipality, the city of Niš). We performed the research on subjects or respondents who live in Brzi Brod. There are 4,462 of these respondents, according to the Statistical Office of the Republic of Serbia – Department for Statistics in Niš (2,136 men and 2,162 women).

o Selecting or deciding on the sample frame. We used a telephone survey to find out about the smoking habits of the residents, which enabled us to exclude from the database all those who did not meet the selection criteria for the sample, specifically, all the residents of Brzi Brod who had never smoked. To define the sample frame, we used: a list of the population of Brzi Brod (made by the local office of Brzi Brod) and the 2011 Census Book. The sample frame consists of all of those who declared themselves (in the telephone survey) to be smokers or ex-smokers (a total of 3,231 or 72.4% of the population of Brzi Brod).

o Selecting the simple size. Given the circumstances (time and costs), we elected 15% as the sample, giving a sample size of 487. Accordingly, the probability of being included in the sample or choice rate was 487/3,231.

The demographic and contextual characteristics of the respondents in the sample are shown in Table 2.

**Table 2:** Demographics and descriptive statistics

| Measure Total | Total | % |
|---|---|---|
| **Gender** | | |
| **Female** | 44.8 | 218 |
| **Male** | 55.2 | 269 |
| **Education** | | |
| **<High school** | 3.0 | 15 |
| **High school** | 57.0 | 277 |
| **College** | 40.0 | 195 |
| **Marital status** | | |
| **Partner/widowed** | 3.5 | 17 |
| **Married/cohabiting** | 45.9 | 224 |
| **Divorced/separated** | 5.8 | 28 |
| **Never married** | 44.8 | 218 |
| **Age** | $39.5^x (15.4)^y$ | |
| **FTND** | $4.2^x (2.7)^y$ | |
| **Time preference rate** | $46.7^x (60.6)^y$ | |
| **Risk aversion coefficient** | $88.1^x (17.2)^y$ | |

$^x$ arithmetic mean
$^y$ standard deviation

The results of the Fagerström Test for Nicotine Dependence show a low degree of dependence among the respondents. The average degree of nicotine dependence in the sample was 3.93. The same indicator was 3.7 for persons successful in smoking cessation and 4.2 for persons unsuccessful in smoking cessation. People successful in smoking cessation (persons with a low degree of nicotine dependence) thought that they could quit smoking at any moment (Ida et al., 2008, p. 6), and they were more patient than people with a higher level nicotine dependence (individuals who had not quit smoking). Their time preference rate was 37%. On the other hand, the time preference rate for smokers with higher levels of nicotine dependence, who had obviously become physical and mental addicts, was 57% (Ida et al., 2008, p. 6). To be precise, patience awards a higher risk aversion coefficient to people with lower levels of nicotine dependence. The risk aversion coefficient for people with low levels of nicotine dependence was 88%. The risk aversion coefficient for those with a high degree of nicotine dependence was 84%. The risk aversion coefficient in the sample was 86%.

## 5.4. Analysis of results

We employed the analysis of variance or ANOVA to study the effect of quitting (the number of days without cigarettes) on the risk aversion coefficient and the time preference rate. According to the number of days without cigarettes, subjects were divided into five groups (group 1: 30 days; group 2: from 31 to 90 days, group 3: 91 to 180 days; group 4: 180 days or more; group 5: no attempt to quit).

The hypothesis that persons successful in smoking cessation are more risk-averse than persons unsuccessful in smoking cessation (Hypothesis 1) was confirmed. In other words, a statistically significant difference was identified, at $p < 0.05$ LOT results of group: $F_{(4, 482)} = 4.613$, $p = 0.013$. Results of Tykey's HSD test showed that the mean value of group 4 (M = 93, 0435, SD = 12.22322)

was significantly different from the mean value of group 5 (M = 85.6098, SD = 18.33339).

The results of the analysis of variance also show that persons who had quit smoking exhibited greater patience than persons unsuccessful in smoking cessation (Hypothesis 2 was confirmed). When considered more closely, the mean value of group 3 (M = 70 0000, SD = 4,472,136) is significantly different from the mean value of group 5 (M = 59.7561, SD = 7,001,742)[1]. The other groups do not differ significantly from groups 3 or 5.

The hypothesis related to the middle-aged and smoking was confirmed by the results of the research (Hypothesis 3 was confirmed). The diagram of the mean values (the product of ANOVA in SPSS) shows that the group of 30-44 years olds exhibited the highest daily smoking (Figure 2). On the other hand, it was middle-aged smokers who had a greater milestone rate, or a larger number of attempts at smoking cessation.

**Figure 2:** Diagram of the mean values of the results obtained by the age group analysis
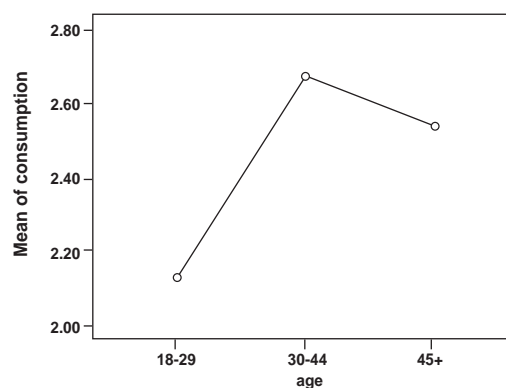


It was found that women stopped smoking to the same extent as men did. The results of this research showed that women make up 48.5% of the people who stopped smoking and 45.8% of the people who failed to quit. Similarly, Japuntich and associates' research detected that women stopped smoking to the same extent as men did, but it was more likely that women, after initial abstinence, would re-light a cigarette, and then intensify consumption (Japuntich et al., 2011, p. 291).

The hypothesis that refers to the connection between the success in quitting and the rational behavior of participants (smokers and ex-smokers) was not confirmed. Those who were either successful or unsuccessful in quitting smoking were not significantly different in statistical terms when it came to rational behavior. Having considered the nicotine dependence and economic variables, it was found that, out of a total of 487 participants, 364 (75% of current and former smokers) preferred safe profit or the alternative of the losing probability (see the list of alternatives on page 12). The average value of the risk aversion coefficient in the sample was 86%. All this suggests that rational behavior is not correlated with smoking behavior.

A broader analysis of the demographic characteristics of smokers indicates that highly educated individuals were more likely to abstain during the six-month follow-up period, to achieve initial abstinence, and to have a lower risk of regression than those without a high level of education (Japuntich et al., 2011, p. 289).

Confirmation of this finding can be found in Harris and Harris's papers. As a higher level of education provides higher income and generally increases the efficiency consumption of all goods, Harris and Harris (1996) believe that an increase in wages (which can be understood as the result of a higher level of education) will provide a greater incentive to quit smoking in the future. The results of Harris and Harris's research of the bad (smoking) habits of Maryland residents showed that highly educated smokers had a strong and reasonable need for smoking cessation, since they found motivation in the pursuit of profit maximization, and the irrational spending of money on tobacco certainly was not the way to achieve that goal (Harris & Harris, 1996, p. 616).

Arthur M. Jones (1994) concluded that successful cessation is concentrated among members of high social classes who are highly educated. The fact that self-control assumptions for explaining smoking cessation are better than assumptions of rational behavior also emerges from Jones's analysis (Jones, 1994, p. 101).

## 5.5. Limitations and future research

The discrepancy between some results of the research and reality can be explained by the research methodology to a large extent.

o For the study, we used a sample that includes residents of only one district in Niš, and not all of them. Furthermore, it is recommended that research include a larger number of respondents in order for the results to be more representative (Ozretić Došen, Krupka & Škare, 2011, p. 183).

o The limitation of this research is that contextual variables were measured via retrospective questionnaires. Therefore, in order to promote the appropriate scientific response to the challenges of the global epidemic of smoking, we may propose the application of methods for data collection in real time. Future research could use these methods to examine whether stronger relationships are found between rationality and milestones when economics and demographic variables are measured in real time.

o It is not possible to control the mixed (confusing) effects of unknown variables. Examples of confusing variables which can potentially affect the results of the research are: the exposure of the subject to other professional agents that increase the risk of smoking, the reduction in personal income due to reduced productivity and more frequent use of sick leave, as well as fire or explosion caused by unquenched cigarettes (Krstev, 2007, p. 11).

o All research of economic rationality must necessarily, in one way or another, face three fundamental and interdependent problems.

o What goals do the participants prefer? In other words, do the participants prefer the goals of pro-individual orientation or the goals of pro-social orientation?

o According to rational choice theory, the goals of pro-individual orientation build the instrumental rationality model, while the goals of pro-social orientation build the model of the values or expressive rationality. If the partici-

pants prefer the goals of pro-individual orientation, then the instrumental rationality model better explains the behavior of the respondents. Otherwise, the model of values or expressive rationality more satisfyingly expresses market participants' behavior.

o Is there a connection between the goals and what is the nature of these relationships?

o Which scale do we use? In other words, should the goals of pro-individual and pro-social orientation be measured with the interval and relational scale that enables the application of all the statistical methods of analysis, or should the analyzed characteristics of the subject be measured with the nominal and ordinal scale that enables the application of certain statistical techniques in a more efficient manner?

o In the explanation of the factors that influence smoking, the time dimension is excluded (observed in the physical, Newtonian sense), and the fact that all activities take place in time is ignored. In this way it is implicitly assumed that all the actions of market participants take place at once.

In order to get a better insight into the role that time has in the decision-making process, it is necessary to analyze the behavior of smokers in the initial and final phases of the research.

o The rational choice model excludes the intuition and irrational thinking that economic agents have when trying to design the future from analysis. Although the application of the rational choice model provides a clearer and more complex understanding of reality, the effectiveness of the presentation content elements still require a minimum of mathematical methods.

In applied contexts, mathematics is not a goal per se. It is only a means to efficient processing of relevant data.

# 6. CONCLUSION

Few concepts have caused such interest in economic science in recent years as that of rational behavior. For a relatively long time, the scope of the economic approach was limited to the market and the analysis of rationality, which was understood as utility maximization, and was focused on production factors and their allocation. Preferences, technology and resources were taken as they are, and the impact of these external factors was the subject of research by other scientific disciplines. This pattern changed radically in the 20th century, when more space may have been created for the analysis of the impact of socio-cultural factors on economic behavior.

Contemporary economic science tries to incorporate non-economic phenomena in the analysis of rational choice, which creates conditions for the analysts to see economic phenomena and their consequences in the right way. Presenting different academic disciplines, Kahneman, Becker, Murphy, and others (analysts) discovered lots of factors that influence human behavior. By including new methods in the analysis of rational behavior, these authors have enriched the analytical instrumentation of economic science. Their work laid the foundation principle of the new reciprocity model between the representatives of various scientific disciplines and reinforced mutual connections between empirical and theoretical research. It is this interdisciplinary collaboration and continuous creative contact between researchers who determine experimental facts, and scientists who propose theoretical explanations, that will almost certainly become the driving mechanism of the progress of economic science in the 21st century.

On the basis of the previously mentioned concepts of rational choice, many studies followed, including very interesting analysis of addiction behavior. In this paper, we considered the example of addiction behavior as related to smoking. The aim of our study was to determine whether economic, demographic and contextual variables can influence smoking cessation. The use of the mathematical model had a special purpose to determine whether smokers are more rational than non-smokers (ex-smokers). The analysis of the impact of nicotine dependence and demographic and contextual variables on

smokers emphasized four statistically significant differences. Individuals successful in smoking cessation were more risk averse than individuals who had failed to achieve smoking cessation (Hypothesis 1 was confirmed). Individuals successful in smoking cessation were more patient than individuals who failed to achieve smoking cessation (Hypothesis 2 was confirmed). Middle-aged smokers exhibited the largest daily consumption of cigarettes, and they would be the most motivated to quit smoking (Hypothesis 4 was confirmed). Women stopped smoking to the same extent as men did (Hypothesis 5 was confirmed). The hypothesis that success in quitting and rational behavior of participants (smokers and ex-smokers) were connected was confirmed (Hypothesis 3 was not confirmed).

In a sense, the present analysis of the dependent behavior of rational choice theory represents an affirmation of the microeconomic approach to appearances. It actually extends a valuable and fruitful tradition in economics, and the models and methods developed in the science are used to study phenomena beyond economics. In addition, this paper shows, in a very concrete way, how economic models allow us to improve the level of understanding not only of the economy but also of the world in which we live.

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## APPENDIX: RATIONAL CHOICE MODEL

Choose one of the alternatives

|  | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|---|---|---|---|---|---|
| Reward | 100 000 | 150 000 | 200 000 | 250 000 | 300 000 |
| Time delay | immediately | in a month's time | In six months' time | In a year's time | In five years' time |
| Winning probability | 100% | 90% | 80% | 60% | 40% |
|  | ↓ | ↓ | ↓ | ↓ | ↓ |
| Choose one |  |  |  |  |  |

## Endnotes

[1]    The quotient of the variance between groups and variance within groups: $F_{(4, 482)}=4.613$, $p=0.013$