Behaviour of subjects in risk markets

Chování subjektů na rizikových trzích

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Abstract: Consumer's behaviour is described mostly by the neoclassical theory in the framework of cardinalistic and ordinalistic models which involve the methodological individualism, the concept of rationalism, the equilibrium and the perfect information of consumer. Consumer in the financial actives market decides in a similar way. Consumer can make decisions also uder the condition of risk and uncertainty.

Key words: actives market, theory of expected utility, prospect theory, risk, uncertainty

Abstrakt: Chování spotřebitele popisuje především neoklasická teorie v rámci svých kardinalistických a ordinalistických modelů, které předpokládají metodologický individualismus, koncept racionality, rovnováhu a dokonalou informovanost spotřebitele. Podobně se rozhoduje i spotřebitel na trhu finančních aktiv. Spotřebitel se také může rozhodovat v podmínkách rizika a nejistoty.

Klíčová slova: trh aktiv, teorie očekávaného užitku, prospektová teorie, riziko, nejistota

Between the situations of risk and uncertainty, there can lay many transitional degrees, which are distinguished by v rate of the accessible information. It can be demonstrated on the following example. There is a bag with one hundred white or black balls. The subject is supposed to take one out and to win or lose depending on the fact that he/she can guess the right colour. If he/she does not know what the ratio of the white and black balls is, he/she experiences uncertainty. If he/she gets the chance to see n balls from the sack, his/her degree of information increases proportionally to the size of n. If he/she could have seen all one hundred balls before, his/her information is complete, he/she enters the risk.

Simply, we can say that the risk expresses a situation when the subject decides on the base of information about the probability distribution of the possible outcomes, which are available. On the other hand, in the situation of uncertainty, this information is missing, the summary of the possible outcomes is not predictable or beforehand recognizable. The economic theory must analyze these problems.

The "new" economy is slowly but inevitably becoming the "qualified" economy – the economy of knowledge; because more and more human advanced discoveries and developments are applied to all kinds of goods and procedures of manufacturing (Šilerová and Kučírková 2008).

MATERIAL AND METHODS

Basic streams of the economic theory are also divided from the point of view of the risk and uncertainty concepts. The neoclassical attitude (Fama 1993) is based on maximizing the goal magnitude (utility, net benefit) and is used mostly in the expected utility theory and works with the probability functions.

The theory of new Keynesians (Stiglitz and Walsh 2002) is based not only on the limited rationality (Simon 1972) and imperfect information, but also on the net benefit maximizing behaviour, even they use the probability methods. The post-Keynesians insist on the non-ergodicity of the probability processes. For instance P. Davidson says that the future evolution cannot be anticipated in principle and the subject functions the in environment of a great uncertainty. The article is interested in comparing of these attitudes.

RESULTS AND DISCUSSION

Systematic and non-systematic risk

Risk can be viewed as a difference between the real future states and the expected future state. This difference arose due to the change of the risk factors, which translated the utility of subjects.

The reason of risk arising is a probability act, which either can result from the patterns of a certain process or one cannot predict it for a certainty. The risk rate can be explained by using the variability of the random quantity, which is most frequently quantified by the standard deviation of the changes of this quantity. There are two kinds of risks, systematic and non-systematic.

The non-systematic risk is unique for any asset (market transaction); its cause can be the entrepreneur risk, low liquidity, management problems etc. It can be lowered by the diversification of the portfolio among a larger number of different activities. Its alternative cost is a risk-less rate of return, it cannot be included in the risk premium.

The systematic risk is related to all assets, that is to the asset market as a whole and it is given by the economic system, for example the stocks market can record lower yields for the recent year than for the last year, the cause for it could be a change in the currency exchange rates, the change in the interest rates, inflation, the political situation and so on. This risk cannot be lowered by the diversification of the portfolio consisting of only inland assets. Its alternative cost is not the risk-less rate of return, it can be included in the risk premium.

The overall risk can be lowered even under the level of the systematic risk thanks to the diversification in the form of buying international assets (international diversification). The cause is that the domestic macroeconomic indicators influence the yields of most of the inland shares in the same way. Therefore, the purchase of the foreign assets deepens the diversification.

Mechanisms of the subject for facing the risk

They are related to the subjective decision instrument about the economic behaviour. These arrangements are the following (according to Knight 1921)

(1) *Consolidation* – Consolidation means gathering the activities, which are characterized by a high level of risk or uncertainty, in larger groups, where this uncertainty is dispersed. Here, in the past, the differentiation processes of the production programs of large corporations took place in the areas of increased uncertainty with regard to the demand dynamics under the influence of technological progress and structural changes.

(2) *Specialization* – The role of the subjective factor in the context of the uncertainty elimination process is expressed mainly in the mechanism of specialization of certain subjects on the activities connected with running a risk. That is mainly the concern of the stock market participants. The specialization results from the fact that the subjects are very different in their ability to face the risk and uncertainty. There is a group of "specialists" existing, today we would say subjects with a positive approach towards risk, who are gifted in the features, which are in this meaning more adequate than in other people's cases. They are mostly also the participants of the risk assets market.

(3) *Diversification* – Diversification is a dispersion of certain economic activity into more activities. These are the most efficient in the case of the negative correlation among the mentioned activities. An example can be the shares of a company producing sunglasses and the shares of a company producing fur coats. If the price of one such share increases, the price of the other one will decrease. Nevertheless, it is very complicated to find such a couple. However, if the shares are not in the perfect correlation, that is their prices do not change completely in the same way, there will always be yields from the diversification. In this meaning, the international diversification is very efficient.

(4) *Spreading the risk* – Another mechanism is a dispersion of the consequences of some economic activity into more subjects. The typical example is an insurance, which represents a sale of a certain part of the respective risk to different subjects. However, a similar role also has the asset market, especially the stock market. It allows the firm owners to change the yield flow in time in the single-shot income, but primarily to spread the risk, which would result from the fact that their property would be allocated only in one firm. The asset market (especially stocks) allows transferring the risk from the subjects, who rather have the risk aversion, to those, who are to run the risk for certain compensation; thereby it is a vehicle of spreading the risk.

(5) *Forecast* – The forecast can be understood as an ability, on the base of the gathered information, learning and experience, to estimate the future trend and that way to influence it partly. It consists mainly in the work of stock and share analysts.

(6) *Not-exposing to risk* – The final way is simply no exposure to risk at all and the management of the economic activities in a generally more certain frame, which itself, on the other hand, can be a very risky strategy.

Reducing the probability of an adverse event occurring increases the producers' expected income and reduces the income variance with a positive impact on wealth (Špička et al. 2009).

Models of behaviour of asset market participants in the relation to risk

Theory of efficient markets

One of the notable theories, dealing with the security rates description (especially stocks), is the theory of efficient markets. It has been developed by Eugen Fama at the beginning of the seventies of the 20th century with the intention of a neoliberal hypothesis of rational expectations, carrying its main structures. The main idea is that the security rates absorb all the relevant information, which is easily accessible, immediately and rightly. The past observations have no impact on the future trend of the security rates.

Presumptions of an efficient asset market

- There are many rational subjects in the market, whose goal is to maximize the net earnings
- There exists a perfect competition in the market; no participant has a privileged position
- These subjects have the abundance of cheap, accessible and up-to-date information
- These subjects react quickly to new information
- The market is highly liquid (cashable)
- Transaction costs are low
- There is a quality infrastructure and a legal market control

There can be three basic forms of the efficient markets defined according to the intensity of efficiency.

1. *Weak form of efficiency* – The security rate includes all historical information and that is why the anticipation based on its past flow is impossible. By this, the technical analysis looses sense.
2. *Meso-scale form of efficiency* – The security rate includes all historical and present publicly available information. By this, also the fundamental analysis (the current situation analysis and the prediction of the future) looses sense.
3. *Strong form of efficiency* – The security rate includes all kinds of information, even the non-public ones. That makes any analysis senseless.

The empirical research never proved the strong version significant, because it was proved that there is a non-public (insider) information present, to which only several market participants have an access and they, based on it, can achieve extraordinary earnings. According to the other two versions of the theory of efficient markets, there can be an extraordinary yield achieved by some of the participants just based on luck or the unexpected information, not on the base of their abilities.

According to this theory, there are no permanently undervalued or overvalued security rates. That means that it is impossible to learn if the share is undervalued or overvalued, because all assets are correctly valued by the market. The actual market price is the best estimation of the equilibrium price of the share.

The neoclassic theory defines the behaviour of these participants on the base of several economic models, of which the most important is the Expected Utility Model by von Neumann and Morgenstern (1953), which is already for several decades the basic subject's decision making model under the terms of risk.

Expected utility model

This model presumes that a subject is able to assign a certain subjective utility to the yield or loss and the utility is given by the function of the expected utility. His/her behaviour is rational and he/she chooses an option, which gets him/her, ceteris paribus, the maximal total utility.

The historic predecessor of the theory of the expected utility is the theory of the expected value, according to which the subject makes the decision based on the expected outcome of different alternatives. If there are two alternatives (1 and 2) of the possible outcome with certain behaviour available (for example the purchase of securities), then the expected value of the yield in future is:

$$EV = p_1 \times M_1 + p_2 \times M_2 \qquad (1)$$

where:
EV = the possible outcome
p_1 (p_2) = the probability of getting the yield M_1 (M_2)

Already in the 18th century D. Bernoulli signalized the fact that it is possible to buy for certain price, the implication in a bet, most of the participants will not be willing to pay more than a certain limited level of this price, no matter what is the expected value. Bernoulli has reached the decision that the yields M_1, M_2 enter the decision making process not on its own accord, but transformed by a function, which, later, got the name of the function of the expected utility. This idea was further extended by von Neumann and Morgenstern. We can show the expected utility model in a simplified form.

It holds that the expected utility is explained by the following equation:

$$EU = p_1 \times U(M_1) + p_2 \times U(M_2) \quad (2)$$

where EU is the expected utility, $U(M_1)$ and $U(M_2)$ present the functions of the expected utility, which explain, how the subject evaluates the prices M_1 (M_2) from his/her point of view. The expected utility function has to fulfil these requirements:

– transitivity
– continuity
– comparison integrity (it is possible to compare any two outcomes)

If the subject, for example a participant of the asset market, who, at the very beginning, disposes of a certain possessions amounting M, decides between buying an asset or not, whereas the amount of the possible yield and also of the possible loss is B, then he/she compares the expected utility of these two possible yields with the expected utility of the wealth he/she would have reached while not realizing the asset market purchase. That is amounting $U(M)$. If the subject buys the asset, the following relation has to be valid:

$$p_1 \times U(M_1) + p_2 \times U(M_2) \geq U(M) \quad (3)$$

In a simplified case, there can be just two options reached and their outcome is M_1 or M_2, so it holds that:

$p_1 + p_2 = 1$

Let us mark that

$p_1 = p$ is the probability of getting M_1

$p_2 = 1 - p$ is the probability of getting M_2

Different types of subject's behaviour at the risk asset market can be differed by the choice of the suitable type of the function of the expected utility. We will show three possibilities of this.

The case, considered by Bernoulli, is a special case of a concave function of the expected utility, where the behaviour is distinguished by the risk aversion.

Risk aversion

According to the graphic expression, the function looks like this; it must have the concave shape (Figure 1 and 2).

One of the functions of the expected utility which we can use here is the following:

$$U = a \times M - M^2 \quad (4)$$

where a is a constant, M is the size of the wealth of the subject.

A standard situation, which we are going to consider, is that with v probability p, the investment into shares will bring a yield amounting to B and the total subjects property will raise to $M + B$, reversely with the probability of $1 - p$, the purchase of the shares will lead to the loss amounting to B, the total assets of the subject therefore decline to $M - B$. By contrast, in the case of the subject's decision not to realize the purchase, his/her assets would stay at the original amount of M. The subject would choose the first option in this case:

$$P \times a(M + B) - p(M + B)^2 + (1 - p) \times a \times (M - B) - (1 - p) \times (M - B)^2 \geq p \times a \times M - p \times M^2 \quad (5)$$

After the adjustments of the given inequation, we can derive the condition for p:

$$p \geq 0.5 \times \left(1 + \frac{B}{a - 2M}\right) \quad (6)$$

The lowest value of p, for which the relation is valid, is the following:

$$p^* = 0.5 \times \left(1 + \frac{B}{a - 2M}\right) \quad (7)$$

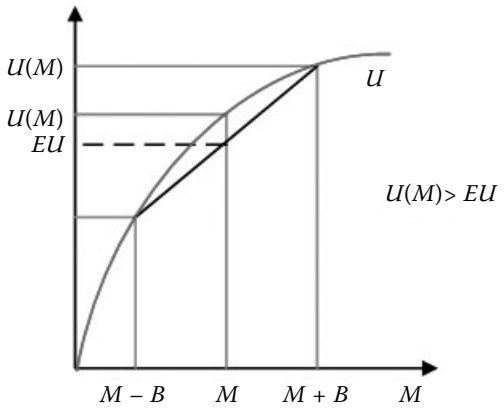

Figure 1. Total utility – risk aversion subject

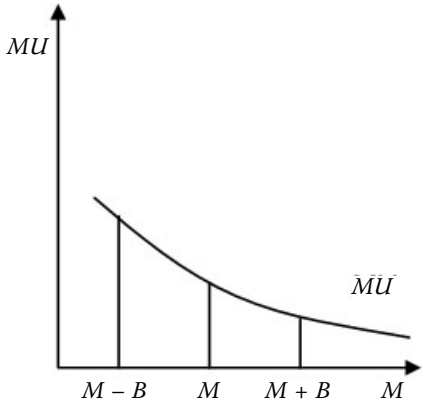

Figure 2. Marginal utility – risk aversion subject

We call it the boundary value probability. The subject wants to realize the stated investment only at the time, when the probability of reaching the positive option (yield) is higher of equal to p^*:

$$p \geq p^* \tag{8}$$

We can note that in case of this expected utility function is the boundary value probability always higher than 0.5, alias the achievement of the yield is far more likely than the achievement of loss. The second feature of the behaviour, being driven by the given function of expected utility, is the fact that, while raising the value B, the boundary value raises too. If the value of the achievable yield (or of the possible loss) was higher, the subject would ask for higher probability of the appearance of the positive alternative, because the subject does not like to risk. Its behaviour can be described as a risk aversion. The marginal utility function is decreasing.

The risk aversion is the most often observed kind of behaviour, but not the only one. Especially at the asset market, we meet also different approach, which is a positive relation to risk.

Positive relation to risk

The expected utility function, which would describe the positive relation to risk, has a convex shape (Figure 3 and 4).

An example of such a simple function is:

$$U = a \times M^2 \tag{9}$$

Let us assume that there is a subject in the same situation as the previous participant, but this one follows the concept of the expected utility function. The condition for the asset purchase would be:

$$P \times a(M + B)^2 + (1 - p) \times (M - B)^2 \geq a \times M^2 \tag{10}$$

After the adjustment of the relation, we get:

$$p \geq 0.5 \times \left(1 - \frac{B}{4M}\right) \tag{11}$$

and for the boundary probability:

$$p^* = 0.5 \times \left(1 - \frac{B}{4M}\right) \tag{12}$$

The boundary probability here is always lower than 0.5 and lowers while B grows. That means that it is enough for this subject when the probability of success is lower than one-half, it would enter the market with the risk, even if the probability of appearance of the positive alternative were lower than unfavourable. Moreover if the value of accessible yield or possible loss gets higher, it will be willing to enter the market even with lower boundary probability value, thus it chooses to risk more, that is to react completely reversely than the participant of which the behaviour showed some risk aversion. The behaviour of this subject is characterized by a positive relation to risk. The marginal utility function is increasing.

The third option, which is not so very common at the risk asset market, is a neutral relation to risk.

Neutral relation to risk

If the model of expected value was about to be applied to everyday decision making with low amounts of money, the function has to be almost linear (Rabin 2000). In this case, the subject's behaviour would be described as one with the neutral relation to risk which can be described by the following way (Figures 5 and 6).

We can consider the following total utility function. This function is linear:

$$U = a \times M \tag{13}$$

If we used the same procedure as in the previous two cases, the outcome will come up as:

$$p \geq 0.5 \quad \text{or} \quad p^* = 0.5 \tag{14}$$

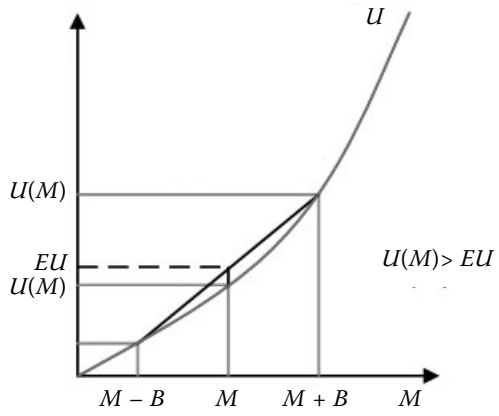

Figure 3. Total utility – risk loving subject

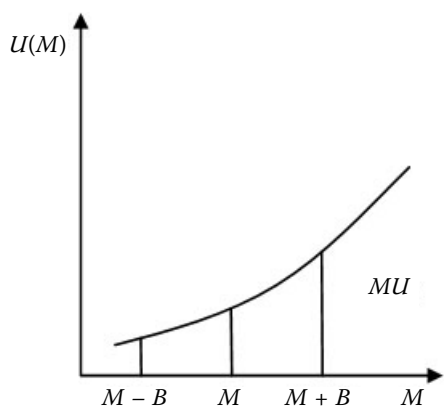

Figure 4. Marginal utility – risk loving subject

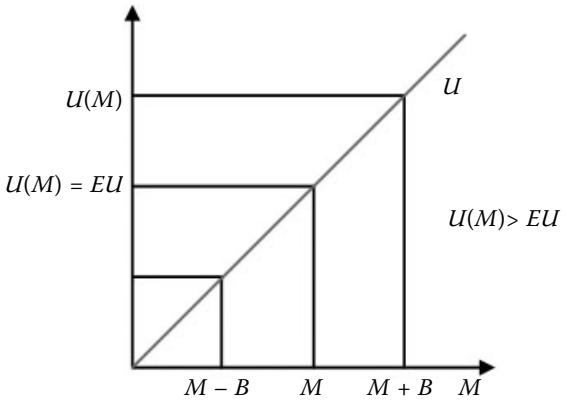

Figure 5. Total utility – risk neutral subject

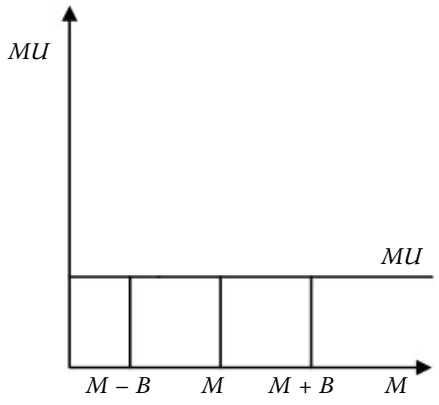

Figure 6. Marginal utility – risk neutral subject

The boundary probability of this subject is independent on the greatness of *M* and *B* and it is always equal to one half, that means the decision made is, under any circumstances, based on a higher probability of achieving the positive alternative than the unfavourable alternative. The changes of *M* a *B* do not have any impact on its behaviour. The function of marginal utility is constant.

No matter what type of the stated behaviour the subjects apply, in any case the present risk represents some costs for each of them. Not even a participant with the positive relation to risk would accept an asset which, in the positive case, increases the wealth and decreases the wealth in the unfavourable case, just for the joy of the game. Even the subject counts on a certain premium for the risk; although he/she subjectively values his/her own cost lower than a participant with the risk aversion would in the same situation.

From the technological point of view, in future it could be possible to consider an upgrade of the tools for the description and evaluation of risk profiles, the tools for ambiguity handling (e.g. utilizing fuzzy logic), which could add still more robustness to strategic profiles and enhance the natural understanding. (Sobotka, Vrana 2007)

CONCLUSION

The theory of efficient markets by Fama and his followers has become one of the pillars of the economic theory of the 80s, as a part of a much wider stream of the neoliberal theories of rational expectance, which were in favour of the free market with minimal regulations. The eventual economic and political arrangements flowing from the behaviouristic concept of Thaler would prop upon certain regulations, which would minimize the negative impact on the asset market failure.

Financial markets should be fully integrated – with the single regulation, accounting and supervision rules, settlement rules etc. across the Eurozone (Rusek 2008).

In the light of the newsmakers of the end of 90s and especially of the first decade of 21st century, the theory of efficient markets probably loses its position in favour of the behaviouristic theories (Skořepa 2004).

The economic decisions under risk and uncertainty can be different from the forecasts of different theories, for example the theory of the expected utility. The prospect theory explains many phenomena, which are out of accord with the expected utility model. For example Tversky and Kahneman (1979) became the main representatives of behaviourism in economic thinking that is in use especially when analyzing the asset markets. However, their perceptions are important of the analysis of the common consumption behaviour. Other alternative theories were developed in the last years; these theories use the expected utility theory but cross its framework (Starmer 2000).

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