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The Cumulative Prospect Theory and Managerial Decision Making

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Abstract: Can managerial decision making be predicted? Why would we want to predict managerial decision making? Managerial job is largely that of making decisions. In order to be successful, those decisions have to be right. In this article authors investigate if the cumulative prospect theory is applicable to managerial decision making and describe some divergent views about the theory. They also explore risk perception under the influence of decision framing. Risk propensity too is explored as it is an alternative way of predicting decision-makers behaviour.

JEL classification: M2

Key words: prospect theory, cumulative prospect theory, decision making

Introduction

In a series of recent laboratory and field experiments on Croatian managers (Tipurić, Prester, 2003), it emerged that risk taking is one of the crucial factors of individual and business success. If willingness to take risk is the differentiator between good and average decision maker, is it possible in some way to induce risk taking?

The main proposition of prospect theory is that if managers 'frame' a decision negatively they will be taking risk. If they frame it positively they will be risk avoiding. Framing means setting a reference point against which something is viewed as a loss or as a gain. If we find a reliable pattern of risk behaviour (risk taking under

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losses and risk avoiding under gains) it could enable managers to manage risk behaviour more effectively.

There is much controversion about the prospect theory. Pablo (1997, 1998) in an extensive literature research show that some experiments support the prospect theory while others deny it.

Another interesting research was done by Küherberger (1999). In a metanalysis of 150 works that investigated the prospect theory framing effect, he found that this two fold pattern (risking under losses and risk avoiding under gains) weakens as the scenario departs from the original 'Asian disease problem'.

There are even researches (Levy and Levy, 2002) that question the shape of the value function of the prospect theory. Wakker (2003) though, criticises the findings. He claims that Levy and Levy data actually support the prospect theory, because they did not take into the account the 'subjective probability function' (also called decision weight).

Wang (1996) in an Asian problem like analysis finds that people get more risk seeking the lower the number of people's life in the simulation. Moreover, if the subject had to imagine that those lives are their relative's lives, they became even more risk seeking. Wang concludes that framing is very context depending.

On the other hand Di Mauro and Maffioletti (2001) state that their results 'confirm the presence of the well-known fourfold pattern of risk attitude'.

According to this vast number of researches that disagree about the prospect theory's two fold pattern (risking under losses, risk avoiding under gains), we explore whether cumulative prospect theory, which predicts a fourfold pattern, has better predicting power. The cumulative prospect theory predicts that people will be risk seeking in the domain of losses but only for higher probabilities. Similarly, people will avoid risk in the domain of gains only for high probabilities. Opposite pattern of behaviour will be observed in low probability conditions.

Before entering into measurement let us briefly describe how the prospect theory was developed to show that the criticism of the same is too hard. Its aim was to show that people are not rational in the sense that classical utility theory postulated. Classical utility theory was actually based on that assumption. Prospect theory's greatest achievement is that with classical utility shows tools that people are not rational. The Nobel prize winner H. Simon also tried to show that rationality assumption do not hold good. Sitkin and Pablo (1992) were the first to challenge the prospect theory. We introduce the cumulative prospect theory, but this cannot be done without explaining the prospect theory. Jet to describe the prospect theory one should go into the origins of decision making under risk.

Decision theory dates way back to the 18th century. Kahneman and Tversky (2000, p. 2) mention the essay of Swiss physicist Daniel Bernoulli from 1738. In his work, Bernoulli introduces the term 'utility' of a decision alternative. This utility is

subjective. Bernoulli postulated the S shaped utility function (which still holds true), a concave function of total wealth to explain why people are generally averse to risk and willing to settle for a lower compensation in exchange for safety. He assumes the rationality of the decision maker, meaning that he will always choose the alternative that maximises his utility.

Simon in 1955 radically criticises the concept of rationality in decision making and introduces a more appropriate concept of rational behaviour than the maximisation of utility. He exchanges global rationality with 'bounded' rationality which is in accordance with the availability of information and computational abilities of the decision maker. The decision maker chooses the first alternative that fulfills a minimal set of requirements. It seems as he was much before his time. 'Economists never took his ideas with any vigor because they just found elegant mathematics that left no room for messier cognitive theories' said Camerer, (2001, p.1).

In the seventies of the last century psychologists started to explore economic decision making. These research had quite different approach from the one Simon suggested. They embarked from the Classical Utility maximization and discovered cognitive mechanisms that departed from the normative behaviour. The most important work of this kind in 1950s was done by W. Edwards and later by Kahneman and Tversky. This prospect theory as developed by Kahneman and Tversky is the alternative to classical utility theory. (Camerer, 2001, p.1).

Central principle of the prospect theory is that decision maker's view in each decision situation is independent. Therefore the value function is defined over changes of wealth rather than total wealth (unlike Bernoulli's utility function which is the function of total wealth, but like Markowitz utility function). Each situation is viewed in terms of gains or losses from some reference point for each situation. Losses are undesirable for about twice from a gain in equal amount. The value function is concave in domain of gains and convex in the domain of losses which defines behaviour in risk situation. By risk behaviour we mean decision making in a risky and uncertain context, that is, whether a decision maker will choose safe or risky alternative. Risk is defined in terms of probability of the occurrence of the alternative. Safety means that the probability of the alternative convergent to one. Uncertainty is a special case of risk when probabilities are not known, and therefore quantitative methods can not be used. The value's function curvature describes the observation that decision makers will be risk seeking in the domain of losses and risk avoiding in the domain of gains. Kahneman and Tversky also introduce nonlinear function of decision weight also called subjective probability. This subjective probability is used in calculus instead of probability. The same maximisation principle holds, that is, the decision maker will choose the alternative for which the product of the value function

and the subjective probability is maximum. Knowing the value function and the subjective probability function one can then predict the decision maker's choice.

At about the same time as Sitkin and Pablo (1992) presented their model (by which they challenged the prospect theory and which we briefly describe in following sections), Kahneman and Tversky in an article called 'Cumulative Prospect Theory' show that the proposed behaviour holds true only for high probabilities and that a preference reversal is occurring at low probabilities.

We believe that if we found the threshold probability under which preference reversal occurs, one can predict and in that way influence managerial risk taking. With this investigation, we also enter into the field of studies of perception of risk, which are not very explored by economists but rather by psychologists.

In order to understand decision framing, preference reversal and how it affects our perception of risk, we shall first define the meaning of the terms.

Risk Behaviour

By risk behaviour we mean decision making in circumstances of risk and uncertainty. That means whether a decision maker will make a sure or risky decision. If the decision maker chooses a sure alternative we say that his risk behaviour is risk avoiding. The probability of the chosen alternative converges to unity. If he chooses a risky alternative his behaviour is risk seeking. A decision is more risky to the extent that the probability of occurrence is lower, alternatives may have high consequence results, or there are so many possible alternatives that makes the manager unable to narrow the selection by use of quantitative methods. We extend risk behaviour to decision making under uncertainty, where by uncertainty we mean that there are no quantitative estimates of possible alternatives, or that there are so many alternatives that the choice can not be narrowed (Beenhakker, 1975, p. 126)

Decision Framing

Decision framing is a term coined by Kahneman and Tversky. It applies to the prospect and to the cumulative prospect theory. Ever since scholars questioned the assumption that managers make decisions by using normative decision making models (March & Shapira, 1987), investigators have proposed and tested various theories that incorporate a decision maker's beliefs or perceptions. Because most managerial decisions involve some degree of risk, scholars have become interested in examining how determinants of risk taking influence such decisions.

Tversky and Kahneman (1981) used the term framing for the finding that simple and unspectacular changes in wording of a decision problem can lead to different preferences for risk taking. Drawing on the prospect theory argued that different wording of formally identical problem makes people code the outcomes of identical options as gains or as losses relative to the reference point. They used the following simulation to show that people are risk averse under gains and risk seeking under losses.

Imagine that the US is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that exact scientific estimates of the consequences of the programs are as follows.

Positive frame (Reference point – 0 life saved)	**Negative frame** (Reference point – 0 dead people)
Safe alternative	Safe alternative
If program A is adopted, 200 people will be saved. [72% participants]	If program C is adopted, 400 people will die. [22% participants]
Risky alternative	Risky alternative
If program B is adopted, there is: • 1/3 probability that 600 people will be saved and • 2/3 probability that nobody will be saved [28% participants]	If program D is adopted, there is: • 1/3 probability that nobody will die • 2/3 probability that 600 will die [78% participants]

Looking closely we see that the simulations are mathematically equivalent and the difference is only in wording. Let in the negative frame 78% of participants chose the risky alternative and in the positive frame 72% chose the safe alternative. This reflection effect clearly violates the invariance principle, which is widely accepted in normative models that form the backbone of decision theory (Kühberger et al., 1999, p.205). It also shows that Bernoulli's assumption that people are generally risk averse does not hold. This phenomenon demonstrates that choice behaviour can be crucially affected by the form in which decision alternatives are presented, rather than being a product of a systematic analysis of expected outcomes (Maule and Hodginson, 2002, p.69).

According to Kühberger et al. (1999, p.205) there is substantial empirical investigation of reflection effect, which show risk taking under losses and risk avoiding under gains, but that effect weakens as the simulation differs with the Asian disease problem. We chose the Sitkin-Weingart simulation because it does not follow the Asian disease syntax. We want to see if we would get the reflection effect even if the simulation differs from the original Asian disease problem, since managerial decisions are rarely so strictly formulated. If no framing effect should emerge from our experiment, percentage of choosing the safe over the risky alternative should not significantly differ from 50%.

Preference Reversal

Preference reversal is often confounded with the reflection effect. Reflection effect means that participants choose different options in an equivalent decision situation (like in the Asian disease problem 78% chose the riskier alternative even though simulations are equivalent). No reflection effect would mean that participants choose equally each alternative. By preference reversal we mean the opposite behaviour pattern then predicted by the prospect theory, that is, risk taking under gains and risk avoiding under losses. The subjective probability has an inflection point around the probability 0,4 as can be seen on the following picture, therefore we hypothesize that preference reversal occurs around that probability.

The picture also shows the effect that people misjudge probability which was explored way back in 1953 (Tipurić 1998). It shows that we overapriciate the likelihood of low probability events and underappricate the likelihood of fairly probable events.

Cumulative Prospect Theory

Cumulative prospect theory was introduced to overcome the numerous examples that showed that two fold pattern does not hold (risk taking under loses and risk avoiding under gains). Take for example Kennedy's executive team (Kennedy, 1998, p.3). The team is facing declining demand for their firm's product, but nonetheless they refuse to risk and enter a new market as would predict the prospect theory. Instead they turn into themselves in a sort of cognitive blockade.

Kahneman and Tversky replaced the utility function with the value function defined by the equation 2. Probability is exchanged with subjective probability, also called decision weight defined with the equation 3. The same maximisation principle holds as in classical utility theory. The decision maker will choose the alternative which has the maximum value as shown in equation 1.

$$V(f)=\sum_{i=-m}^{m} f_i w(x_i) \tag{1}$$

$$f(x)=\begin{cases} x^{\alpha} & x \geq 0 \\ -\lambda(-x)^{\beta} & x \leq 0 \end{cases} \tag{2}$$

$$w(p)=\begin{cases} \dfrac{p^{\gamma}}{(p^{\gamma}+(1-p)^{\gamma})^{1/\gamma}} & x \geq 0 \\ \dfrac{p^{\delta}}{(p^{\delta}+(1-p)^{\delta})^{1/\delta}} & x \leq 0 \end{cases} \tag{3}$$

Since the decision maker chooses the option with the highest value, and the value being the product of value and subjective probability function a four fold pattern of behaviour is emerging.

Coefficients $\alpha=\beta=0.88$ show that the value function is symmetric about the origin. Coefficient $\lambda=2.25$ shows that we dislike losses 2.25 more then a gain in equal amount. Coefficients $\gamma=0.61$ and $\delta=0.69$ are nearly the same which shows that the subjective probability is nearly the same in domain of losses or gains. The subjective probability function is shown on the picture 1. X denotes the amount of the potential outcome, whereas p denotes the probability of the alternative. These function are now known but it has taken over twenty years of research to come to this explicit functions (Wakker, 2003).

Risk Perception

Sitkin and Weingart (1995, p.1575) define risk perception as individual's assessment of how risky a situation is in terms of probabilistic estimates, of the degree of situational uncertainty, how controllable that uncertainty is, and confidence in those estimates. Risk perception appears to relay strongly on personal traits and socio-cultural parameters, such as education, experience, habits, political orientation, beliefs, and values (Michalsen, 2003, p.2) or age, gender, culture, hierarchy level proposed by Tipurić, Omazić, and Hruška (2003, p.2), or industry (Pablo, 1999, p. 92-107). Perception of risk is at best an imprecise phenomenon. Since perception affects all aspects of managerial decision-making, its imprecision makes unstructured and complex choices something less than an exact science. Perception is important in decision making because it provides a means of gathering information in search for relevant alternatives (Harrison, 1999, p. 200). MacCrimmon and Wehrung (1986, p. 34) on the other hand, divide managers into risk takers and risk averters. Risk takers

will perceive lower risk, while risk averters will tend to look at the worst-case scenarios, biassing probabilities and overestimating possible losses.

Several studies indicate that risk perception is complemented or dominated by subjective or intuitive assessments of risk, which has prompted a debate over a possible theory-practice gap (Harris and Emmanuel, 2000, p.2). Expert exhibit the same types of biases as lay people with respect to perception of risk, especially when forced to go beyond the limits of their observable expertise. Probability judgments are especially vulnerable to the presentation and organisation of events in risk assessment, as individuals are relatively insensitive to omitted events and overly sensitive to events presented in great detail. There is evidence that gender and age may influence the evaluation of risk, although the precise interpretation is uncertain (Skjong and Wentworth, 2002, p. 538). According to Sitkin and Weingart (1995, p. 1576) decision framing is a very important influence on decision maker's perception. They cite researches from Neal, Bazerman and Alperson (1986) Singh (1986) Tversky and Kahneman (1986) (1992) which show that influence of problem framing on decision making is robust. However, Sitkin and Weingart state that these studies have not directly examined the causal mechanisms that underline the observed behaviour. Therefore, they propose introduction of a cognitive mechanism through which observable behavioural responses occur. They hypothesise that positively framed decision will be perceived as involving higher risk than negatively framed situations that leads to risk avoidance in the domain of gains. They actually state that there is negative relationship between perceived risk and making risky decisions, that is risk avoidance is greater if higher risk is perceived then when a decision maker perceives low risk. Their work implies that managers who wish to either increase or decrease the risk taken by their subordinates or others can most effectively target their efforts toward problem framing. Following the Sitkin Weingart simulation we test the hypothesis that positive frame will induce higher perceived risk then the negative frame leading to risk avoidance in positive frame and risk seeking in negative frame.

Entrepreneurship and Risk Perception

Despite the high risk involved, thousands of individuals decide to start ventures. Past research, however, has found that entrepreneurs do not have a high-risk propensity, that is, a great willingness to knowingly take risks. Simon, Houghton and Aquino (1999) suggest that risk perception differs because of certain types of cognitive biases lead individuals to perceive less risk. Cognitive biases are common types of mental shortcuts used to make judgments. Further they say that research on behavioural decision-making indicated that individuals neither comprehensively search for, nor accurately interpret, information because their cognitive capacity is limited. To cope with these limitations, they employ cognitive heuristics and simplifying strategies

which may lead to a number of cognitive biases. If risk perception influences risk-taking, it becomes important to determine what leads to variations in risk perception. Some scholars have argued that individuals' decision process, particularly a greater susceptibility to cognitive biases, may lower their perception of risk.

Risk Propensity

Pablo (1997) argues that only when risk propensity is introduced as an additional causal variable can contradictory predictions of risk behaviour be resolved. She states that risk propensity dominate factors related to situational characteristics. Risk propensity is not a stable trait of an individual, but rather it is explained as a current tendency that results from risk preferences, inertia and outcome history (Pablo and Sitkin, 1992, p. 27). Sitkin and Pablo found also other influences on risk propensity like age, gender, the amount of potential gains and losses but they bound themselves on only those three influences.

Risk propensity as a determinant evolved from the researches that show stable decision maker's behaviour over time[1]. Sitkin and Pablo identified three main categories of departures from the prospect theory which they named risk preferences, inertia and outcome history. These three independent and measurable variables form risk propensity construct which is defined as individual's temporary tendency to take or avoid risk (Pablo, 1997, p. 8). Sitkin and Pablo argue that risk propensity is generally applicable to individuals and organizations as decision-making entities (Pablo and Sitkin, 1992, p. 32), unlike the prospect theory for which Paese et al. (1993) argue that may not be as valid in group decision-making (Pablo, 1997, p. 7).

Risk propensity has been defined as the general likelihood that an individual will behave in a more or less risky manner across various situations (Slattery and Ganster, 2002, p.92). This construct represents a consistent pattern of risk behavior that influences how risks are evaluated and what risks are deemed to be acceptable. Some scholars have found that individuals exhibit stable differences in whether they prefer or reject risk taking, but other scholars have failed to identify the existence of any reliable dispositional differences in risk taking (MacCrimmon and Wehrung, 1990).

Although Sitkin Pablo model of risk propensity driven behavior is an interesting and very practical model it has its shortcomings. It gives good predictions only in the medium level of risk propensities.

The Hypotheses

Kühberger et al. (1999, p.205) report that reflection effect weakens with simulations that part from the 'Asian disease' structure. One asks if this framing effect is robust enough to be applied on managerial decision-making. Managerial decisions are seldom in the Asian disease form. Therefore by modified Sitkin Weingart simulation (the simulation involves business risk of launching a new product instead of car racing) we test if we will get a reflection effect. The simulation is presented in Appendix. We start by null hypotheses that we get no framing effects, that is, frequency of participants response on both simulation should be around 50%.

H1=There should be no reflection effect in simulation that depart from Asian disease problem

Kühberger et al. (1999, p.217) with a meta-analysis based on 150 empirical investigations conclude that the predictions of the cumulative prospect theory for low probabilities are wrong. They obtained weak risk aversion under gains and weak risk taking under losses. In their study, only 23% of simulations involved probabilities less than ¼. They did not analyse possible causes of the observed behaviour. They also did not state what is the stronger behaviour pattern in simulations with low probability. We on the other hand believe that the cumulative prospect theory predictions are valid and propose a different method for testing the propositions, namely, we propose measurement with simulations that requires that participants state the probability under which preference reversal occurs. The simulations are also presented in the appendix. Our simulations are more like Cubitt, Munro, Starmer (2002, p. 33-36) experiment in which they also asked their participants to evaluate probabilities explicitly. We could not adopt their research method because it mostly involved gambles, which does not adequately describe managerial decision-making (March and Shapira, 1986, p.1410). Therefore our next hypothesis is:

H2= probability at which preference reversal occurs is above 0,4.

Although Sitkin and Pablo in 1992 propose that risk perception is a very extensive construct that takes into account organisational and situational characteristics, in both measurements (Sitkin and Weingart 1995 and Pablo 1997); they tested only the influence of problem framing on risk perception. They believed that that influence of problem framing on risk perception is strongest. Since we are exploring influences on managerial decision-making, we want to test if differently framed decisions will also induce different risk perceptions. We adopt the Sitkin Weingart (1995, p.1577) argument that it is still unexamined how decision framing comes to affect decisions. If framing of the decision does in fact change the perception of risk than the risk

perception measures should differ for the positive and negative simulation. On the contrary, if decision framing does not change decision-makers perception then risk perception measures should not be different for those two simulations. Since we question the influence of decision framing in situations which depart from Asian disease syntax, we also question the impact of decision framing on perception. Therefore our third hypotheses are:

H3= positively framed decisions will not be perceived as involving higher risk then negatively framed decisions

We would also like to see how much entrepreneurs differ from ordinary managers regarding risk. Therefore we state two hypotheses regarding the difference between risk propensity and risk perception of entrepreneurs.

H4= Managers have lower risk propensity then entrepreneurs

H5= Managers perceive higher risk than entrepreneurs

Methods

This is our third investigation of decision making under risk and uncertainty. The first two (Tipurić and Prester, 2003) showed preference reversal, therefore this time we tried to make the simulations more realistic on the ground of previous results. We use the same methodology as Sitkin and Weingart and Pablo (1997). Our simulation follows the structure of Sitkin Weingart simulation, except that our respondents had to imagine that they were launching a new product instead of car racing. The comparison is made because we believe that higher risk and uncertainty present in transition countries will give different results. The methodology consists of using simulations of business decisions which are standard for investigating decision making (Pablo (1997, p. 9)). Half of the participants obtained the negative and half the positive simulation. Additional test are done by 7-point Likert Scales. The use of questioners for investigation of decision making is grounded on two assumptions; First, managers usually know how they would react in real decision situation (Shafir, Diamond, Tversky, 2000, p.341), (MacCrrimon and Wehrung, 1986, p. 80). The other assumption is that respondents do not have special reason for hiding their true preferences (Kahneman and Tversky, 2000, p. 19).

Sample

Unlike the sample of A. Pablo, where only oil executives were questioned, our sample involves executives from various industries – from banks to civil engineering. The justification for involving different industries we found in the work of A. Pablo (1999, p. 92-107) in which she shows that different industries perceive risk in different ways and have different risk propensities.

We conducted our research on 67 MBA students who are also managers. Most of the students (39 out of 67) all fall in the category of only 5 years experience. The primary functional areas were general management (21%), production (15%), finance (12%), informatics (12%), and 33% stated their work is something else. In the sample 58% were male. Interestingly in the top management women dominate (6 out of 8 top executives). Most of the participants (79%) work in privately held companies. That fact is of no interest to our investigation except that it proves that our managers are responsible for the outcomes of their decisions. The ratio of paying for the postgraduate studies is 43% (paying on their own): 57% (paid by the company). As such they represent successful managers. As much as 55% of respondents consider themselves as entrepreneurs. Therefore the sample is relevant for testing weather entrepreneurs have different perception of risk.

Results

Decision Framing

Decision framing was tested by a simulation in which participants had to choose whether they will risk and launch a new product or they would settle for less risky alternative. In both simulations if they decided to risk and launch a new product they could get government subventions or loan. If they chose the safe alternative they still get the loan. In the negative simulation the word loose government subvention is used and for positive simulation keep the loan is used (simulations are given in the appendix). Respondents chose the risky alternative (82%) regardless of simulation, as can be seen from the following table:

Table 1: Ratio of Risk Taking over Risk Avoiding

Simulation	Risk	Safety	Total
Negative	79,41%	20,59%	100,00%
Positive	84,85%	15,15%	100,00%
Total	82,09%	17,91%	100,00%

Table 2: The Framing Effect

Simulation	Risk	Safety
Negative	49,09%	58,33%
Positive	50,91%	41,67%
Total	100,00%	100,00%

As we can see from the table 2, there is a very weak framing effect present, because percentages in positive and negative do not differ significantly. The χ^2 was evaluated using the frequencies from the Asian disease problem. We obtained χ^2 =26,79 which is far greater then the threshold value (χ^2 =7,83, d.f.=1, p=0,005). The same analysis was done for risk avoiding. Thus we have to agree with Kühberger (1999, p.205) that further the simulation from the original Asian disease problem the less framing effect is detected. What we can learn from this experiment is that successful managers in Croatia are risk takers (82%). Generalizing this result one concludes that successful managers take more risk regardless of framing.

Preference Reversal

Preference reversal was also tested with two simulations. Half of participants obtained a 'secure' alternative and were asked to state the probability for changing to a riskier option. The other half of the participants had to imagine they a risky job and had to state the probability they would switch to a lower paid but secure job. The simulations are given in the appendix. The average probability for changing jobs was p=0,48 for both simulations. That is higher then presumed probability p=0,4. The χ^2 test was evaluated on the frequency of respondents who chose the probability less then p=0,4. The χ^2=66,00 is greater then the threshold value (χ^2 =7,83, d.f.=1, p=0,005). Therefore our second hypothesis is accepted. Our results are also in accordance with the investigation of Watkins (2003, p.2) who, investigated individual estimates of various possible deaths in comparison with statistics of those deaths. If his results are depicted graphically the inflection point p is at 0,5.

On the basis of the difference of obtained preference reversal probability from the one predicted by cumulative prospect theory, we can not safely apply cumulative prospect theory findings to managerial decision making. We do not agree with Kühberger et al. (1999, p.217) that cumulative prospect theory does not hold. That is, risk taking under losses happens only for high probabilities and risk avoiding in negative for low probabilities.

Payoff Size in Simulations

In the Sitkin Weingart simulation we used the same amounts that the authors propose. If those values are compared with the average wage for the switch of jobs (3.040 $) one concludes that maybe offered amounts were too high for the responders to imagine the situation. That is in accordance with findings of Holt and Laury (2001, p. 1) who state subject may not imagine well the situation in case of high monetary outcomes. We state this observed phenomenon because Kühberger et al (1998, p.222) state that probabilities and payoffs are not independent because they both enter in the Prospect theory value function. Interestingly they found that the median value is 600, which is the value used in original Asian-disease problem.

Preference Reversal Probability and Payoff Size

We found positive correlation between preference reversal probability and payoff size (r=0,2). This positive correlation means that more sure the subject where about switching their actions the larger payoff they demanded. That is an absolutely reasonable course of action. It means also that more unattractive an option looks the subjects would demand higher payoffs.

Risk Perception

Risk perception was manipulated with the use of simulations. Responders had to answer on 7-point Likert scales (given in the appendix). The measurement takes into account the simulations.

The average values on these questions are given in the following table.

Table 3: Average Value of Perception of Risks of Launching a New Product

	How big Risks	Potential gain	Motivation to risk
Negative simulation	3,871,36	2,641,54	2,911,57
Positive simulation	3,941,63	2,621,88	2,911,67

If framing does affect risk perception then average values received for positive and negative simulation should differ. In fact positively framed simulation is perceived as involving lower risk. We tested if these differences in average values are statistically significant and obtained following measures:

Table 4: Student t-test Coefficients for Testing the Difference between Average Values in Respect to Simulations

	How big Risks	Potential gain	Motivation to risk
T	2,869	4,263	3,832
P	0,006	0,000	0,000

The t test for all three statements shows that there is statistical significance between these two sample means, because the t values exceeded 2,66 for df.=60. That means that decision framing did affect risk perception, although the influence is weak. Therefore the hypothesis that decision framing does affect risk perception is accepted.

Interesting results emerged when we analyzed risk perception and risk propensity of entrepreneurs versus managers. The risk propensity measures are given in the following table.

Table 5. Average Risk Perception Values Depending on the Entrepreneurial Status

	How big risks	Potential gain	Motivation to risk
Entrepreneur	4,06± 1,71	2,57 ± 1,55	2,81 ± 1,70
Non entrepreneur	3,52 ± 1,05	2,73 ± 1,87	3,08 ± 1,29

Obviously entrepreneurs have higher risk perceptions which is in accordance with findings of Simon, Houghton, Aquino, (2000).

Table 6: t-test Coefficients for Testing the Difference between Average Values in Respect to Entrepreneurial Status

	How big Risks	Potential gain	Motivation to risk
T	11,666	9,326	9,817
P	0,000	0,000	0,000

The t test for all three statements shows that there is statistical significance between these two sample means, because the t values exceeded 2,66 for doff.=60. That means that entrepreneurs have significantly different perceptions of risk than managers, thus our forth hypothesis is accepted.

Risk Propensity

In literature we found several studies that show that there is no difference in risk propensity between entrepreneurs and managers (Sarasvathy, Simon, Lave (1998. p.

207), Palich and Bagby (1995, p. 427) and Simon, Houghton, Aquino (2000, p.1)). Palic and Bagby (1995) for example state that entrepreneurs frame decision more positively which leads them to perceive less risk and that they do not have greater risk propensity. We, on the other hand found difference in risk propensity that is in accordance with the meta analysis done by Stewart and Ross (1999, p. 10)

Table 7. Risk Propensities of Entrepreneurs and Non Entrepreneurs

Entrepreneur	N	Mean Risk propensity	s.d.
Yes	37	5,08	1,16
No	26	4,15	0,96

Regression analysis showed that correlation coefficient is r=0,392 meaning that higher risk propensity can predict weather the responded has entrepreneurial ambitions. The t=9,1 p<0,001 shows a clear difference between these two samples means. Therefore we can conclude that entrepreneurs have higher risk propensities, which is not in accordance with Simon, Houghton, Aquino, (2000) who claim that entrepreneurs have lower risk perception but shame risk propensities.

Conclusion

In this study, we have attempted to extend the examination of the prospect theory by testing the framing effects and preference reversal predicted by the cumulative prospect theory. We started with a belief that cumulative prospect theory predictions can be applied to managerial decision making. We laid out our hypotheses as if those propositions did not hold and tried to prove them wrong. Unfortunatly that was not the case. We obtain a very weak framing effect at the loss frame but preference reversal in the gain frame. Regardless of simulations our subjects were more risk taking (82%). The preference reversal occurred at p=0,48 which is greater then the probability at which subjective probability function has the inflection point. That makes us conclude that preference reversal might not be connected to the inflection point of the subjective probability function suggested by the cumulative prospect theory. Our results agrees with the results of Watkin's (2003, p.2) empirical research that the inflection point is around 0,5.

Considering the general lack of main effects for initial framing condition across studies, it appears that the cumulative prospect theory framing effects found in most risk taking research cannot be safely generalised to risk taking in dynamic uncertain environments such as managerial decision making. Although we can not safely use the prospect theory propositions on managerial decision making we still have to

pinpoint the enormous contribution this theory gives in decision making as a general field.

Kühberger (1998, p.211) noted, moreover, that the size of framing effects appears to be a function of a variety of aspects of the framing manipulation. One factor that is especially relevant in this context concerns the magnitude of the outcomes. It is conceivable that framing effects could change in magnitude or even reverse direction for very large payoffs. But while such large magnitude payoffs might be common in actual managerial situations, it would be difficult to manipulate them in a controlled experimental setting. We tried to simulate such decisions by asking subject to state the monetary outcome of changing their decisions. That revealed that monetary outcomes (3.040 $) are far lower than the ones used in Sitkin Weingart simulation. Because of that subjects probably could not imagine well the situation of such high monetary outcomes. Holt and Laury (2001, p. 1) state that participants may not imagine well a situation with high monetary outcomes which in turn resulted in a weak framing effects. We are not as strict as Kühberger (1999, p.217) who claims that the cumulative prospect theory does not hold, but we agree that its predictions are to be used with great caution in managerial decision making.

Decision framing does influence risk perception. It is a very useful finding that is not very explored in the literature. It shows that positively framed situations lead the decision maker to perceive less risk. It means that by presenting a problem in positive light one can influence and predict risk perception and thus risk behaviour.

The interesting finding that entrepreneurs versus managers perceive lower risk and have higher risk propensities call for more explorations in dynamic uncertain environments that explore both the individual and cognitive processes that underlie risky decisions in organizations. Therefore we suggest that further research should be in the direction H. Simon proposed in 1955 (p. 101) - the discovery of heuristics and biases that managers use in order to simplify decision problem and to meaningfully exploit the opportunities that risky decisions entail. That may be more helpful to understanding and learning about the managerial decision process then trying to evaluate the probabilities decision-makers attach to a potential outcome.

NOTE

[1] The prospect theory's value function is defined over changes of wealth therefore the theory is fully situational, that is, there is no mechanism to take into account stable characteristics of the decision maker. Kahneman and Tversky were not satisfied with this one variable function because they saw in their experiments that not all decisions are valued undependably. They believed that such decision problems could be taken into account if the value function was a function of two variables – initial wealth and changes. Aware of the mathematical complications that would arise, they settled for this simplified one variable function. (Kahneman and,Tversky, 2000, p. 32)

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APPENDIX

Sitkin Weingart Simulation (Adopted from Sitkin and Weingart (1995, p.1584)

Positive frame	Negative frame
You face a tough decision involving the launch of a new product. The competition is tough. If you launch the new product you have 42% probability to enter among five best manufacturers, to win 300,000 kn government subventions and a reward for quality of the product. If you decide not to launch the new product you can keep the loan ease in the sum of 500,000 kn. What will you choose? ☐ Launch ☐ Not launch	You face a tough decision involving the launch of a new product. The competition is tough. If you launch the new product you have 29% probability that you wouldn't succeed to obtain the planed market share by which you loose 300,000 kn of government subventions and 500,000 loan ease. If you decide not to launch you lose government subventions. What will you choose? ☐ Launch ☐ Not launch

Preference reversal test

Positive frame	Negative frame
Imagine you have 5 years work experience since you obtained your Masters degree. You have a good, secure and well paid job. With your knowledge and experience you have good chance to star-up a small prosperous firm. This move is risky but it can bring you greater rewards. How probable is this situation in comparison to your current situation? _____,__ % For what monthly wage would you undertake such a risk _____ kn/ month What is the probability for your risking with that wage _____,__%	Imagine you have for 5 years now a successful little firm. So far you were successful in dealing with risk. Now for the first time you face a bigger loss. Will you risk and try to save a company or you will accept an offer from a friend for a lower salary but a secure job How probable is this situation in comparison to your current situation? _____,__ % For what monthly wage would you accept your friend's offer _____ kn/ month What is the probability for your accepting this lower paid but secure job _____,__ %

This is big risk for me	I have to risk if I want to gain	The possibility of gain motivates me to risk
(1-I absolutely agree 7-I absolutely disagree)	(1-I absolutely agree 7-I absolutely disagree)	(1-I absolutely agree 7-I absolutely disagree)
☐ 1	☐ 1	☐ 1
☐ 2	☐ 2	☐ 2
☐ 3	☐ 3	☐ 3
☐ 4	☐ 4	☐ 4
☐ 5	☐ 5	☐ 5
☐ 6	☐ 6	☐ 6
☐ 7	☐ 7	☐ 7
☐ 8	☐ 8	☐ 8