SCIENTIFIC ARTICLES

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HYPERBOLIC DISCOUNTING AND ITS CONSEQUENCES: EMPIRICAL ANALYSIS ON THE BASE OF SURVEYS

Introduction. Time preferences have always been in the center of the economists' concerns.

This crucial priority lies in a fact that the idea of time preferences influences not only individuals' well-being, but also a national welfare. It can be one of the explanatory factors of low savings, indexes of health behavior and so on. The concept of time preferences induces the person to choose between costs and benefits at different moments in time. Each decision entails a series of consequences and additional costs.

How people are able to establish priorities or be inclined to resist different kinds of temptations will be reflected in their consumption at the current moment and will have an impact on a future consumption plan, especially in the period after retirement combined with a lower income and sensitivity to savings. Every day we face different situations, which force us to make a choice: buy shoes right now, leave it for later, spend money now or deposit in a bank to earn an interest rate, quit smoking and enjoy it in presence or start thinking about destructive impact of smoking on our health. All this list can be continued for long, situations can be different, the only thing in common is the necessity of self-control. There are different constraints which prevent people from committing wrong choice or from procrastination of making any choice, such as loans, deadlines or simply our inner self-control, which depends on many different subjective factors. The classical economic model does not take into consideration psychological and cultural peculiarities, which have a large impact on the process of decision-making. The absence of these variable leads to misleading results on practice. Even the mood the agent can cause severe deviations in understanding the economic behavior.

In this paper the model with an adjustment for cultural and psychological is introduced. The differences between cultural dimensions and belonging to the group of risk averse individuals and their impact on the setting discount rate are illustrated in a light of this research. Despite the comparative analysis of exponential and hyperbolic discount models, the important drawbacks of the most widespread discount model are determined and several anomalies are discussed. The survey is focused on formalization of time-inconsistent preferences and tendency to procrastinate depending on the structure of costs.

We start from a consideration of a theoretical background of utility model beginning with a classical model and ending with quasi-hyperbolic discount model which combines the features of prior concepts. Also measures against procrastination and different temptations, named as commitment devices, are put forward. The disparity in individuals' behavior is explored from the perspective of awareness of self-control problems by the division of consumers to naïve and sophisticated.

Then we analyze why people differ substantially in consumption plans and levels of savings; different methods are reviewed. The long-term discount rate and the short-term discount rate are compared between each other. We use such instruments as violin plots, regression model and decision trees.

Finally, we describe obtained data through the questionnaire and the results revealed by means of analysis tools. The core of the work lies in the establishment of the relationship between country variable, which contains the information on cultural peculiarities, national welfare and the level of consumption, risk aversion variable, implying that individual tends to skip any risk by sticking with already existent prospect and the subjective discount rate. Then the discussion on the results is conducted, explanations in favor of the extended with psychological forces are outlined and shortcomings of the model and their solutions in order to reduce their effect on occurred bias are described.

Some words about classical model of intertemporal choice. Some people tend to consume more today and suffer from a lack of savings in future. The allocation of income between the current consumption and the future one underlies the concept of intertemporal analysis.

The first author, who contributed to the intertemporal analysis, was Fisher (1930) by proposing in-

different curves, which are used for representing how the rational individual will distribute the consumption between the past and the future. The main assumptions for this model are the absence of uncertainty, consideration of the two periods and the perfect capital market. Each curve supposes two goods and illustrates such combination of present and future consumption that generate the same satisfaction and how the former one can be transformed into the next one by making investments in the real capital projects. The utility is being maximized by moving to the higher indifferent curve. According to the shape of these curves, we are able to identify whether the patient consumer was being examined or an impatient one. The patient consumer tends to save more and in case of the increase in the current consumption he tries to decrease a future consumption by relatively same amount of units in order to save the equal indifferent curve. In light of the patient consumer indifferent curve has a gradual slope, whereas considering the impatient consumer, who in contrast is more likely to spend more right now instead of leaving it for later, we will have a steep slope of the indifference curve. Hence, the shape of the Fisher's indifference curves is crucial in terms of saving and borrowing decisions and depends on the individuals' time preferences and the diminishing marginal utility. The concept of indifference curves has become the main basis for the development of the discounted utility model. Fisher (1930) considered different determinants of the time preferences and formulated them as a combination of objective and personal drivers. The list of personal factors is composed of «foresight», which depicts how well the individual is able to foresee future and «fashion» that has impact both on the interest rate and on the distribution of wealth itself.

Later Paul Samuelson introduced a discounting model for Fisher's indifference curves analysis implying a multiple amount of the time periods as a two-period Fisher's model might be inappropriate on practice for some situations (Samuelson, 1937).

In the classical economic theory, the exponential utility model is a standard framework for examining intertemporal decisions. However, due to the large amount of the empirical researches, comprising of the questions about some hypothetical situations and subsequent individuals' decisions, the validity of this concept is in question. The issue about exponential utility model is that discount rate is unified and constant for any economical agent and does not take into consideration any external factors or psychological motives, which can influence individuals during a process of decision-making.

In order to understand the concept of the exponential utility I need to represent the list of the important assumptions, which underpin this model.

First of all, people's time preferences are positive, which means that people prefer to receive goods as soon as possible and the subjective discount rate takes values less than 1.

Secondly, preferences are considered to be time-consistent, which implies the constant discount rate as it was already mentioned above. The ratio of the discount function in any period to the prior period is equal to the discount factor.

Thirdly, the utility in any period does not depend on the utility in any other period. The same thing can be said in terms of the consumption independence.

Additionally, the utility function is stationary and continuous, which indicates that individuals do not change their preferences over time.

However, all the theoretical assumptions which underlie the exponential utility model couldn't find a wide application in practice and also exponential model used to face different kinds of anomalies which will be discussed later during this work. Considering the field of the intertemporal choice and discounted utility model it is crucial to mention the key axiom about how individuals evaluate their consumption plan. This axiom presumes that integrating new alternatives to the already existing plan can be accomplished only by regarding accumulated consumption in the previous periods and the influence of the new alternative on the consumption in the future periods. Despite the fact that in theory these assumptions seem to be normatively compelling it is hardly can be found in the real life. Usually people are not fully aware of their future plans or they can evaluate their optimal plan by being too self-confident or being conscious about chance to fail (optimism and pessimism cognitive biases). Evidently, classical model ignores the problem of uncertainty stressed by Heteredox Economics, especially by Post Keynesian approach (Davidson, 1972; Carvalho, 1992).

The desire to go to the Italian or Vietnamese restaurant is undoubtedly influenced by the previous experience, which challenges the question about consumption independence.

Also exponential model was unable to explain why gain are discounted according to the higher subjective discount rate than losses are.

The crucial point in studying exponential discounted utility model lies in the time-inconsistency, which wasn't taken into consideration, but was often observed during lots of empirical researches. The idea of time-consistent preferences defines that if person prefers 1000 dollars now over 1500 dollars in one week, he will still have same preferences if will be asked about one year and one year and half. Hence time preferences remain constant whereas time horizon becomes wider.

Let assume that we have an individual that has three years till retirement left and he is about to distribute his income and expenses in the most sufficient way. Time-inconsistent preferences imply that when we observe high discount rate between utility in the period t and utility in the period t+1 and relatively low rate between t+1 and t+2 whereas when the period t+1 actually comes, discount rate between t+1 and t+2 is way higher

than it was initially expected so the individual will carry out the different consumption plan. Time consistent preferences suppose that optimal consumer plan remains the same through time.

However, in practice it can be easily demonstrated that time preferences are influenced by many different factors both objective and personal, which make them unstable over a time period.

Some researchers argue that time-inconsistent preferences are often hard to be evaluated as the person changes his attitude at different times. This problem eliminated in some papers (Goldman, 1979; Laibson, 1996; 1997) by using Pareto criteria, which states that one alternative prevails over another one, when the person considers this alternative the most attractive among the whole range of perspectives. However, Pareto criteria turns out to be too weak for any assumptions when one outcome certainly generates a greater utility than another one.

All the points mentioned during this chapter lead to the necessity of the utility model to be further expanded by including the careful analyses of all gaps and anomalies occurred in practice and the emergence of such modifications as «hyperbolic» and «quasi-hyperbolic» discounting.

Some words about hyperbolic discounting. The concept of the constant rate failed on practice as a wide range of laboratory studies revealed that discount rates in the short-run use to predominate over the discount rates in the long-run. This discrepancy is hold in the hyperbolic discount function, which implies a diminishing discount rate.

Every individual faces the daily situation whether to consume the good now or save it for later. The hyperbolic discounting model gives an explanation for the question why do people tend to overweight present to future, why do they are most likely to have the low level of savings after the retirement and why do they tend to frequently borrow in the credit market. When people are about to plan their future consumption they are willing to meet deadlines, give up on bad habits and start saving in advance in order not to suffer from the lack of money after the retirement. When the moment of the retirement actually comes, our real income is lower than we expected. This gap between long-run intentions and real short-run actions shows the contradiction between peoples' short-term preferences and long-term desires.

In the economic literature the first one who made researches in the field of time-inconsistent individuals was Strotz (1955). He proposed two strategies that might be employed by a person who foresees how her preferences will change over time: the "strategy of precommitment" (wherein she commits to some plan of action) and the "strategy of consistent planning." (wherein she chooses her behavior ignoring plans that she knows her future selves will not carry out) (Frederick et al, 2002).

The thing is that hyperbolic discounting is taken into consideration mostly in terms of explanation of time-inconsistency. However, hyperbolic discounting appears to be valid enough merely when not only time-consistency is violated, but also stationarity is not hold. Violations of both assumptions cause certain choice reversals, which can be explained by the concept of hyperbolic discounting, but again, only in case when they both are not adhered. Time-inconsistency occurs when the person is asked in a zero period whether to get 100$ in a month or 110$ in two months and he is willing to wait for a higher reward one extra month. When it gets closer to the end of the first month, he exhibits the choice reversal, which means that he is becoming less patient and more excited about a sooner, but smaller reward rather than a larger gratification that implies additional month of waiting. In general terms the concept of time-inconsistent preferences describes the contradiction in preferences between long-term plans and short-term decisions. Being asked far in advance the individual is ready to act relatively patient whereas the closer he gets to the lower reward the more he is willing to opt for it instead of choosing the more beneficial alternative.

The individual violates the term of stationarity if he prefers 100$ tomorrow to 110$ in a month, but rather have 110$ in two months than 100$ in a month. When we analyze the violation of stationarity, the time period doesn't change like it does in a light of time-inconsistency. Individual is being asked in a zero period about two possible outcomes, which can be obtained in different time periods, the similarity is that the time difference between two offered prospects is the same whenever he is proposed to get them. In the example above the time-difference between 100 and 110$ is one month and according to stationarity axiom individual is obliged to choose the same reward no matter which time frames are stated. There is one more explanation for choice reversals, which is called time invariance (Halevy, 2015). It refers to the marginal rate of substitution, meaning that 100$ today is equal to 110$ in any moment asked. However, this kind of difference in a consumption can be estimated due to some changes in economic wealth, which do not depend on consumers' decisions. If time invariance is not satisfied, it could be a mistake to identify hyperbolic discounting. Unfortunately, designing experiments that will observe time invariance requires large costs and long process during which the experimental methodology loses its power. So, Krupka and Stephens (2013) analyzed time-variance and received outcomes that presumed time instability to be not a random variable, considering different economic factors.

Janssens et al (2017) designed an important experiment, through which they examined the effects of violations of all three assumptions in order to make conclusions about low savings. They claim that in some cases violations of time invariance emerge due to the liquidity

constraints so that consumers have less access to informal credit and tend to lose more wealth over time. That is why, not only hyperbolic discounting should be measured as a driver for choice reversals, but also liquidity constraints should be analyzed. In order to examine the influence of liquidity constraints they conducted an experiment among the participants, who suffer from a lack access to credit and savings and possess highly volatile income (Janssens et al, 2017). These findings represent a strong importance for design of commitment saving devices. Also for the targeted group of participants, who operate under the imperfect financial market, the liquidity constraints imposed by the government policy might be too strong and harmful.

Under the concept of the hyperbolic discounting two types of consumers are highlighted: naive and sophisticated. The way how the individuals are going to behave depends on the degree how they are aware of their time-inconsistency. Naive consumers do not recognize the issue of the time-inconsistency so they do not foresee that their future selves will differ from the current ones and strongly believe that their initial plan will be carried out in the future. Sophisticated consumers, in contrast, do realize that this problem exists and use a commitment as a tool how to fight with their self-control issues. Commitment is a promise made by individuals in order to follow their current plans in future. There are different examples of the commitments, such as deadlines, which drive people to finish work on time, loans that play role of a special constraint on the overconsumption as the individual becomes limited in their spending and even marriages can be viewed as a commitment tool because it restricts persons when it comes to different kind of temptations or hot states. Focus on self-control problems also takes place when it comes to information-acquisition decisions. Standard economic models accept that priority be given to acquiring any free information as it results in more profitable decisions. You can ask for advice of your friend when it comes to the decision about potential investments or take your time, processing information and examining investment strategies. Self-control problems can lead to ignorance of information due to the increased likelihood of a possible misbehavior as a consequence. Nowadays, in terms of the information abundance the chance of bias caused by obtaining not valid information leading to a future misbehavior is extremely high, which implies the necessity of careful, selective information gathering.

In terms of the sophisticated consumers further issues such as impatience or procrastination can be accurately considered. If both outcomes are viewed from the long-term perspective, individuals are able to act relatively patient. Far in advance they are ready to wait for a more beneficial alternative, however, when the moment actually comes, people fail to wait one extra day so they prefer an immediate gratification. For example, assume that you can have a thirty-minute break in 102

days or go for a twenty-minute break in 101 days. If you consider both opportunities today, the chance of having a longer break and one day of waiting sound way more reasonable. But when the date of the twenty-minute break comes the preferences face a reverse, which is called "magnet effect", and bring out the impatience to prefer an immediate reward instead of waiting. Also there is a term or partial naivety formulated by O'Donoghue and Rabin (2003), when the person is aware of the time-inconsistent preferences, but underestimate their influence. This approach sounds way more realistic among the other, whereas the standard economical model assumes that consumers are fully sophisticated and able to foresee their behavior.

Procrastination. An often used implication of time-inconsistent preferences is procrastination. All people use to procrastinate during their life period. Some of them leave their unpleasant duties for later quite regular and some of them try to solve this problem using some commitment devices such as deadlines. Procrastination is based on two important questions – which task to perform and when. When we are about to start the project we consider long-term benefits, whereas our decision to put off something is based on the immediate effort.

Procrastination does not necessary mean that people spend lots of time to persuade themselves to actually start doing the task. Procrastination can also occur during the mid-term stages, when, for example, the person has started the project, but was not willing to finish some mid-term tasks, so he procrastinated the end of the plan. It often happens, when the beginning does not demand many efforts and the vast amount of efforts should be implemented in the middle of the project or in the end. Hence, the type of procrastination strongly depends on the cost structure. Also according to the intuition of economic researchers O'Donoghue and Rabin (2003), who have conducted various experiments in a field of the behavioral economics and procrastination, in particular, the expansion of the proposed alternatives can cause procrastination more probably. This can be explained by the evidence, that new options can be potentially more beneficial for the individual, but include higher costs, which will result in a systematic delay (O'Donoghue and Rabin, 2003).

How it was already mentioned before, consumers can be divided in several categories depending on the degree of their understanding about time-inconsistent preferences. Awareness about time-inconsistent preferences and self-controls problem is extremely significant in terms of procrastination due to the natural application of procrastination for self-control problems. Naive consumers formulate their future plans and the way how they are going to accomplish their performance target and when the period of carrying out their plans arrive, their preferences face the reversal and they fail to meet their initial assumptions and hopes and end

up not completing the long-term task at all. Each type of procrastination implies inevitable losses or foregone opportunities. If the person has started the project, but wasn't able to finish it, he didn't only lose the potential benefits which could possibly arise by the end of his work, but also wasted his effort on the stage of the beginning. In contrast, sophisticated consumers are aware of the self-control problems and they are presumed to foresee their future behavior more accurately. It is clear that naive consumers are more likely to procrastinate than sophisticated consumers. However, the degree of the awareness is often hard to be measured, so anyone can be potentially vulnerable to procrastination. Also the definition of partial naivety exists as a separate category which demonstrate the type of consumers, who understand the core of time-inconsistency problem, but use to underestimate its magnitude. The concept of procrastination is under attention in terms of the hyperbolic discounting as the desire to put off is connected with immediate costs, contradicting their long-term plans, which is similar to the desire to get a sooner gratification rather than waiting for a more pleasant alternative. Needless to say, that procrastination takes place only when the project is worth of starting. Otherwise, procrastination is not meant to arise. O'Donoghue and Rabin (2002) examined the question of procrastination with exogenous costs by applying a two-parameter model originally developed by Phelps and Pollak (1968), which has the following look:

$$U^t(u_t, u_{t+1}, ..., u_T) \equiv \delta^t u_t + \beta \sum_{\tau=t+1}^{T} \delta^\tau u_\tau.$$

This model consists of two important variables, such as b, which represents standard "time-consistent" impatience, whereas the parameter beta illustrates a time-inconsistent preference for immediate gratification. For beta equal to 1, these preferences are time-consistent. But for beta less than 1, at any given moment the person has an extra bias for preferring now over the future. Beta is basically an error which describes «self-control» issues due to the contradictions it causes, expressed as a prevalence of the current well-being over the future one at any period of time (O'Donoghue and Rabin, 2002). More and more economists have been including lately the psychological factor of self-control problems in their analyses in order to compute the discount function for intertemporal choice. Needless to say, that self-awareness doesn't matter and doesn't presume to be relevant in terms of the sequences of outcomes or long-term commitments. Sequence of outcomes implies that person doesn't need to choose, whether to have a dessert today night or not, but commits to the series of deserts, which can be consumed or not during next three months, which implies long-term decisions. Under these circumstances, barely could the person accomplish the most appropriate for him choice so the role awareness is not valid enough. Also if the consequences of one decision do not have an impact on other decision's payoff,

those two are considered to be disconnected, which again decrease the influence of self-awareness on decision-making process. Self-control problem reflects an important magnitude on people's behavior as it leads to people not behaving in their own interests and, as a result, harming themselves. In some cases, the size of the harm is not large, but systematical harm emerged during the range of decisions possesses a danger for people.

On the other side, if two decisions are connected, the shift in behavior can be explained by self-control problems. The following research was established in terms of two-stages projects in O'Donoghue and Rabin (2002) paper, but can also be applied for multiple period works. On every step the individual faces a choice to accomplish the task or not without any commitment devices available. The chance that self-control problems occurs depends on a fact, if the task suggested is laborious or a pleasant one. The main requirement is that person possesses certain believes about his behavior and that he chooses his actions according to the principles of maximization his utilities and preferences. Immediately the cognitive bias can be considered in a light of this assumption due to the inability of the individual to carry out the strategy, which will satisfy his needs or to analyze which kind of decisions will maximize his well-being. The terms procrastination is used when it is the matter of putting off the tasks repeatedly based on a willingness to work in the near future, but then changing one's mind when that near-future date arrives.

From the first sight it may sound that fully sophisticated person is not prone to procrastinate according to this definition of procrastination. However, he tends to delay as well if the immediate gratification is stronger than the cost structure. Hence, procrastination plays a vital regarding consumers' level of being sophisticated as it appeared to be a sphere, where sophistication might be a misleading factor. Taking all the points above into consideration, it is clearly assumed that person is more likely to procrastinate on the stage, which contains the highest cost comparing to the other phases of the project. Moreover, naives tend to procrastinate way more, than sophisticated consumers do as they strongly believe that they will perform the task in the next period despite the occurred delay. Unlike the naives, sophisticated agents are more willing to carry out the plan on the first stage due to their awareness that in case of the delay they are going to procrastinate the performance for long period of time. It means, that if they decide to procrastinate some task, they are okay with this delay and they have already set up the moment when the task will be actually completed. Many papers include the deadlines as the most important commitment tool, which is used by consumers in order to prevent themselves from the procrastination. One study – by Ariely and Wertenbroch (2002) – proved that people with exogenously imposed deadlines were more likely to perform the project in a sufficient way than the group of people who were pro-

posed to establish deadlines on their own and ended up having a longer delay and less successful grades.

All the discussion above was mainly hold in case of the onerous opportunities, which can cause procrastination to a larger extent. However, another research conducted by O'Donoghue and Rabin (2001) assumes that providing individuals with more extra opportunities, which sometimes bring even more pleasure and increase their well-being, can lead to procrastination as well and procrastination important goals is more serious than procrastination unimportant goals. This can be explained by the following conclusion: «If a new option has a sufficiently high long-run net benefit, the person will plan to do this new option rather than what she would have otherwise done; and if this new option has a sufficiently large cost relative to its immediate benefit, the person now procrastinates» (O'Donoghue and Rabin, 2001).

The second anomaly that people tend to procrastinate more often important tasks rather than unimportant or increasing importance of tasks induces the chance of the emergence of procrastination can be illustrated by a simple example based on a person's saving plan. Let us suppose that the person is determined to save 10,000 euro for retirement 35 years from now. He is earning right now 1% interest rate in his account, but he can easily make a transfer and start getting 5% interest rate instead of the current one. This alternative doesn't imply high costs, can be performed without much effort and is worth of considering. However, the decision about the retirement plan in undoubtedly crucial for many people, which can result in a possibility that the person will spend many years looking for any rate, higher than 5% and meanwhile will procrastinate and lose money in exchange for investing in a potentially profitable plan – 5% rate.

This sub-topic can find a significant practical applicability as it allows to schedule the working process in the most sufficient way so any employee will be capable of accomplishments the parts of the project despite the variations in they disabilities.

The Reference-Point Model. Hyperbolic discounting is not capable of explaining, why gains are discounted with a higher weight than losses are. The main contribution to this anomaly was made by Kahneman and Tversky (1979) in their paper dedicated to the violations of general axioms of expected utility model, who interpreted the overweight values of gains comparing to losses under the concept of risk aversion and developed a prospect theory model. This model evaluates the certainty effect assuming that people tend to assign a greater weight to alternatives, which can happen with a certain guarantee, comparing to less possible one, and explains the concavity of utility function. The person is considered to be risk averse, if he prefers to stick to already existing prospect rather than shift to a risky one. If we consider so-called positive domain implying certain gains and slightly possible larger gains, individual

opts for a former one, which reveals risk averse. Therefore, same effect occurs in a negative domain, when seeking for a less probable loss over a certain smaller loss reflects risk seeking. Also, Kahneman and Tversky (1979) emphasize, that during decision-making people disregard a wide range of components, which means that different decompositions lead to different preferences. This anomaly is called the isolation effect. What is more is that people use to evaluate opportunities from a perspective of the final stage. They do not view the prospects as a sequence. Two risky outcomes can be regarded in a standard form whereas the choice between the investment in the risky venture with a particular probability of losing capital if it fails or getting some percentage in case of success and fixed return rate seems more complicated to be measured. If we look at these alternatives on the basis of isolations effect, the certain reward obtained by investing in a secure venture, for example government bonds, appears to be more attractive. However, the results obtained during this pattern can be ambiguous and lead to the contradiction with a standard expected utility model. Usually the decision tree is used as tool to view the outcomes as a sequence and compare risky and riskless prospects. The prospect theory entails two stages in the choice prospect: the editing phase illustrates the basic analysis of the offered opportunities and the second stage implies the estimation of prospects and choice of the prospect with the higher value. The changes in values should not be reviewed just from the preliminary point, both the position that serves as reference point, and the effect of the change (positive or negative) from that reference point have to be considered.

How it was mentioned earlier, the decision is influenced by the people's awareness of their inconsistent preferences. However, at the moment, when they are not capable of identifying the violations their preferences bring, the prospect theory could be a useful tool in measuring those anomalies. This concept possesses a potential significance due to considering the way how the prospects are recognized and how gains, losses and ambiguous outcomes are evaluated under the risk.

On the basis of the prospect theory the Reference-Point Model as a modification of the hyperbolic model was introduced. This model is considered to be crucial in terms of people's attitudes towards risk and explanation why people use to discount losses less intensively than gains. The theory of reference point formation was proposed by Köszegi and Rabin (2006, 2007), who included a psychological factor of gain-loss utility and argued that preferences are reference-dependent and reference point is based on the people's rational anticipations about their behavior. They decomposed the model proving that estimation the probability weights influence the psychological part, but does not have any impact on a consumption utility as it represents a «rational» component of the model. Also the possibility of

including the prospect with an outcome zero as a minimum one into the mix of different prospects was examined. Whereas the standard models are based on summarizing all data or individual estimation, the Reference-Point Model looks for a balance between both of methods in order to obtain more explicit parameter estimates by means of Bayesian analysis.

The model of habit formation. The model of habit formation plays a vital role to the surveys about consumers' utility as it explores the responses of real spending to various shocks. The idea is that consumers' utility partly depends on current consumption relative to past consumption

$$U^t = \frac{1}{(1-\sigma)} \left[\frac{C_t}{C_{t-1}^\gamma} \right]^{(1-\sigma)}.$$

In this formula current utility U depends on the consumption in a current period relative to lagged consumption. The parameter y depicts the importance of the reference level relative to current consumption. In terms of habit formation this formula can be rewritten

$$U^t = \frac{1}{(1-\sigma)} \left[\frac{C_t}{C_{t-1}} C_{t-1}^{1-\gamma} \right]^{(1-\sigma)}.$$

Habit-forming consumers are willing to smooth both the level and the change in consumption as they do not like large decreases in their consumption. Habit formation model explains a hump-shaped response by the gradual response of the level and change in the consumption to changes in interest rates or income. That is why, when these consumers agree to hold a risky asset, which threaten the stability of their income, they ask for a higher risk premium. This model also reveals the important dynamic correlations between consumption, output, interest rate and inflation, which were not considered in standard models earlier. The findings acquired by using this model fit the real data in a more sufficient manner due to the implementation of the consumer's incentive to smooth the change and the level of consumption to income shocks and gradual decline in inflation during a disinflation. The main conclusion is that after some financial shocks consumption faces the sluggish adjustment only in the short-term.

Quasi-hyperbolic formulation. Despite the fact that hyperbolic discounting is subject to be a large step in a field of time preferences as it managed to fit a large sample of real data, this concept failed to predict such anomalies as a "sign effect" which implies that people discount gains with a higher value than losses, "magnitude effect' focusing of higher discount rates for a larger reward in contrast to a relatively small. These and other variations were not reflected in a hyperbolic discounting but they triggered another explanatory model called quasi-hyperbolic discounting. The core is that this models still appeals to the same premises as hyperbolic did about individuals' impatience about immediate trade-

offs but for the rest of the period hold the discount rate constant. It still shows that individual acts impatiently in terms of today and tomorrow, exhibiting low discount rates as it was stated in hyperbolic discounting, whereas the discount rates from tomorrow onwards remain constant by analogy with exponential discounting model. Therefore, the discount rate is not increasing over time. Basically quasi-hyperbolic discounting represents the combination of both discounting models discussed earlier. Its advantage compared to other lies in a distinctive border between the "short-run" and the "long-run". It was proved that in contrary to hyperbolic discounting quasi-hyperbolic discounting can be applied in analyses including the technique of dynamic programming. Under the infinite horizon using hyperbolic discounting is quite challenging.

Quasi-hyperbolic discounting was first established by Phelps and Pollak (1968) regarding inter-generational preferences. Later it was adopted by Laibson (1997) to carry out survey covering the savings behavior of a consumer with self-control problems who has access to imperfect commitment devices (e.g. illiquid assets). The result of Laibson's research supposes consumers to undersave as a result of the overconsumption during early stages.

Quasi-hyperbolic discounting was implemented in terms of a procrastination (O'Donoghue and Rabin, 1999), retirement decisions (Diamond and Köszegi, 2003), job search (Paserman, 2008), and addiction (Gruber and Koszegi, 2001).

Formally the decision makers' utility has a following definiton:

$$U^t = u(C_t) + \beta \sum_{i=1}^{\infty} \delta^i u(C_{t+i}).$$

Determinants of the subjective discount rate. Subjective discount rate is an important innovation in terms of discounting model and a crucial measure of individuals' impatience. This variable is needed to be considered during the analysis of low savings with an explanation why economic behavior varies depending on situations and different framings.

Usually the subjective rate is evaluated through different hypothetical choices by asking the participants how much they would demand as a compensation or how much they agree to pay in order to delay or speed up gains or losses. Subjective discount rate is inseparable with a mental discounting process, which in turns is based on individual's cognitive ability. Discount rates vary among different groups and categories as no information is to be perceived identically by different people. First of all, as it was discussed earlier people do not necessary prefer to get the whole bunch of information they have been provided with due to the high costs arisen during elaboration of information and collection of it. Even when this preliminary stage of data collection is over, the individual still has to process information

and come to some kind of conclusions and again he is constrained by his cognitive capacity. He might suppose, that he has gathered the all necessary information, while there are still some methods left which he is not aware of. Also he might have framed the strategy which he considers as an optimal one due to the volume of data he perceived, while this strategy can be completely misleading because of the ambiguous sources of information or some irrelevant data. It has been proved, that better financial knowledge generates lower subjective rates. Getting higher education leads to deeper knowledge and enhancement of the ability to gather information and use it in a sufficient way. Anyway there still going to be a cognitive bias due to the extreme importance of some factors in contract to the lack of usefulness of the same variables among different participants according to their personal priorities, experiments, habitats, needs and beliefs. Also gender and age have a certain impact on the formation of the subjective rate.

Subjective discount rates can be also explained by the current economic environment and national welfare, which described by the rate of inflation and the index of well-being. The individual who operates in a relatively stable market and does not face some sharp exogenous shocks, tends to act more patiently than the person who has less access to the commitment devices such as credits and performs in a difficult environment because when individuals face the absence of the commitment devices he is tempted to deviate from the initial plan (Janssens et al, 2017). The subjective rate can be examined in a light of groups with similar strategies. The results obtained during this experiment can differ significantly among the groups due to the different extent to which the subjects include subjective rates in their decision-making.

The better understanding of mental discounting process will allow to fulfill some gaps arisen considering standard economic models.

Some words about the methodology of our empirical research. During the exploratory analysis several technics will be implemented, such as violin diagrams, regression model and decision tree, in order to compare the short-term discount rate and the long one between each other, so that the most reliable discount model will be revealed. One more thing to be examined is the effect of country differentiation on the formation of the subjective discount rate.

Violin plot emerged not lot time ago, it was introduced in the software package NCSS in 1997 and described by Hintze and Nelson (1998).

Violin plot is a useful tool for visualizing the distribution of the data and its probability density. The advantage of this visual is that it provides with a more profound information than box plot does. When the big sample of data is collected it cannot be stated without some valid proof that observations are subject to the normal distribution due to some outliers. Violin are able to

fit big amount of data with different categories while the box plot is a limiting visual device. Usually bar plots are used in order to determine the mean value and the standard error and illustrate some summary statistics, such as range and quartiles. Histograms can be applied to multimodal data but at the same can be a misleading method as well and requires much space for many distributions. Violin device is applied to show the shape of the distribution and it is very compact as it doesn't compose a big number of points. Wide parts of violin plot give information about the high probability that the chosen variable will take the certain value, whereas the skinnier parts reflect the low probability. Overlaying the box plot on top of the violin pot will show the information about median and interquartile range.

The research is based on questionnaire which includes such questions that assume two different options. That is why, there is a need to introduce the concept of binary variable. Binary variable is a discrete variable that implies two different alternatives which are often labeled as 1 or 0. For example, binary variable can take values success/failure, male/female, presence of headache/absence etc. This concept is widely used in terms of classification. If the respondent belongs to the certain category, his answer is coded as 1, if no-it is coded as 0.

We suppose that discount rate is normally distributed due to its extensive use in the field of economics and its convenience. It is characterized only by two variables: mean or it is also called expected value and standard deviation, which makes the research less complicated. Mean is basically a computed average value. Standard deviation gives information about the spread of distribution. If data has a small standard deviation, the shape of the curve will be tighter and taller. In contrast, having larger standard deviation leads to getting a flatter and wider curve. The main assumptions are that the curve is symmetric at the center, which means that data is equally spread around the mean value, peak of the curve is represented by the mean of the data and the total square is equal to 1. However, on practice hardly can be this perfectly symmetric curve obtained. So if there is any suspicion that data is normally distributed, it is need to be checked by several statistical tests if this null hypothesis about normality is true. Aim is to transform data that way that it reminds of the shape of the normal distribution. When we talk about normal distribution, we deal with the concept of the confident interval. The confident interval contains a proportion of data which lies between an upper and lower bound of a probability distribution. Usually 95% or 99% are used. The rest percentage includes the information about the tails of distribution. The confidence interval is a measure of uncertainty. The higher confidence level entails the higher proportion of the data is located in the inner part of the curve and guarantee the higher level of certainty. The

normal distribution is a significant tool for calculating probabilities of many real events in different spheres.

In order to illustrate different outcomes obtained during a range of choices the decision tree is generally used. This learning tool is very easy for understanding and predicting the best value of the targeted variable according to costs, benefits and probabilities. A decision tree begins with a single node (also called root node), which is split into different subgroups, which in turn give a rise for more nodes and further outcomes and it can be expanded till the endpoint or till no more alternatives are possible. In this survey the program R studio will be used for constructing the decision tree. This tool represents a possible alternative to a logistic regression and can be implemented in many different fields. Decision tree presents an important advantage in contrast to a logistic regression as it handles nonlinearity and also provides with valid results even if the survey deviates from assumptions. Also it is easy to be performed due to its simplicity and no need for a careful data processing as it works with heterogeneous and missing data.

During the formation of the decision tree researcher is able to identify which kind of outcome each alternative will bring depending on different conditions, compare them in the future and determine which one is considered as an optimal one. Once again-no need for data to follow any precise distribution, which is explained non-parametric framework for a decision tree method. The missing values are taken as in isolated category or the can be combined into some other existing categories. This method is crucial in terms of decision-making as it contains all significant factors for the particular choice. However, if one single variable close to the root node is being modified, it can change the structure of the decision tree dramatically and result in a lack of credibility and loss of its simplicity.

Elements of the model. The main goal in this cross-country analysis is to identify, whether risk-aversion and differentiation between countries influence the subjective discount function or not. Are there some country peculiarities which have a certain impact on a discount rate and is there a difference between the weight which assign risk-averse person to the current and future consumption comparing to risk-seeking individual or the environment in which person operates does not present a great importance.

Also the model will provide a proof that a discount rate tends to diminish as the time period becomes greater, so that hyperbolic discounting model is way more relevant to be applied on practice comparing to an exponential. In order to make the difference between a discount rate for a short-term period and the rate for a long one be evaluated the participants experienced the alternatives at different points in times. The model is based on a questionnaire spread within people from different countries and different ages. The questionnaire consists of 5 questions, which reveal the preferences and

discount rates by modelling hypothetical situations in which participants are asked about the amount of compensation that could make them indifferent to an extra period of waiting or in which they are proposed to choose between different alternatives. Components of questionnaire:

1. Age

In some surveys it was proved that age is one of the factors influencing the subjective rate as elder people have more responsibilities and family to care about, so they are more vulnerable than youngers to the present consumption in contrast to future. However, elder people should also take into consideration such distant plans as a retirement plan, savings for children' future, which make them sometimes restrict their current consumption and save for later in order to stick with a plan about their consumption after retirement when they inevitably face a lower income. The question about age seems to be quite ambiguous as the youngers are less patient due to their psychological features of character building and lack of plans for future, but at the same time adults suffer more from negative economic shocks because of the broader range of responsibilities and inability to adapt to changes as fast as youngers do.

In this survey 103 participants took part. The majority of respondents lie in the age group between ages of 21 and 26 and represent students or graduates. People older than 26 refer to specialists. There are some outliners represented by subjects in age of 17 and 53. Hence, the main focus will be on students.
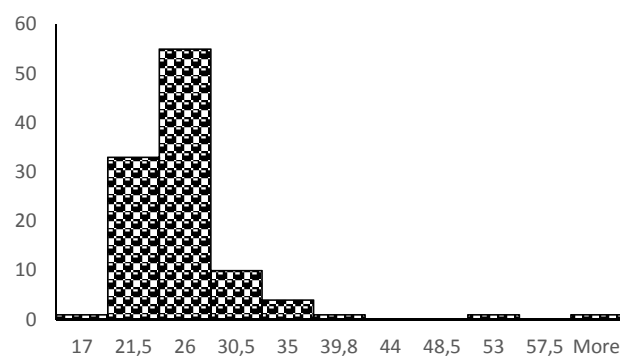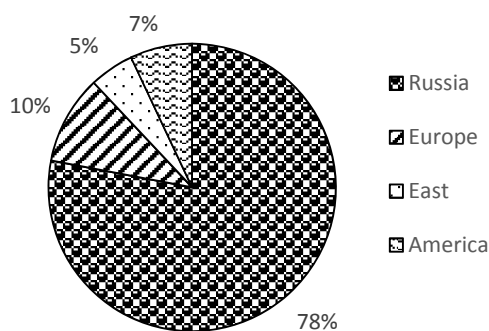

2. Country

This variable implies different economic environments, political systems and cultural routes, which can cause significant variations of time discounting. Normally the effect of culture was not included in standard economic models and did not represent an interest for economists. However, the growing amount of literature has demonstrated that preferences can be endogenous and can be formed with various societal and cultural norms and standards (Bowles, 1998; Eugster et al, 2011; Fehr and Hoff, 2011). Culture has an impact on all spheres of individual's life such as a cognitive ability, personality, economic knowledge and time perception. Also different countries possess different levels of wealth and education. The majority of researchers have

established that wealthier people show the higher degree of patience (Lawrance, 1991; Harrison, et al, 2002; Yesuf and Bluffstone, 2009). Poor household demonstrate relatively short time horizons and more interested in investments which can bring an immediate gratification as they have limited budgets.

Mei Wang, Marc Oliver Rieger, and Thorsten Hens have introduced a significant survey including 53 countries studying the impact of cultural dimension on time preferences. They examined the waiting tendency across different countries to compute the interest rate and compare it to the annual market rate. They claim that differences in consumption might be explained by the differences in market rates, inflation rates, access for a credit market and the wealth level of country described by log (GDP/capita) (Wang et al, 2016). The different tendencies in cultures such as individualism and collectivism have also been studied. I consider this analysis as one of the crucial in terms of time preferences and empirical evidence of the hyperbolic discounting. That is why, I feel relevant to include the country variable to the regression model and estimate the magnitude of it on a subjective discount rate.

There were distinguished several groups by geography: Russia, America (including Brazil, Mexico and Argentina), Europe and East. The motherland of the majority of respondents is Russia, their share in all sample reached 78 per cent. The second largest share of 10 per cent belongs to European citizens. The remaining percent constitutes respondents from other countries.


3. Short-term discount rate

The first question is aimed at revealing the short-term discount rate for individual who is asked to choose between getting 100 dollars immediately and waiting one more year to receive a higher reward equal to 150 dollars. The computed rate will be consequently compared to the discount rate obtained from the question about longer time perspective. This task identifies to which extent is the respondent impatient. According to the pie chart, 73 per cent are willing to get cash right now and only 23 per cent agree to wait. It means, that the overwhelming majority of respondents tend to care more about current well-being and their discount rate exceeds the break-off rate in this case equal to 50 per cent under which the individual is assumed to be indifferent between 100 dollars now and 150 dollars later.
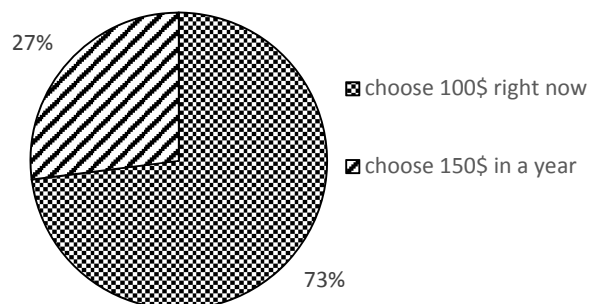
4. Commitment device

The next term is connected with an external force which can prevent individual from procrastination. It is likely, that individual strongly believes the project to be completed in the nearest future, but at the same time keeps delaying a working process when the planned date of completion arrives. As soon as the individual realizes that it is hard for him to stick with his original plan, he has an opportunity to impose himself with some kind of commitment devices which can motivate him to perform the task more effectively.

The participants were asked about the moment when they are willing to start doing the project which takes one day to be accomplished before the deadline equals to one month will be over. The preferable amount of days until the deadline is determined by the respondents themselves depending on their self-awareness of their dynamic inconsistent preferences. The obtained results are depicted on a histogram below.
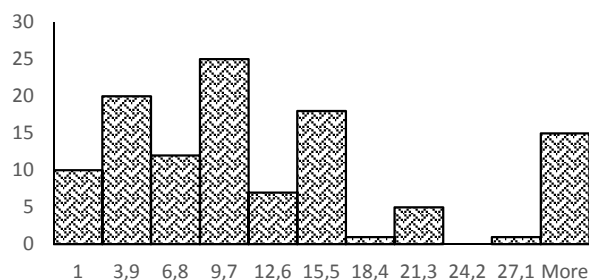
According to the outcomes, respondents, on average, are more likely to start the project in the second half of the month from 7 till 10 days before the end of the deadline. However, there is a significant portion of people, who are ready to start more in advance-in a first half of the given time frame. The category called "More" is mainly composed of respondents who are committed to start at the time that they receive an assignment. This decision was coded as 30 days which means that they do not hesitate to proceed precisely on a date of launching a project.

It should be said that some respondents left the notes to their answers, explaining their desire to divide the project performance into several parts so they do not need to perform the whole project in a one day as it was initially set. Nevertheless, there is still a fair share of re-

spondents who tend to start the project close to the completion of the deadline, even in a day before they exceed it.

5. Gamble

The goal of this question is to identify whether the person is risk-averse. In order to do that respondents are offered two different alternatives: to get 1000 dollars for sure or take a risk and try to earn 2000 dollars with 50 per cent probability of success. During a process of decision-making each economic agent inevitably deals with uncertainty such as a risk of inflation, risk of a lower income, risk of losing a job. Hence, being risk-averse or loss-averse has a vital impact on individual's preferences. For example, if individual expects his income to decrease he will rather reduce his consumption in the future period than in a current one as he mentally takes savings as losses accompanied by the reduction in his present well-being. The risk evaluation can make a substantial contribution to the discount utility model.

The diagram shows that the vast majority of respondents voted for the guaranteed option of getting 1000 dollars, which means that people in our sample are risk averse.
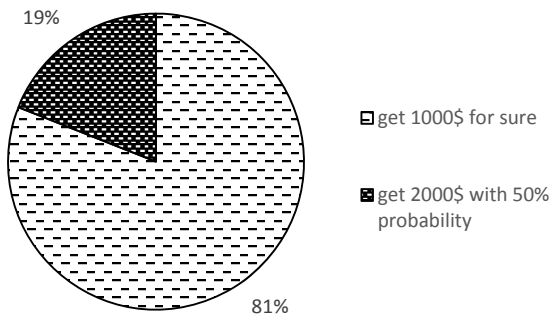

The next question in terms of risk aversion is about options for investment. There are two possibilities: invest in secure, risk-free bonds with assured return equal to 5 per cent, which is smaller than return of 7 per cent obtained by investing in stocks. However, stocks represent a threat due to different risks, volatility and a chance to lose all money in case of bankruptcy.
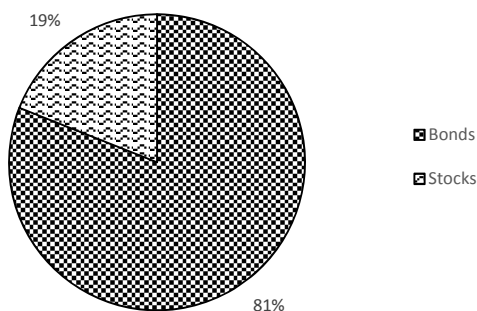
From the pie chart it is clear that the majority of respondents prefer a secure investment to risky stocks. Only 19% per cent is willing to take a risk and invest in stock associated with a risk of total money loss with 50% probability.

6. Long-term discount rate

It comes to the formation of long-term discount rate which will be compared to the short-term in order to measure the credibility of hyperbolic discount model. There is a question about purchasing of property and two possible how you can do this. Either you are saving for 3 years in order to by apartment on your own money or you are taking a loan for 5 years and immediately moving in. The cost of the flat is 1000000 euros and the payment for a loan is 1500000 euros. The first opportunity demands patience and willing to cut off the current consumption. The second one implies an immediate gratification and higher costs in the end.
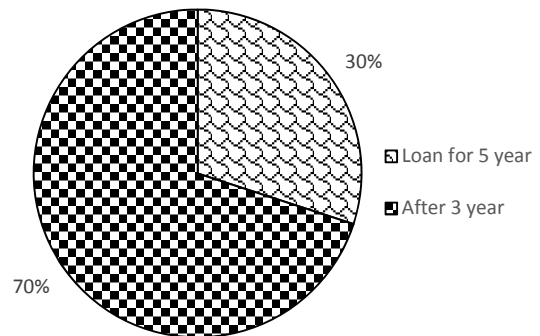
The respondents appeared to be more patient during this question as 70 per cent of the total sample are ready to save money and buy the flat in three years. This interim outcome shows that when it comes to more distant future people tend to act relatively more patient than in the closest time periods. It will be explored further by means of violin diagrams, regression model and decision tree.

The discount model. Hyperbolic discounting assumes that long-term discount rate differs substantially from a short-term discount rate due to the higher concern about the current well-being and diminishing value. As the hyperbolic discount model is considered as a most reliable on practice, it was implemented in this paper. In order to evaluate the credibility of the hyperbolic model two question about discount rate and different time horizons are included. Two variables are fully examined in the analysis: do respondents prefer 100 now or 150 in one year and do they rather take a loan for buying a flat or take their time and start saving their own money for three years. The rest of the factors played the role of the explanatory variables.

The model emphasizes on the influence of country and risk aversion factors on the subjective discount rate. Through the regression model we obtain the estimated values of discount rates including all variables described

above. The coefficients of all explanatory variables are computed and according to p-values such parameters as European group and risk aversion are considered to be significant. Belonging to American group is taken as a basic feature, so coefficients of the variables illustrating other country groups show the difference of the changes of the short-term discount rate with the switch from America to any other country. The coefficient of European group variable is extremely high, which indicates the decrease in the discount rate and the likelihood of choosing 150 dollars in the future instead of 100 dollars now. This result shows that European people are more patient in contrast to American ones. Same explanation is applied with the variable risk aversion based on the choice between bonds and stocks. Bonds are taken as a basic feature and high coefficient of the model means that the switch to riskier investment is connected with a drop in the discount rate. Hence, risk seeking people demonstrate higher degree of patience.

Then, in order to estimate the long-term discount rate and compare it with a short-term rate the willingness to take the loan is taken as an explained variable and same factors are included as explanatory variables. According to the results, even with a big confident interval, there is no significant connection between discount rate and included indicators. The previous question is based on precise alternatives: 100 dollars now or 150 in one year, which can reveal the subjective discount rate directly, whereas the question about long-term discount rate seems to be ambiguous in a light of the discount rate as it includes not only this parameter, but also the desire and opportunity to take the loan. This question implies some other factors which have impact on respondents' answers.

The violin plots are used to visualize the distributions of both discount rates. The average values for five years and one year are 8 per cent and 60 per cent. We assume that computed average values of discount rates represent the mean values and stimulate the distribution of these values using violin plots. It should be taken into account apart from the calculated values of discount rates that we suppose one per cent or very few people to have zero discount rate, which means that they are completely indifferent to the value of money. This assumption is made according to the necessity of two parameters in terms of the normal distribution-mean and standard deviation. The average value itself doesn't give any statistically significant information. Hence, the normal distribution cannot be plotted only with a help of one point and requires additional value. The shape of plots corresponds to the normal distribution. It becomes evident from the violin plot that discount rate is unstable through time and discount time for the nearest future is extremely higher than for more distant time period. One of the possible explanations could be the use of hyperbolic discounting which rejects the hypothesis about a single discount rate for any time period.
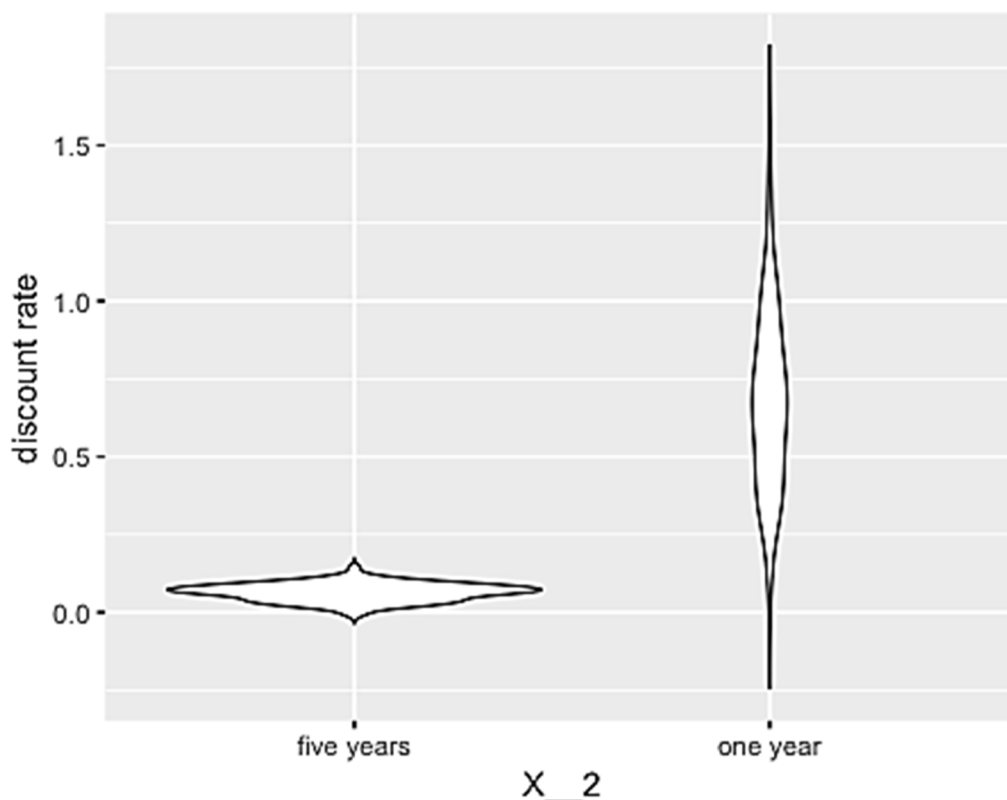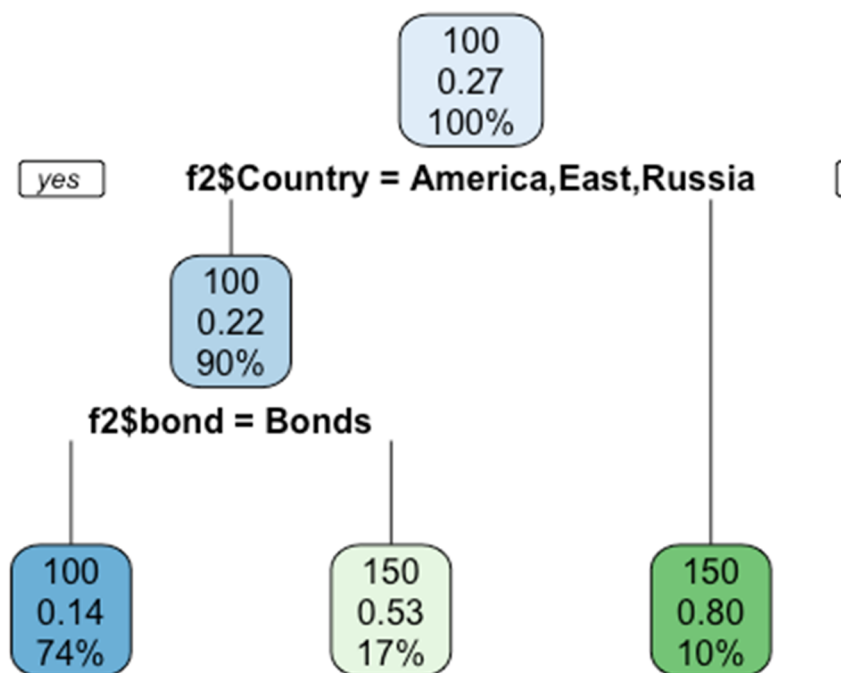
We will start in a root node with a question about a country factor. In every stage depending on factors respondents are divided into two categories and the amount of people, who are willing to make a decision between two outcomes: 100 dollars right now or 150 one year later, is calculated The left branch of the tree displays the positive answer for each choice and the right one-the negative reply. First we allocate respondents according to the question, whether they belong to America, East, Russia or not. According to the division of the sample, 90 per cent of the respondents originate these countries. The rest of the participants come from Europe. In each node there are three numbers: the percentage shows the proportion of respondents who reply positive or negative on each factor variable, decimal fraction illustrates how many people vote for 150 dollars later and the number above means the reward which was preferred by the majority of the respondents in a precise node and stage. The next stage lies in the question about the possibility to invest in secure bonds. The vast majority are likely to choose stocks and among this sample only 14 per cent have chosen 150 dollars later. Among people who prefer risky investments the decision of choosing 150 dollars in one year turned out to be predominant. As a result, the decision tree shows that the amount of patient respondents prevails over the impatient subgroup.

Conclusion. The approach of this paper was to identify, whether there is a certain impact of cultural peculiarities and risk aversion on time preferences and the formation of the subjective rate through the cross-cultural survey. Also during the practical part, the null hypothesis about the diminishing value of the rate was explained by hyperbolic discounting. The effect of uncertainty was carefully examined. The question about an access to the lending and borrowing tool was also included in the survey due to its possible impact on time preferences.

However, it is hard to explain all kind of anomalies only in terms of the hyperbolic model. Firstly, we assume that the respondents evaluate the nearest payoff and more distant one with the same analytical power. In contrary, some papers highlight that people due to some cultural perceptions do not evaluate the future reward as a real one, which leads to overweighting the current reward. There is an example of Latino people, who view time as a circular concept so they tend to orient more on the current well-being (Wang et al, 2016).

It was proved that a significant proportion of respondents demonstrate the impatience when two different time perspectives are compared between each other. The questionnaire consists of single payoffs which results in the decreasing discount rate, which is consistent with the hyperbolic discounting. However, Loewenstein and Prelec (1993) draw attention to the fact, that if people face the sequences of outcomes, they, in contrast to isolated outcomes, prefer an improvement of their utility through time. The explanation might be the adaption for different levels of utility and viewing positive or negative shifts as deviations from the standard of the consumption which is obtained at each level, which allow people to recognize positive changes as the most valuable (Loewenstein and Prelec, 1993). Therefore, impatience is frequently met in a light of single outcomes, whereas the sequence of outcomes entails the desire for improvement of the utility. There is one more difficulty which arises during the holding of an experiment. People while responding do not receive real payoffs so their answers cannot be considered as fully credible due to the lack of powerful incentives. Further-

more, we focus mainly on students as a subsample, but data presents some outliners expressed by some considerably older respondents than the majority of respondents.

Nevertheless, the effect of psychological and social factors: cognitive ability, cultural aspects, visceral influences, temptations on intertemporal analysis is evident. The main goal to illustrate different levels of discount rates among the countries according to the various degree of patience was achieved. There are some possible extensions to this paper, which will lead to more valid results and more complex model. In the future the model can be supplemented by including in questionnaire the part about losses so the difference in discounting gain and losses and preferable time gap can be jointly examined. Also the respondents can be separated according to the certain domains of their behavior. This idea requires complicated observations of the respondents' incomes and educational background in the dynamics so the analysis is carried out on practice. We can assume that people who graduate from the economic universities are more informed about the money value, inflation and discount function than people, who operate in other fields. That is why, it is crucial to divide all obtained data in some homogeneous groups. Anyway, this survey is an important step at establishment the correlation between the subjective discount rate and culture. Despite this observed link, the role of risk aversion with regard to the discount function, is also empirically confirmed. All the factors mentioned in this survey provide a valuable framework for further study of utility model and time preferences.

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Владімірова М. Ю., Розмаїнський І. В. Гіперболічне дисконтування і його наслідки: емпіричний аналіз на основі опитувань

У ході цього крос-культурного дослідження тимчасових переваг перевіряється достовірність моделі гіперболічного дисконтування. У даній статті порівнюються моделі експоненціального дисконтування і гіперболічна модель і пропонуються різні модифікації існуючих концепцій. Згадуються різні види аномалій, які викликають необхідність розширення моделі гіперболічного дисконтування. Ця стаття спрямована на вивчення моделі дисконтування, процесу прийняття рішень і формування суб'єктивної ставки дисконтування індивідів з точки зору поведінкової економіки, шляхом включення в модель таких психологічних чинників, як культурне й економічне середовище, а також несхильність до ризику. Ці доповнення призводять до більш складної і такої моделі дисконтування, що заслуговує довіри. Прокрастинація розглядається як пряма реалізація гіперболічного дисконтування. Крім того, виділено потенційні недоліки, що виникли в ході експериментальної частини, і запропоновано можливі рішення. Емпіричний аналіз заснований на опитуваннях.

Ключові слова: ставка дисконтування, тимчасові переваги, гіперболічне дисконтування, прокрастинація, несхильність до ризику.

Vladimirova M., Rozmainsky I. Hyperbolic Discounting and Its Consequences: Empirical Analysis on the Base of Surveys

During this cross-cultural research regarding time preferences the credibility of hyperbolic discounting model is examined. This paper is based on the comparison between the exponential discounting model and hyperbolic model and proposal of different modifications to the existing concepts. Different kind of anomalies, which bring up the necessity of the extension of the hyperbolic discounting model, are mentioned. This paper is aimed at exploring the discount model, the process of decision-making and the formation of the individuals' subjective discount rate from the standpoint of behavioral economics by including in the model such psychological factors as cultural and economic environment and risk aversion. These supplements lead to more complex and credible discount model. The term of procrastination is considered as a direct implementation of hyperbolic discounting. Furthermore, the potential drawbacks occurred during the experimental part are highlighted and possible solutions are proposed. Empirical analysis is based on the surveys.

Keywords: discount rate, time preferences, hyperbolic discounting, procrastination, risk aversion.

Владимирова М. Ю., Розмаинский И. В. Гиперболическое дисконтирование и его последствия: эмпирический анализ на основе опросов

В ходе этого кросс-культурного исследования временных предпочтений проверяется достоверность модели гиперболического дисконтирования. В данной статье сравниваются модели экспоненциального дисконтирования и гиперболическая модель и предлагаются различные модификации существующих концепций. Упоминаются различные виды аномалий, которые вызывают необходимость расширения модели гиперболического дисконтирования. Эта статья направлена на изучение модели дисконтирования, процесса принятия решений и формирования субъективной ставки дисконтирования индивидов с точки зрения поведенческой экономики, путем включения в модель таких психологических факторов, как культурная и экономическая среда, а также нерасположенность к риску. Эти дополнения приводят к более сложной и заслуживающей доверия модели дисконтирования. Прокрастинация рассматривается как прямая реализация гиперболического дисконтирования. Кроме того, выделены потенциальные недостатки, возникшие в ходе экспериментальной части, и предложены возможные решения. Эмпирический анализ основан на опросах.

Ключевые слова: ставка дисконтирования, временные предпочтения, гиперболическое дисконтирование, прокрастинация, нерасположенность к риску.