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INDIVIDUAL AND GROUP DECISION MAKING: ARE GROUPS MORE RATIONALLY CONSISTENT THAN INDIVIDUALS?

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Introduction

Expected utility theory has occupied a dominant role in the study of decision making under risk and it has been generally accepted as a *normative* model of rational choice, and extensively applied as a descriptive model of economic behaviour. Therefore, it is assumed that all rational people would wish to obey the axioms of the theory (von Neumann & Morgenstern, 1944), and that most people actually do, generally.

Several authors have shown the existence of anomalies or violation of Expected utility theory, since the famous Allais paradox (Allais, 1953), and there have also been several authors who tried to provide accounts of these anomalies by proposing new theories.

This thesis describes several classes of choice problems in which preferences systematically violate the axioms of Expected Utility Theory and presents an alternative theory developed by Kahneman and Tversky's called Prospect Theory (1979; Tversky & Kahneman, 1992) .

This description allows me to address the main topic and the main aim of this thesis: verifying whether group decision makers violate Expected Utility Theory more, less or to the same extent as individuals actually do.

Experimental evidence on this field will be reported in order to critically evaluate the issue and to finally answer the opening question.

1 - Expected Utility Theory

1.1 - Foundations, axioms and assumptions

Varian (2006) expresses the standard model of consumer behavior in a simple statement : " people choose the best thing they can afford" (p.33). This is essentially a constrained optimization situation in mathematical terms. The objects of consumer choice are referred to as consumption bundles, which are a list of the goods and services that are involved in the particular choice problem being considered. If a consumer chooses the x-bundle to the y-bundle, it means the x-bundle is preferred to the y-bundle and this can be written as $(x_1, x_2) > (y_1, y_2)$. In discussing the foundation of the Standard Economic Model (SEM) it is necessary to make a distinction between the basic axioms of the model and other relevant assumptions that accompany it. Following Wilkinson (2008), the axioms can be described as follows:

Completeness

An assessment between any two consumer bundles, X and Y, must lead to only one of these mutually exclusive outcomes:

a) X is preferred to Y $(x_1, x_2) \geq (y_1, y_2)$

b) Y is preferred to X $(y_1, y_2) \geq (x_1, x_2)$

c)The consumer is indifferent between the two baskets $(x_1, x_2) \sim (y_1, y_2)$

Transitivity

Dealing with three different baskets, X, Y, and Z, a consumer who prefers basket X to basket Y, and basket Y to basket Z, must also prefer basket X to basket Z.

If $(x_1, x_2) \geq (y_1, y_2)$ and $(y_1, y_2) \geq (z_1, z_2)$, then $(x_1, x_2) \geq (z_1, z_2)$

Correspondingly, a consumer who is indifferent between basket X and basket Y, and between basket Y and basket Z, must be indifferent also between basket X and basket Z.

Reflexivity

Any bundle is at least as preferable as itself : $(x_1, x_2) \geq (x_1, x_2)$.

In addition to the above axioms there are three main assumptions, particularly relevant in situations where there is uncertainty. They can be summarized as follows (Wilkinson, 2008):

Cancellation

This is the principle that any state of the world that results in the same outcome regardless of one's choice can be cancelled or ignored. This notion has been captured by different formal properties , such as the substitution axiom of von Neumann and Morgenstern (1944), the extended sure-thing principle of Savage (1954), and the independence condition of Luce and Krantz (1971). Thus, if X is preferred to Y then the prospect of winning X if it rains tomorrow (and nothing otherwise) should be preferred to the prospect of winning Y if it rains tomorrow, because the two prospects both result in the same outcome (nothing) if there is no rain tomorrow . The main point of this assumption is that only one state of the world will actually be realized, which make it reasonable to assess the results of options separately for each state. The choice between options should therefore depend only on states in which they yield different outcomes (Tversky & Kahneman,1986).

Dominance

This is perhaps the most obvious principle of rational choice: if one option(X) is better than another (Y) in one state and at least as good in all other states, then option X is dominant over option Y and should be chosen. Dominance is both simpler and more compelling than cancellation and transitivity (discussed earlier) and it serves as the cornerstone of the normative theory of choice (Tversky & Kahneman, 1986).

Invariance

This condition is essential for any normative theory: different representation of the same choice problem should yield the same preference. That is, the preference between options should be independent on their description. This principle is so basic that it is tacitly assumed in the characterization of options rather than explicitly stated as a testable axiom (Tversky & Kahneman, 1986).

1.2 - Choice under uncertainty

Uncertainty arises because the consequence of a decision is not a single sure outcome but rather a number of possible outcomes (Gravelle & Rees, 2004). It is supposed that there exists a vector (e_1, e_2,… , en) of environmental variables (variables whose values are determined by some mechanism outside the economic system and which can be regarded as parameters) , where each variable can assume a finite number of values Ej = (j= 1,2,…, n). A state of the world is described as a specific combination of the value of the environmental variables , i.e. a specific value of the vector (e_1, e_2,…, en). It is easily understandable that the number S of states of the world is also finite and these states are indexed by a number s= 1,2,…, S and it is used Ys to denote the level of income the individual gets in state s. Three essential properties of the set of states of the world underpin this theory and are basic to all subsequent analysis:

a) The set is exhaustive, in that it contains all the states of the world that could possibly obtain.

b) Members of the set are mutually exclusive, in that the occurrence of any one eliminate the occurrence of any other.

c) The occurrence of any state of the world is not under the control of any decision-taker and cannot be influenced by the choice of any economic agent, or by any coalition of agents.

These properties qualify the precise formalization of the situation of "uncertainty" for purposes of the theory. Three further assumptions have to be made:

a)All decision-takers catalog the possible combinations of environmental variables in the same way.

b) Only when one state of the world arrives, all decision-takers will be able to recognize which state of the world exists and will agree on it.

c) The probability of the event that a particular state of the world will take place may vary for different decision-takers, but all probabilities satisfy the basic probability laws. The probability associated with the *s*th state by decision-taker *i* , denoted π_{si}, lies on the interval $1 \geq \pi_{si} \geq 0$, with $\pi_{si}=1$ implying that *i* regards state *s* as the certain event , and $\pi_{si}= 0$ implying that *i* regards state *s* as an impossible event. The probability of one or another of several states occurring is the sum of their probabilities and the probability of their concomitant occurrence is zero, and , especially, one of the S states must occur.

Having covered properties and assumptions that underpin the theory of choice under uncertainty, it is possible to deal with the optimal choice under uncertainty and what is usually called the von Neumann-Morgenstern Theory of Expected Utility (EUT) .

It is assumed that there is a single good, which is measured in units of account , and which can be thought as 'income': y_s (s= 1, 2 , . .. , S) an amount of income which the decision-taker will receive if and only if state s occurs. The individual assigns a probability π_s to state of the world s, and denote the vector of probabilities by $\pi= (\pi_1, \pi_2, . . . , \pi_s)$, while $y= (y_1, y_2, . . ., y_s)$ is the corresponding vector of state contingent incomes. A prospect P is defined as a given income vector with an associated probability vector or as a probability distribution of incomes:

$P = (\pi, y) = (\pi_1, \pi_2, \ldots, \pi_s, y_1, y_2, \ldots, y_s)$

A different prospect is obtained changing the probability vector π, or the income vector y (or both). Any decision has as its only and entire consequence some prospect P, and so choice between alternative actions or decisions is equivalent to choice between alternative prospects. A preference ordering over decision can be derived from a preference ordering over their associated prospects.

1.2.1 - The axioms

To analyze choice under uncertainty it is required a theory of the preference ordering over prospects, explained by three axioms described below:

Ordering of prospects

If the decision-taker prefers one prospect to another or is indifferent between them, these relations of preference and indifference are transitive. For any two prospects P_j, P_k, exactly one of the statements $P_j > P_k$, $P_j < P_k$, $P_j \sim P_k$, is true, while we can assume $P_j > P_k$ and $P_k > P_l$ thus $P_j > P_l$ and similarly for the indifference relation ~. This axioms means that the preference ordering over prospects has the same desired properties of completeness and consistency which are attributed to the preferences ordering over bundles of goods.

Preference increasing with probability

The decision-taker always prefers the prospect which gives better possibility of receiving the higher-valued outcome, while two prospects with the same probability of getting the better outcome would be regarded as equivalent.

Context independence

In order to state this axiom it is necessary to introduce the concepts of *standard prospect* and *compound prospect*. A standard prospect is a prospect involving only the greatest and the smallest income value with probabilities *v* and (*1- v*) respectively, where $1 \geq v \geq 0$. A compound prospect Pc ,instead, is one which has, for at least one of its outcomes, another prospect rather than a single value of income.

Pj ~ Pcj all J= (1,2, . . . , n)

Saying it in words: the decision-taker is indifferent between a given prospect and a compound prospect formed by replacing each value of income by its equivalent standard prospect. For example, suppose that the decision-taker is indifferent between (a) £70 for certain, and a 50-50 chance of £200 or £10 , and (b) £100 for certain , and a 75-25 chance of £200 or £10. This axiom asserts that he/she would then be indifferent between a 50-50 chance of £70 or £10, on the one hand , and a 50-50 chance of obtaining one of two further gambles: (a) a 50-50 chance of £200 or £10, and (b) a 75-25 chance of £200 of £10, on the other. The fact that values of income, and their equivalent standard prospects, may be included in prospects, does not change their basic relation of indifference (which is what the term ‘context independence’ tries to convey).

1.2.2 - Properties of Utility function

It is usual to call the function *v(y)* , with Y representing incomes, a utility function, since it is a real-valued numerical representation of a preference ordering . ‘Utility’ it is not to be interpreted as quantity of satisfaction, well-being or other specific sensation but simply as a name for the numbers which results when we carry out a series of paired comparisons.

The value $\bar{V}_j = \sum_{s=1}^{S} \pi_s^{1} \bullet V^s$ is the *expected utility* of prospect Pj, and the axioms should be interpreted to mean that the decision-taker chooses among projects as if to maximize expected utility.

The axioms described above imply some features of the utility function *v(y)*: it increases with income, y ; it uniquely defined relative to the greatest and the smallest value; and it bounded above by the value 1 and below the value 0. Furthermore, the fact that the decision-taker can be assumed as if he/she maximized expected utility implies another important property of the function. However there are other properties which require further assumptions in order to be explained. For this type of analysis it is useful making the assumption that the utility function is differentiable at least twice in its entire domain, that is, if the derivatives v'(y) and v''(y) exist for all y in the interval between the smallest and the greatest value. The derivative v'(y) is called the *marginal utility of income* and v''(y) is the rate at which marginal utility of income changes with income. The second assumption concerns the attitude of the decision-taker toward risk. Suppose that the decision-taker is confronted with a prospect $P = (\pi, y_1, y_2)$. The expected value of the outcome is $\bar{y} = \pi y_1 + (1-\pi) y_2$ and the *certain equivalent* of the prospect is, yc, as that value of income which satisfies $yc \sim P$ or equivalently $v(yc) = \bar{v} = \pi v(y_1) + (1-\pi) v(y_2)$: the amount of income which, if received for certain, would be regarded by the decision-taker as just as good as the prospect P. yc is indifferent to P and its utility must equal the expected utility of P .

The three possible relationships between the certain equivalent yc and the expected value of the outcomes $\bar{y}$ are:

(a) $yc = \bar{y}$. The decision-taker values the prospect as its expected value. In this case,

$$\pi v(y_1) + (1-\pi) v(y_2) = \bar{v} = v(y_c) = v(\bar{y}) \qquad [a]$$

where $\bar{y} = \pi y_1 + (1-\pi) y_2$. A preference ordering over alternative prospects can be based totally on the expected values of the outcomes of the prospects, with higher expected value always being preferred to lower.

(b) $yc < \bar{y}$. The decision-taker values the prospect at less than its expected value. In this case,

$\pi\, v(y_1) + (1-\pi) v(y_2) = \bar{v} = v(yc) < v(\bar{y})$ [b]

In this case a preference ordering over alternative prospects could be based on the expected values of outcomes, since they overstate the values of the prospects. To predict the ranking it is required to know the utility function or the certainty equivalents.

(c) $yc > \bar{y}$. The decision-taker values the prospect at more than its expected value . In this case,

$\pi\, v(y_1) + (1-\pi) v(y_2) = \bar{v} = v(y_c) > v(\bar{y})$ [c]

Neither in this situation a preference ordering over prospects could not be based on the expected values of outcomes, since these now understate the values of the prospects. To predict the ranking it is needed again to know the utility function or the certainty equivalents.

A way of classifying attitudes to risk is provided by these three cases, based on comparison of the certainty equivalent and expected value. In the first case the decision-taker is *risk neutral* ; in the second he/she is *risk averse* , and in the third case he/she is *risk attracted.*

It is necessary to consider the implication of these three cases for the utility function v(y). First, the definition of convex and concave functions. Given some function f(y) , defined on a convex set Y, the function is concave if and only if

$f(\bar{y}) \geq kf(y_1) + (1-k) f(y_2)$ $0 \leq k \leq 1$ y_1, y_2 elements of Y

where $\bar{y} = ky_1 + (1-k) f(y_2)$. A linear function fulfills this equation as an equality, while a strictly concave function satisfies it as a strictly inequality.

However, in equations [a], [b] and [c], if we replace *f* by *v*, we see that case (a) , risk neutrality, corresponds to a linear function (at least over the range $[y_1, y_2]$), while case

(b) , risk aversion, corresponds to a strictly concave utility function (over the range $[y_1, y_2]$) , in addition, the function *f(y)* is strictly convex if –f(y) is strictly concave, and so case (c) , risk attraction, corresponds to a strictly convex utility function.

The risk averse individual prefers to have a certain income of $\bar{y}$ rather than the risky prospect $P= (\pi, y_1, y_2)$, where $\bar{y}$ is the mean of the risky incomes y_1, y_2. The risky prospect is costly to the risk averse individual in that it reduces the expected utility compared with the certain prospect of $\bar{y}$. A monetary measure of the cost of risk can be obtained by asking individual how much of his certain income he would be willing to give up rather than facing the risky prospect . This sum of money *r* is the *risk premium* or *the cost of risk* and is defined by

$$v(\bar{y} - r) = \pi v(y_1) + (1-\pi)v(y_2) = \bar{v}$$

since the individual is indifferent between the risky prospect P with expected income $\bar{y}$ and the certain income $(\bar{y} - r)$. Comparing $v(\bar{y} - r) = \pi v(y_1) + (1-\pi)v(y_2) = \bar{v}$ which defines the risk premium and, with $v(y_c) = \bar{v}$ which defines the certainty income y_c it is possible to see that

$$v(y_c) = \bar{v} = v(\bar{y} - r)$$

and the risk premium for the prospect P can equivalently be defined by

$$r= \bar{y} - y_c$$

The implicit assumption in the preceding observations of attitudes to risk that is the meaningful to place sign restrictions on v’’(y) hints that the utility function v(y) is not an ordinal utility function. This function v(y) is not a unique illustration of the decision-taker’s preferences. By changing one or both of the outcomes in the standard prospect it is possible to obtain, for each certain income y, a different probability *v* at which the decision-taker would be indifferent between the certain income and the standard prospect.

2 - Inconsistencies with the basic tenets of utility theory

Expected Utility Theory (EUT) has occupied a dominant role in the study of decision making under risk and it has been generally accepted as a *normative* model of rational choice, and extensively applied as a descriptive model of economic behaviour. Therefore, it is assumed that all rational people would wish to obey the axioms of the theory (von Neumann & Morgenstern, 1944), and that most people actually do, generally.

Several authors have shown the existence of anomalies or violation of Expected Utility Theory, since the famous Allais paradox (Allais, 1953), and there have also been several authors who have tried to provide accounts of these anomalies by proposing new theories defined by Starmer (2000) either "conventional", when they accept some of EU axioms, or "nonconventional" (see Wilkinson, 2008, chapter 3, for a synthetic presentation).

Since Kahneman and Tversky's Prospect Theory (1979; Tversky & Kahneman, 1992) has been surely the most influential of these non conventional theories, I shall focus my attention on Prospect Theory (PT), especially on its original formulation provided by Kahneman and Tversky 's (1979) in their seminal article published in Econometrica.

The aim of their famous paper "*Prospect theory: An analysis of decision under risk*" is to demonstrate that Expected Utility Theory is not an adequate *descriptive* model of choices and to advance an alternative account of decision under risk.

In the first part of this article Kahneman and Tversky examine several anomalies that violate axioms of EUT, while in the second part they provide the first presentation of Prospect Theory.

2.1 - The Critique

Kahneman and Tversky open the critical section describing decision making under risk as a choice between prospects (x_1, p_1; . . . ; x_n, p_n) or gambles, and reminding the three tenets on which the application of Expected Utility Theory is based:

(i) Expectation : $U(x_1, p_1; \ldots ; x_n, p_n)= p_1u(x_1) + \ldots + p_n u(x_n)$.

This means that the total utility of a prospect, *U* ,is the expected utility of its outcomes.

(ii) Asset integration : $(x_1, p_1; \ldots ; x_n, p_n)$ is adequate at asset position *w* if $U(w + x_1, p_1; \ldots ;w + x_n, p_n)>u(w)$

Meaning that a prospect is acceptable if the utility consequential from adding the prospect to one's assets exceeds the utility of those assets alone.

(iii) Risk aversion: *u* is concave ($u''<0$). In Expected Utility Theory, risk aversion implies the concavity of the utility function. A risk averse person is one who prefers a certain prospect (x) to a risky prospects which provides x as expected value.

The authors, then, introduce the method on which their conclusions are based, namely "hypothetical choice problems". They actually devised several imaginary choice problems and asked students and university faculty to provide their responses imagining to be in the choice situation described by a short scenario similar to the following:

Which of the following options would you prefer?
A: *50% chance to win 1000 Israeli pounds* B*: 450 Israeli pounds for sure* *50% chance to win nothing*

Source: Kahneman & Tversky (1979)

Since at the time of the study the monthly income for a family in Israel was about 3000 pounds, the 2 options refer to a significant amount of money for the participants. Each participant was presented with several choices of this type in randomized order.

The authors defend the validity and generalizability of this method of research, that "relies on the assumption that people often know how they would behave in actual situation of choice, and the further assumption that subjects have no special reason to disguise their true preferences" (Kahneman & Tversky, 1979; p. 265). Furthermore, the authors think that if people are accurate in describing their choices the emergence, in these hypothetical problems, of systematic violations of expected utility theory can provide evidence which contradicts such a theory.

2.2 - Certainty, Probability, and Possibility

According to the Expected Utility Theory, the utilities of outcomes are weighted by their probabilities. The authors' purpose is to show how people's preferences systematically violate this principle in a series of choice problems. The first effect that is reported is the phenomenon labelled *certainty effect,* which develops from the known example introduced by the French economist Allais (1953; see also Allais & Hagen, 1979; and Prelec, 2000 for a recent discussion) if we present people with the following situations of choices:

Situation A: Choose between:

a) 98% chance to win 500 Million Francs b) 100 Million Francs with certainty

Situation B: Choose between:

c) 0,98% chance to win 500 Million Francs d) 1% chance to win 100 Million Francs

Source: Kahneman & Tversky (1979)

Allais found most people preferred b in situation A and c in situation B. Allais commenting the choice of his hypothetic decision maker says: "..*he is perfectly aware* *that 2 chances in 100,000 is a non negligible quantity, but his view is that this quantity does not offset for him the reduction in the possible gain from 500 to 100 million, whereas for him by contrast, the achievement of certainty by raising the chance of winning from 98% to 100% is well worth this reduction*" (Allais & Hagen, 1979, p.102)

Tversky and Kahneman (1979) use a similar problem with moderate instead of large gains. The percentage of respondents choosing each options is given between brackets.

Problem 1: Choose between	
A: [18]	B: [82]
2,500 with probability 33%	2,400 with certainty
2,400 with probability 66%	
0 with probability 1%	
Problem 2: Choose between	
A: [83]	B: [17]
2,500 with probability 33%	2,400 with probability 34%
0 with probability 67%	0 probability 66%

Source: Kahneman & Tversky (1979)

The empirical choice made by respondents, given between brackets, violate expected utility theory since 80% of respondents in problem 1 show the following preference:

u(2400)>.33 u(2500)+.66u(2400)

while 83% of them show the opposite preference in problem 2. What is even more interesting is that analysis of individual pattern of choices show that 61% of respondents make these "contradictory choices" and, apparently, do not realize that problem 2 is obtained by eliminating from problem 1 the 66% probability to win 2400 from both options.

These results show that people overweight outcomes that are considered certain and this effect violates the substitution axiom of EUT which states that if Y is preferred to X ,thus any (probability) mixture (Y, p) must be preferred to the mixture (X, p).

Another situation, where the substitution axiom fails, is presented in the problems below:

Problem 3

A: 4000 with probability 80%	or	B: 3000 with certainty
[20]		[80]

Problem 4

C: 4000 with probability 20%	or	D: 3000 with probability 25%
[65]		[35]

Source: Kahneman & Tversky (1979)

Problem 4 is obtained by dividing by 4 the probability of winning of both the option of problem 3. As it can be seen, in brackets, participants perceive the two problems as different and make choices that violate substitution axiom. As the authors say “apparently, reducing the probability of winning from 1 to .25 has a greater effect than the reduction from .80 to .20.” (Kahneman & Tversky, 1979, p.267).

2.3 - The reflection effect

Reversing the signs of the outcomes of the problems provided above so that gains are replaced by losses, the two authors have been able to show the existence of what they label *reflection effect.* The preference between negative prospects is the mirror image of the preference between positive prospects. This pattern causes that risk aversion in the positive domain goes with risk seeking in the negative domain (aspect, the latter, which was noted earlier by Markowitz (1952). Furthermore, these problems with the reversed signs show consistency with the *certainty effect* where outcomes which are obtained with certainty are over-weighted relative to uncertain outcomes. The certainty effect results in a risk averse preference for a sure gain over a bigger gain that is simply probable; whereas in the negative domain, the same effect contributes to a risk-seeking preference for a loss that is just probable over a minor loss that is certain. Therefore, the certainty effect seems to increase the aversiveness of losses and the desirability of gains.

2.4 - Probabilistic insurance

In the insurance domain, EUT, assuming the concavity of utility function for money, suggests that probabilistic insurances - in which people pay a premium in order to reduce the probability of suffering a given damage- should be preferred to regular insurance in which people pay a premium in order to be totally compensated in case of a specific damage.

Using an imaginary experiment, Kahneman and Tversky (1979) were able to show that probabilistic insurance are, on the contrary, rather unattractive. They presented the research subjects with the following scenario.

Suppose you are in doubt whether to insure or not a given property against fire or theft. Somebody informs you that there exists a new program labeled "probabilistic insurance" according to which you pay half of the regular premium. If you have a damage there is 50% of probability that you can pay the other half of the premium and the insurance company covers the whole damage and 50% of probability that the company will give you back your insurance payment but you are not compensated at all for the damage you suffered. Would you purchase this probabilistic insurance?

The answer provided by a large majority of respondents (80%) was negative, thus showing that reducing the probability of a given loss from p to p/2 is less attractive than reducing this probability for p/2 to 0.

2.5 - The isolation effect

In 1972 Tversky found that people, in order to face with simpler choice between alternatives, frequently ignore components that the alternatives have in common and concentrate on the components that distinguish them. Such a decomposition can be done in different ways for the same pair of prospects, and different decompositions can induce different preferences. Kahneman and Tversky (1979) define this phenomenon the *isolation effect.* The effect is explained by the following problem (Kaheman &Tversky, 1979):

Problem 10

This is a two-stage game. In the first stage there is 75% probability to end the game without winning anything and a 25% probability to go on to the second stage. In the second stage you have to choose between:

a) 80% probability to win 4000 *b) 3000 with certainty.*

You must do the second stage choice before that the game starts.

Source: Kaheman &Tversky, 1979

As the authors point out, in this game, if probabilities of the two stages are taken into account, the choice is between:

a) .25 x.80= .20 to win 4000 b) .25 x 1= .25 to win 3000

The above two options are the same as in Problem 4, but in this case 78% of respondents chose the prospect b) in contrast with the modal choice in problem 4. According to Kahneman and Tversky (1979) this difference is due to the fact that respondents do not take into account the first stage of the game that is shared by both the options of the second stage, and as a consequence they do not calculate correctly the probabilities associated with the final states.

The isolation effect contradicts the basic assumption that choices are determined exclusively by the probabilities of the final states.

Kahneman and Tversky (1979) show, furthermore, that preferences may be modified also by different representation of outcomes as illustrated in the following problems. Between brackets are reported the percentage of respondents who chose each option.

Problem 11-

You have been given 1000 in addition to what you already own. You are requested to choose between the following options:

A: 1000 with 50% probability B: 500 with certainty

[16] [84]

Problem 12- You have been given 2000 in addition to what you already own. You are requested to choose between the following options:

C: - 1000 with 50% probability D: - 500 with certainty

. [69] [31]

Source: Kahneman and Tversky (1979).

The majority of respondents chose the certain option in problem 11 and the uncertain one in problem 12, replicating the reflection effect. However in problem 12 there is no actual loss since participants are given 2000 instead of 1000 as in problem 11 and in terms of final states A=C and B=D. Respondents apparently ignore the bonus given at the beginning of the game in both problems, and focus on change of wealth. This is the foundation stone of the new theory advanced by Kahenman and Tversky (1979).

2.6 - Prospect Theory

As we have seen, results of Kahneman and Tversky's imaginary experiments have shown several phenomena that invalidate EU theory. On the basis of this critique the authors propose a new model, Prospect theory, whose aim is describing how people make their decisions.

According to Prospect theory, decision processes consist of two stages: editing and evaluation. In the editing phase the decision maker does a preliminary analysis of the options of choice and often represents them in a simplified way. In the evaluation phase these “edited prospects” are evaluated and the prospect with the highest value is chosen.

In the editing, that will be later called also "framing phase” (Tversky & Kahneman, 1992), decision makers apply the following operations:

- **Coding** means that decision makers distinguish outcomes that represent gains from those that represent losses and they do so by adopting a reference point that usually is the current position, but it can be changed as a function of the formulation of the prospects or of decision maker’s expectations.
- **Combination** refers to the fact that, in order to simplify prospects, the probabilities associated with identical outcomes can be combined (e.g. 200 with 25% + 200 with 25% = 200 with 50%).
- **Segregation** refers to the separation of the riskless component of a prospect from the risky component. So a prospect that offers: 300 with 80% and 200 with 20%, can be decomposed as 200 with certainty and 100 with 80%.
- **Cancellation** is an operation that can be applied to sets of two o more prospects. With the term cancellation the authors refer to phenomenon already described as isolation effect, that is ignoring the first stage of a sequential game or ignoring the bonus provided at the beginning of the game. Under the label of cancellation the authors include also the discarding of elements that are common to two options. In this way the choice between (200 with 20%, 150 with 50%, -100 with 30%) and (200 with 20%, 100 with 50%, -50 with 30%) becomes the choice between (150 with 50%, -100 with 30%) and (100 with 50%, -50 with 30%).
- **Simplification** consists of rounding of probabilities or outcomes (101 →100 or 49% →50%), and of discarding of particularly unlikely outcomes.

- **Detection of dominance** refers to the inspecting of the available options in order to spot the dominated alternatives that will be directly eliminated without any further consideration.

  The editing operation are applied whenever it is possible since they smooth the progress of decision, however they may interfere with each other so that the resulting final edited prospects will depend on the sequence of the editing operations.

  Introducing the editing phase the authors recognize that, contrary to what is assumed by EU, people do not directly evaluate the options as they are given. On the contrary, they actively re-construct the prospects and they do so in a systematic (predictable) way. This re-construction is responsible of many of the anomalies of preferences that have been discussed as violations of EUT.

  After the editing process, decision makers evaluate the edited prospects in terms of two scales labelled π and υ.

  The π scale results from combining each probability p with a decision weight $\pi(p)$ which indicates what is the impact of the probability on the whole value of the prospect. It is important to stress that π is not a probability and $\pi(p) + \pi(1\text{-}p)$ is typically less than 1.

  The scale υ indicates the subjective value assigned to each outcome. Since outcomes are defined in relation to a neutral point of reference, the value υ is the value of the deviation, the value of the gain or loss.

  In their first presentation Kahneman and Tversky (1979) limit their attention to simple prospects (e.g. x, p; y, q) that are neither strictly positive nor strictly negative (regular prospects). The basic equation of the theory (Kahneman and Tversky, 1979, p. 275) is:

  "If (x, p; y, q) is a regular prospect (i.e. $p+q < 1$, or $x \geq 0 \geq y$, or $x \leq 0 \leq y$) then

  $$V(x, p; y, q) = \pi(p)\,\upsilon(x) + \pi(q)\,\upsilon(y),$$

Where υ (0) = 0, π (0) = 0, and π (1) = 1. As in EUT, V is defined on prospects, while υ is defined on outcomes. The two scales coincide for sure prospects, where V (x, 1.0)= V (x) = υ(x)."

Kahneman and Tversky (1979) acknowledge that other authors, like Markowitz (1952), Edwards (1962), Fellner (1965), and van Dam (1975) have suggested some of the elements of the new evaluation model. Nevertheless none of the other authors was able to advance an new complete model able to explain all the anomalies.

2.7 - The value function

Of special interest in Prospect Theory is the value function. The authors make explicit that they propose to extend to perception and valuation of non sensory attributes the same features already emerged studying perception and judgment of physical attributes. In perception of brightness, weight, loudness or temperature individuals compare new stimuli with an adaptation level resulting from past and present context of stimulation (Helson, 1964). Such an adaptation level does exist also when people evaluate monetary outcomes, and, as a consequence, the value function represents value attached to changes in wealth (gain or losses) with reference to a neutral reference point.

Furthermore, Kahneman and Tversky (1979) suggest, again extending data concerning perception of physical change, that this function is concave above the reference point (that is for gains) and is convex below the reference point (that is for losses), as shown in figure 1. The figure shows also that it is assumed that marginal value of gain and losses decrease with their magnitude.

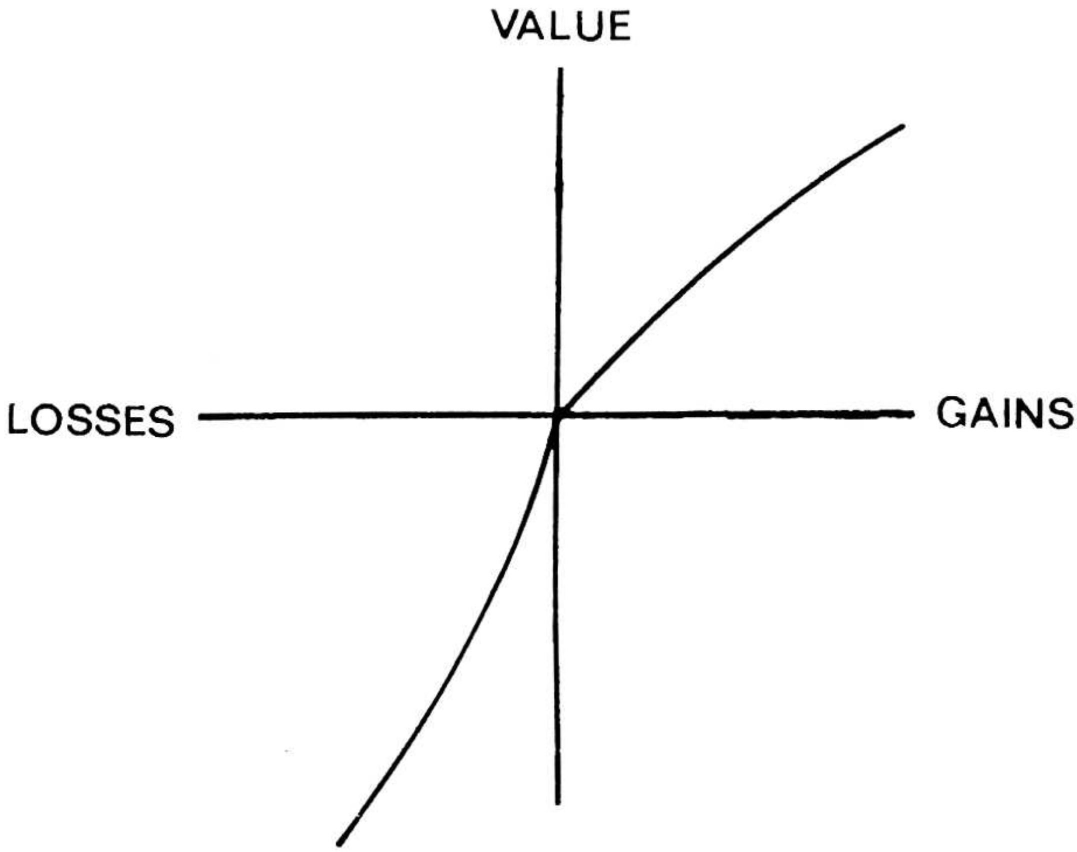

Figure 1 – A hypothetical value function

Another important characteristic of the value function, according to Prospect Theory, is that "losses loom larger than gains", that is winning 100 Euros induces a positive experience that is smaller than the negative experience associated to a loss of 100 Euros. Summarizing the value function in PT is: "a) defined in deviation from reference point, b) generally concave for gains and commonly convex for losses, c) steeper for losses than for gains" (Kahneman & Tversky, 1979, p. 281).

2.8- The weighting function

Kahneman and Tversky (1979) call attention to the difference of decision weight from probabilities. Therefore, decision weights do not obey to probability axioms and are not to be interpreted as measure of degree of belief. To give an example they suggest to imagine a gamble in which it is possible to win 1000 or nothing by tossing a coin. In this very simple situation any reasonable person can understand that there is 50% probability to win 1000, nevertheless the decision weight π (.50) will be smaller than .50. This is so because π measures the "impact of events on the desiderability of prospects, and not merely the perceived likelihood of these events" (Kahneman & Tversky, 1979, p. 281).

The weighting function π, that connects decision weights to probabilities, has the following important properties:

- Π is an increasing function of p, with $\pi(0) = 0$ and $\pi(1) = 1$. In other words, outcomes dependent on impossible events are ignored, and the scale is normalized by making a ratio between $\pi(p)$ and π associated to a certain event.
- For small probabilities π is a subadditive function of p, but this is not true for large probabilities.
- Very low probabilities are underestimated.
- For all $0 < p < 1$, $\pi(p) + \pi(1-p) < 1$. This is the subcertainty property. The slope of the weighting function within the interval 0-1 indicates the sensitivity of preferences to the changes in probability. Subcertainty means that preferences are less sensitive to changes in probabilities than it is assumed by expectation principle.
- subproportionality, according to which "for a fixed ration of probabilities, the ratio of corresponding decision weights is closer to unity when the probability are low than when they are high" (Kahneman & Tversky, 1979, p.282).

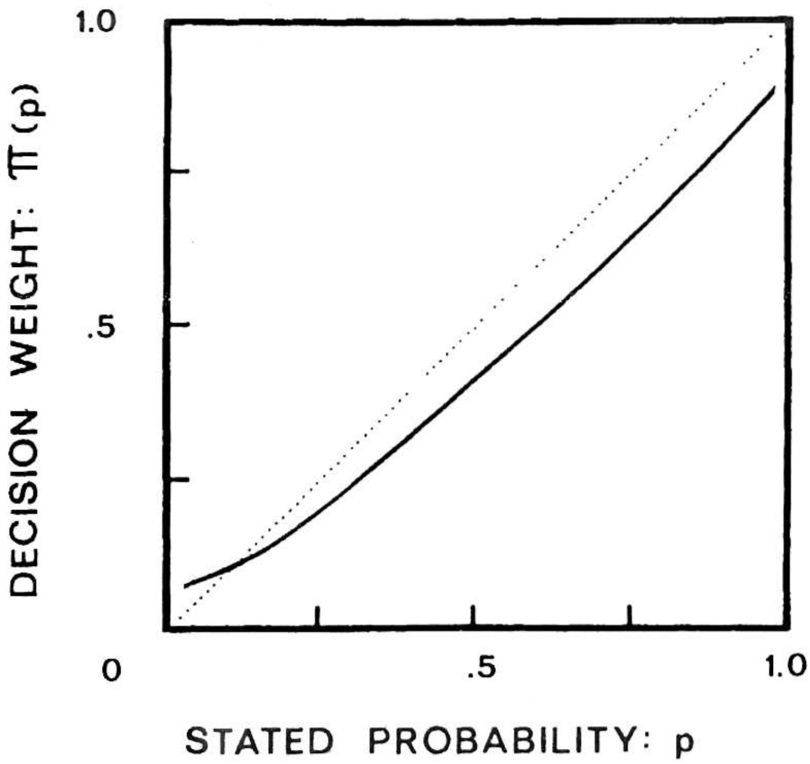

Figure 2 represents an hypothetical weighting function which complies with overweighting, subadditivity, subcertainty, and subproportionality (1979 version).

Complying with overweighting, subadditivity, subcertainty, and subproportionality, makes the function π shallow in the open interval and produces sudden changes near to the end points 0 and 1.

These discontinuities are coherent with the notion that, if an event is given a weight, this cannot be too small. A similar discontinuity there exist to the higher point so that any weight is always smaller than 1. According to the authors this effect reflects the categorical distinction between certainty and uncertainty. Furthermore, simplification of prospects during the editing process can induce the decision maker to get rid of events extremely unlikely and consider event with high likelihood as certain. In other words people are not good at "treating" extreme probabilities and events with very low likelihood can be either ignored or overweighted as well as the difference between high probability and certainty can be either ignored or inflated.

In the final discussion of their seminal paper Kahneman and Tversky (1979) explain how PT can provide an account of attitude toward risk, and suggest several potential extensions of the original formulation that will be better developed in the article of 1992.

As far as attitudes toward risk are concerned, they show that the violation of independence axiom, exemplified by problem 1 and 2, previously described, if:

$$\pi(.33)/\pi(.34) > \upsilon(2400)/\upsilon(2500) > \pi(.33)/1-\pi(.66)$$

is an effect of subcertainty and more precisely of the inequality $\pi(.34) > 1-\pi(.66)$.

Anomalies described with problems 3 and 4 are due to subproportionality of π if

$$\pi(.001)/\pi(.002) > \upsilon(3000)/\upsilon(6000 > \pi(.45)/\pi(.90)$$

The preference for regular insurance over probabilistic insurance can be also explained by prospect theory which assumes that probability of losses is oveweighted (losses loom larger).

In general, attitudes toward risk in Prospect theory are explained as jointly shaped by υ and π and not exclusively by the utility function. Therefore, in general people are risk averse for gains and risk seeking for losses, but the opposite can be true for very small probabilities. So the overweighting of small probabilities may favor both gambling and insurance, while the S-shaped value function would be against such choices.

2.9 - Shift of reference point

In the whole article it has been assumed that the status quo acts as the point of reference, which is probably what happens in most of the cases. However there are cases in which decision makers may adopt a different point of reference such as the aspiration level.

The authors give as an example the case of an unexpected tax withdrawal from a monthly pay check that is likely to be experienced as a loss and not a reduced gain. It is also possible that people who have recently had a change in wealth have not yet adapted to it and do not use it as reference point. An hypothetical entrepreneur who has already lost 2,000, but has not yet adapted to his losses, and is asked to choose between a sure gain of 1,000 and an even chance to win 2,000 or nothing, will probably edit the problem as a choice between (-2,000, .50) and (-1,000) rather than as a choice between (2,000,.50) and (1,000). If this is the case he will tend toward more risky than he would have done adopting the second prospect of choice. The possibility that decision makers use as reference point a past wealth position, since they have not adapted to recent losses, may explain why they accept risky gambles that would not accept otherwise.

It is also possible that decision makers formulate their decision problem in terms of final assets, as assumed in decision analysis, rather than in terms of gains and losses. By doing so decision makers adopt zero as reference point on the scale of wealth and the value function will be concave everywhere. This shift of reference point has powerful consequences since it eliminates risk seeking, or rather limit it to gambling with very low probability.

In everyday life economic decisions consist of paying many in order to get a desirable prospect. According to standard decision theories when we have to decide whether to pay 10 for a gamble in which we have 1% probability to win 1000 we are confronted with the following choice:

A: (990,.01; -10,.99) B: (0).

However, given the prevalence of the isolation effect, people are much more likely to evaluate the gamble and its cost separately, and decide to purchase the gamble if the combined value is positive, that is if:

$$X\ (.01)v(1{,}000)+v(-10)>0$$

Thus, people are expected to exhibit more risk seeking in deciding whether to accept a fair gamble than in deciding whether to purchase a gamble for a fair price. The location of the reference point, and the manner in which choice problems are coded and edited emerge as critical factors in the analysis of decisions.

3 - Experimental investigation into collective decision making under uncertainty

As we have shown in previous paragraphs there is now overwhelming evidence concerning the violation of Expected Utility Theory (EUT). However such evidence is mostly based on decisions made by isolated individuals, while in everyday life many economic decisions are taken by groups (e.g. form the Federal Open Market Committee to families). While there is an extended social psychology literature concerning group decision making (see Kerr, MacCoun & Kramer, 1996 for a review), in the economic context, research examining -with salient cash rewards- when and how group decisions differ from individual decisions has appeared only recently. In the following some of the most interesting studies of this recent literature will be presented. Two of the articles (Shupp & Williams, 2008; Baker, Laury & Williams, 2008) address the issue of risk preferences, the third one (Cheng & Chiou, 2008) examines the effect of framing on risk choices at individual and group level, and the fourth one focus on common-ratio inconsistencies (Bone, Hey & Suckling, 1999). All the articles adopts research designs finalized to investigate whether group decisions are more or less consistent with EUT in comparison to individual decisions.

3.1 - Risk preference differentials of small groups and individuals, Shupp, R.S., Williams, A.W. (2008). *The Economic Journal*, 118, 258-283.

3.1.1 - Aim of the experiment, hypotheses and research design

In the introduction of their article, Shupp & Williams (2008) discuss previous literature concerning group versus individual decisions correctly reminding that interest for risk preference of group decisions started with social psychological research on the so called “risk-shift” in the early 1960s (see Isenberg, 1986, for a review). In these studies, based on choice dilemma questionnaires, participants chose actions in hypothetical situations involving risk but without a salient response contingent reward structure. Even though first results suggested that groups were generally more risk oriented than individuals, subsequent research showed that groups do not always make riskier decisions. These contradictory results were later explained in terms of “group polarization”, a label which suggests that group decisions move in the same direction of the prevailing individual decisions, but assume a more extreme position. If individual positions are risk averse group decision results to be even more risk averse, and if individual positions are risk seeking group decisions result to be more risky.

Kerr et al. (1996), in a comprehensive review of this literature, conclude that “there are several demonstrations that group discussion can attenuate, amplify, or simply reproduce the judgmental biases of individuals and research conducted to date indicates that there is unlikely to be any simple, global answer to the question (p. 693)”. Furthermore, the available evidence suggests that group discussion can improve performance only when there is a demonstrably correct normative solution to the problem under consideration.

Reviewing previous literature, Shupp & Williams (2008) point out that this literature focuses on two possible consequences of having a group rather than an individual make a decision.

As first consequence, it is hypothesized that groups may make more rational decisions in the sense that their decisions are more in line with the game theoretic prediction for a given task. The few existing studies provides contrasting results. On one side, Bornstein and Yaniv’s (1998) ultimatum bargaining study, Cox’s (2002) study involving trust games and, to a certain extent, Kocher and Sutter’s (2005) beauty contest experiments show that that groups do, although not always initially, play closer to the game-theoretic prediction. On the other side, Cason and Mui’s (1997) dictator game study and Cox and

Hayne's (2006) first-price sealed-bid common-value auction experiments found that groups decisions lie further (or just as far) from the game-theoretic prediction than the decisions made by individuals, resulting to be less rational (or, in some cases, no less irrational) than individuals.

The second consequence involves Expected Utility and Shupp & Williams cite three studies (Bateman and Munro, 2005; Bone et al., 1999; Rockenbach et al., 2007) that intended to investigate whether groups make choices that are more in line with EUT. None of the studies provided evidence supporting the claim that EUT describes groups decision better than individual ones. Finally, Shupp & Williams refer to a couple of studies directly addressing the issue of risk preference in which individual and three person groups preferences were compared (Harrison et al., 2005; and Baker et al., 2006). Results of these studies did not show any significant difference between individuals' and groups' risk preferences.

According to Shupp & Williams (2008) when comparing individual and group risk preferences it is possible to make 2 alternative hypotheses (conjectures): a) the group-averaging null conjecture according to which there will be no systematic difference between the group's willingness to pay decision and the average of the group members individual decisions for a specific lottery , and b) the group-shift alternative, according to which there will be a systematic difference between the group and average individual decision.

In the cases in which it will be possible to reject the null conjecture, the authors intend to assess whether this shift occurs toward the risk-neutral focal point or away from risk neutrality. Finally the authors anticipate that the variance of group decisions in a given lottery will be smaller than that of individual decisions.

Shupp & Williams (2008) in order to study risk preference differentials between individuals and groups, adopt a task consisting of 10 lotteries with increasing probability (from 10% to 90%) to win $20, for each lottery participants are requested to make their bid that may range from $0 to $19,99). Shupp & Williams decided to use a maximum demand price method in order to avoid the so called "endowment effect" associated with the minimum selling price method. A total of 100 participants were recruited from undergraduate economics classes at Indiana University, Bloomington, and two experimental designs were adopted.

Design I was a between subject design with two conditions of decision making: individual vs. group choice. In this design, each participant made decisions as either an individual or a member of a three-person group. Sixteen participants were used as individual decision makers and 48 other participants were randomly assigned to three-person groups.

Individual or group decision-making unit registered on a record sheet nine bids corresponding to nine different lotteries with a chance of winning ranging from 10% to 90% in 10% increments. In the individual choice condition each participant was endowed with $20 and all lotteries paid either $20 or $0. In the sessions with groups, all groups were endowed with $60 and all lotteries paid either $60 or $0. Each group member was paid an equal one-third share of total group earnings. Groups had a maximum of twenty minutes to discuss the problem and agree on the bids to be entered. All groups were able to reach unanimous agreement in considerably less than the allotted time. The task lasted less than one hour and on the average each participant was paid $21,98.

Design II was a repeated measure design with 36 other participants who first made decisions as individuals and subsequently as a member of a randomly assigned three-person group. This design, beyond assessing the difference between individual and group decision, will offer the opportunity to examine how the risk preferences of specific individuals are aggregated into a group risk preference. In this case each session lasted less than one hour and half and participants were paid $47,72.

In order to analyze these data, certainty equivalent ratio (CER) was calculate for each choice, by dividing the sum corresponding to maximum willingness to pay for a lottery by the lottery expected value. When the CER is equal to one there is a risk neutral preference, when CER is greater than unity there is a risk seeking preference, and when CER is less than one there is risk aversion.

3.1.2 - The results

Data were submitted to several analyses. As first step the existence of an individual versus group risk preference difference was assessed by aggregating the individual data from both Design I and Design II and comparing them to the group data from Design I. The authors present first a graphical overview of CER (mean, median and standard deviation) across the nine lotteries comparing individual and group values, and then the results of statistical analyses (regression model, paired comparison tests) that confirm the significance of the described tendencies.

From graphical overview it can be observed that:

1. In the 10% to 40% lotteries, considering either mean or median CERs, groups appear to be more risk averse than individuals.
2. In the 70% to 90% lotteries, considering either mean or median CERs, groups appear to be less risk averse than individuals. It is worth noting that both groups and individuals in these high win-percentage lotteries are closer to the risk-neutral benchmark than in the low win-percentage lotteries.
3. CER dispersion is smaller for groups than individuals in all lotteries.

In the regression analysis, CER is the dependent variable and the independent variables are: a group-decision dummy variable (GRP), a set of eight lottery dummy variables (LOTi, I ¼ 20, 30, . . . , 90, where i corresponds to the lottery win percentage), and eight

GRP x LOTi interaction terms introduced in order to test the fact that group vs. individual effects vary systematically across the nine lotteries. Without going into detailed results of this analysis it is sufficient to say that regression-based results are generally consistent with the observations derived from visual inspection of the mean CER.

The authors provide also further statistical support of the existence of a significant interaction between the lottery win-percentage and the effect of group decision making. The meaning of this interaction is that groups tend to be more risk averse than individuals in the higher-risk (lower win-percentage) lotteries and less risk averse (approaching risk neutral) in the lowest-risk (high win-percentage) lotteries. Concluding the section of this first statistical analysis the authors provide also statistical results showing that individual CERs are significantly different from the risk neutral point (CER=1) for lotteries aside for 10% and 20% lotteries, whereas group CERs are significantly different from neutrality for all lotteries aside for 70%, 80% and 90% lotteries.

The second phase of the analyses is intended to examine how individual group members CERs are aggregated into a group CER.

First the authors verify that Design I and Design II group-decision samples are not significantly different between each other, so that it can be concluded that group decisions are not, on average, significantly affected by the fact that Design II participants had previously submitted bids as individuals (but had not seen the outcome from those decisions).

As far as the aggregation of individual decisions into a group decision is concerned Shupp & Williams advance the following alternative conjectures (hypotheses):

1. the group-averaging null conjecture, according to which the group CER does not systematically differ from the average individual CER;

2. the group-shift conjecture, according to which group CER is significantly different form average individual CER;
3. the group focal-point conjecture, according to which group discussion tends to move the group CER toward the risk-neutral benchmark.

Wilcon Mactched-Pairs test show that the group averaging null conjecture can be rejected in low win-percentage lotteries (10% to 40%) where group CER is constantly lower than mean individual CER, a result that is coherent with results of the analysis on the independent samples of Design 1.

Contrary to results of Design 1, however, the group averaging null hypothesis cannot be rejected for high win-percentage lotteries (80% or 90%). According to the authors this is due to the fact that the individuals in the Design II sample are, on average, less risk averse in the high win-percentage lotteries than the individuals in the Design I.

On the whole, the authors think that individual and group data in the high-risk lotteries provide supporting evidence to the conclusion that group discussion leads to more risk-averse decisions. In fact, in each of the four highest-risk lotteries 10 of the 12 group CER observations, 83.3%, are more risk-averse than the mean individual CER. Less strong evidence of this tendency emerge from the five lowest-risk lotteries where only 48.3% of the group CERs are more risk-averse than the mean individual CER.

The Design II data are, according to Shupp & Williams, consistent with results of Design I data with regard to decisions in the highest risk lotteries and confirm, albeit with a small sample, that group discussion tends to induce a choice shift toward increased risk aversion in high-risk situations.

As far as the group focal point conjecture is concerned it is true for only 33.3% (12 of 36), 30.6% (11 of 36), and 41.7% (15 of 36) of the paired observations over the three highest, medium, and lowest risk lotteries, respectively.

3.1.3 - Summary and conclusions

In the summary and discussion section, the authors draw the following conclusions:

- Certainty equivalent ratios vary significantly across lotteries with different percentage of winning. For both groups and individuals, with increasing win percentage, the median CER moves closer to the risk-neutral benchmark.
- In the higher-risk lotteries (10% to 40%) , the average group is significantly more risk averse than the average individual.
- In the lowest-risk lotteries (80% and 90%) , the average group is approximately risk neutral and significantly less risk averse than the average individual.
- In lotteries with a win percentage from 50%, to 70%, both groups and the individuals are equally risk averse.
- As hypothesized the variance of CERs is lower for groups than for individuals in all lotteries.
- In general, for both groups and individuals, as the win percentage increases the median CER moves upward toward unity, CER dispersion is reduced , and the coefficient of relative risk aversion eventually decreases toward the risk neutral benchmark .

In conclusion, using three person groups instead of individuals appear to bring about more complex effects than was anticipated, since these effects are moderated by inherent riskiness of the property right being considered for acquisition.

Nevertheless it is possible to conclude that group discussion induce a significant increase of risk aversion in case of high risk lotteries, while individuals and groups do not differ and are both more risk neutral in the lowest risk lotteries.

3.2 - Comparing small-group and individual behavior in lottery choice experiment, Baker, R.J., Laury S.K., Williams, A.W. (2008), *Southern Economic Journal*, 75, 367-382.

3.2.1 – Aim of the experiment, hypotheses and research design

Baker et al. examine previous literature using lotteries to elicit risk preferences focusing their attention on the papers by Harrison, Lau et al. (2005) and by Shupp and Williams (2008) that investigated decisions made by groups. The two papers provide contrasting results. While Harrison, Lau et al. (2005) found no evidence of differences in the choices of individuals and three-person majority-rule groups, Shupp & Williams, as we have reported above, did find significant differences.

However, Harrison, Lau et al (2005) used a procedure that differs from the one used by Shupp & Williams both in terms of task features and in terms of condition imposed to the deciding group. In fact Harrison, Lau et al. (2005) used a lottery choice task in which the decision maker has to choose between a "safe" and a "risky" lottery while Shupp & Williams used a task in which decision makers have to indicate a bid they would be willing to pay in order to play each of a set of lotteries with increasing win percentage. Furthermore, in Harrison, Lau et al. (2005) study the three persons constituting the group were not allowed to discuss face to face while such a discussion was present in Shupp & Williams (2008) groups. Baker et al. mention also a paper by Colombier et al. (2006) in which group members cannot directly communicate, as in Harrison, Lau et al. (2005), but must come to a unanimous group decision through an iterative voting process or have a random decision imposed on the group. Their results are generally in line with those of Shupp & Williams and not with those of Harrison, Lau et al. (2005).

Baker et al. adopt the task developed by Holt and Laury (2002). Subjects were presented with a menu of 10 lottery-choice decisions. Decision makers had to choose between a lottery with a small difference between the low-payoff and high-payoff outcome (safe option) and a lottery with a larger difference between the low-payoff and high-payoff outcome(risky option). Payoffs were identical in all 10 decisions; but the probability of the high-payoff outcome increased in 10% increments from 10% in the first decision to 100% in the last decision. In each decision the subject was asked to choose which lottery he preferred to play. One of these decisions was randomly chosen for payment by throwing a 10-sided die. The total number of safe-lottery chosen was used as measure of risk preferences. Using such a measure a risk neutral subject would choose the lottery with the highest expected monetary payoff for all winning probabilities. In other words she/ he would choose the safe lottery for winning probabilities from 10% to 40% and then switch to the risky lottery for the winning probabilities from 50% to 100%, while a risk averse person would choose the safe lottery for winning probabilities from 10% to more than 40% and a risk seeking person would start choosing a risky person for winning probabilities even lower than 40%.

Baker et al. realized a study with a design very similar to the one of Shupp & Williams. They have, in fact, 30 subjects making individual choices only; 45 subjects making choices in three person groups only; and 45 subjects who made in sequence individual, group and individual choice (IGI condition). The first two set of participants represent a between subject design, while the third set represents a within subjects design. The last design differ from the within subject design used by Shupp & Williams since subjects are requested to make one further set of individual choices after the group choice. This is intended to assess whether and how group choice affect subsequent individual choices.

3.2.2 - The results

The first statistical analysis explored the possible impact of demographic features (gender, race, income, student status, major) on individual lottery choice decision.

Demographic effects were measured by a Poisson regression model using data from the Individual choice condition of experiment 1 and phase 1 of the sequenced IGI experiment. Results of this analysis show that none of the demographic variables affects significantly individual choices between safe and risky lottery.

As second step, group and individual decisions from the between subjects treatment are compared for differences in the total number of safe-lottery choices. Results of Poisson regression model are not significant, indicating that there is no significant difference between groups and individuals in the number of safe choices. The authors however, commenting a graphical representation of the data suggest that the pattern of the results is similar to the interaction emerged in the study by Shupp & Williams.

To investigate this potential interaction between type of decision maker (individual or group) and lottery-win percentage used a clustered-logit regression with the binary lottery choice (safe = 1or risky =0) as the dependent variable, type of decision maker (group= 1 individual =0), lottery winning percentage, and their interaction. Results of this analysis show, indeed, a significant interaction between groups versus individual decision making and lottery winning percentage, very similar to the one emerged in the study by Shupp & Williams (2008).

Finally, the results from the sequenced IGI experiment are examined to explore how individual decisions are aggregated to form a group decision and the impact of group decisions on subsequent individual lottery-choice decisions.

Data from the IGI condition show that group choices are consistent with expected utility since there is a unique switch point from the safe to the risky lottery. Individual choices on average appear consistent with risk aversion. The comparison of individual (phase 1) and group (phase 2) choices by means of Wilkoxon signed-ranks matched-pair test reveal a significant difference: 10 out of 15 groups chose more safe lotteries than the mean of their members.

Of special interest are the results concerning the individual choices after the group choices: from the graphic representation provided by the authors it appears that, for each winning percentage, the mean of the individual choices at time 3 has moved closer to the group mean in comparison to the initial individual mean at time 1. In order to test this difference an ordinary least square regression with the differences of individual choices from phase 1 to phase 3 as dependent variable and the difference between individual choice in phase 1 and the group choice in phase 2 as independent variable. The significant and positive coefficient emerged (*b*= 0.6663) indicates that each positive difference in the number of safe choices the group made in phase 2 from the group member in phase I increases the change in the number of safe choices made by the group member in phase 3 from phase 1 by 0.67. Therefore, participating in phase 2 has a significant, positive impact on subjects" safe lottery choices in phase 3.

Finally, since data suggest the existence of an interaction between type of decision maker and winning percentage, a clustered logit regression was applied to sequenced data also. Results confirm the existence of a significant interaction. Phase 2 groups deviate from the risk-neutral set of choices less than phase 1 individuals in the lowest- and highest-winning-percentage lotteries, but the reverse is true for the 50-60%-winning-percentage lotteries.

3.2.3 - Conclusions

In the conclusion, Baker et al. summarize their result outlining the following main points:

1- coherently with the results reported in previous studies, individual lottery-choice decisions tend to exhibit risk aversion as revealed by the count of safe lotteries chosen;

2- this basic risk-aversion result is found to extend to three-person group decisions;

3- Poisson regression analysis reveals that gender, race, educational indicators, and other demographic factors do not significantly influence the safe-lottery choices by isolated individuals;
4- while Poisson regression does not show a significant difference between independent samples of three-person group-versus-individual lottery-choice, a logit regression model utilizing clustered-robust standard errors reveals that the probability of choosing the safe lottery is significantly affected by an interaction between type of decision maker (group or individual) and the lottery-winning percentage. This interaction emerges also from within subject data;
5- Relative frequency plots of safe-lottery choices for each lottery pairing illustrate that groups tend to deviate less frequently than individuals from the risk neutral point;
6- data from the between subjects design show that three person group choices are more risk averse than mean individual choices;
7- participation in the phase 2unstructured group discussion has a significant impact on subsequent individual choices: post discussion individual decisions tend to move toward the group decision.

The authors conclude suggesting the need to further investigate the existence of risk-preference differentials revealed by small groups-versus-isolated individuals can address a variety of interesting issues.

According to Baker et al., beyond replications with larger samples new studies are needed in order to clarify remaining problems concerning, among other things, artifacts due to order effects; the impact of dimension of group and of decision rules (unanimity vs. majority); learning process and stability of the various risk preference measures.

3.3 - Framing effects in group investment decision making: role of group polarization, Cheng P-Y., Chiou W-B. (2208) *Psychological Reports*, 102, 283-292.

3.3.1 - Framing effects

Before presenting this article it is worth describing what is intended as “framing” in the original formulation proposed by Tversky & Kahneman (1981, 1986).

While the rational theory of choice assumes that equivalent formulations of a choice problem should give rise to the same preference order (Arrow, 1982), there exists evidence showing that framing options either in terms of gain or in terms of losses brings about different preferences (Tversky and Kahneman, 1986). The most famous example of this effect is that of the “Asian disease” (Tversky & Kahneman, 1981). Participants were asked to:

"*imagine that the U.S. 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 the exact scientific estimate of the consequences of the programs are as follows."*

The first group of participants were presented with a choice between two programs:

Program A: "200 people will be saved"
Program B: "there is a one-third probability that 600 people will be saved, and a two-thirds probability that no people will be saved"

72% of participants choose program A, 28 % program B

The second group of participants were presented with the choice between:

Program C: "400 people will die"
Program D: "there is a one-third probability that nobody will die, and a two-third probability that 600 people will die"

78 % preferred program D, 22 % program C.

Source: Tversky & Kahneman, 1981

Programs A and C are identical, as are programs B and D. The change in the decision frame between the two groups of participants produced a preference reversal: when the programs were presented in terms of lives saved, the participants preferred program the secure program, A (= C). When the programs were presented in terms of expected deaths, participants chose the gamble D (= B). The framing effects, which violate the invariance principle of Expected utility theory, are considered the most important phenomena in behavioral economics (Wilkinson, 2008).

3.3.2 - Aim of the experiment, hypotheses and research design

In examining the literature on framing Cheng & Chiou point out that several variables have been show to play a moderating role on framing, therefore we already know that:

1- framing effects are more strong in single risky events than in multiple risky events (Levin et al. 1986);

2- framing effects are reduced when decision task require rationality and explanation (Miller & Fagly, 1991), and when task requires more responsibility and more information is provided (Schoorman et al. 1994);

3- framing effects are reduced in task that require to evaluate only one attribute instead of two (Levin et al. 1985), to evaluate near instead than distant events (McElroy & Mascari,2007);

4- finally framing effects are reduced –or eliminated- with participants high in need for cognition engaged in deep information processing (Simon et al. 2004), if participants adopt an analytic style of processing instead of an holistic one (McElroy & Seta, 2003).

Framing effects have been shown to vary in intensity also as a function of the domain of choice. Within the domain of risk choice framing effects appear to be most strong for health question (see Asian disease), followed by business and gambling (Kuhuberger, 1998). However, the authors say, research so far has been concentrated on framing effects on individual decision making without considering the many important situation in which in everyday life small group make important and consequential decisions.

In the literature on group decision, in social psychology, two distinct lines of research have been developed: the choice shift and the decision making under risk.

Research on choice shift started with the paper by Stoner (1961) who originally claimed that groups are more risk oriented than individual members (risk shift). Afterwards, other authors got opposite findings showing a cautious shift (Fraser et al, 1971). Finally Moscovici & Zavalloni (1969) concluded that the phenomenon was to be defined "polarization" since group decisions did move in a more extreme position but in the same direction of the average individual position. If the last was oriented to risk group decision resulted to be more risky, but if individual member on average were risk averse, group decision resulted to be even more risk averse.

According to the theory framing a decision problem as a gain should induce risk aversion while framing it as a loss should induce risk seeking. Cheng & Chiou hypothesize that framing and group discussion may interact and have an impact on group decision. More precisely they hypothesize that the polarization of group discussion will potentiate framing effects so that group decision, when the problem is framed as a gain, will be more risk averse than individual decisions and, when the problem is framed as a loss will be more risk seeking than individual decisions.

Cheng & Chiou realized a study with 120 students (57 male, 63 women). The participants were randomly assigned to one out of four investment scenarios resulting from a 2 (frame: gain vs. loss) x 2 (investment size: small vs. large). The investment scenarios were adapted from those originally used by Tversky & Kahneman (1981).

As an example the following is the "large gain" problem choice.

"You bought "Prosperous Fund" one year ago, using $100,000 of your personal savings. Given the fund's competent management you have earned some money. However, the fund's management company thought that the market was mature and instructed the close-end fund to liquidate. To thank investors for their long-term support the company not only repaid investors their investments amount but also offered two

options: (Choice A) a guaranteed bonus of $ 25,000 or (Choice B) a 25% chance to gain $100,000 and 75% chance to gain nothing."

Participants received credit course, but were not paid. In the first phase they had to indicate individually their preference for each of the two options (safe/risky). They had to indicate their relative preference on a non graded scale with the two choices as endpoints and with an anchor of 1 indicating complete preference for Choice A and an anchor of 100 indicating complete preference for Choice B.

On the basis of this first individual decisions participants with extreme tendency scores toward risk (either too low or too high) were excluded. One week later participants were invited in groups of three person to reach a group decision after sufficient discussion.

3.3.3 - The results

Data of individual choices confirmed that the manipulation produced the typical framing effect. Independently from investments size in the gain frame subjects preferred the cautious choice (mean small inv.= 27, mean large inv. =26) while in the loss frame subjects preferred the risky choice (mean small inv.= 75,7, mean large inv. =71,5).

Following this, in order to assess whether group polarization increased the framing effect a 2 (size of investment: large, small) x 2 (decision making setting : individual group) mixed factorial Anova was applied to participants' responses. Data from gain and loss condition were analyzed separately.

As anticipated, in gain condition group decisions resulted significantly more cautious than individual ones, and in loss condition group decisions resulted significantly more risky than individual ones. Both these effects were independent from investment amount.

3.3.4 - Conclusions

Discussing their results the authors correctly admit the limitation of their study concerning mostly their external validity. This can be limited both because of the specific type of subjects (students instead of people with investment experience) and because of the scenario procedure adopted.

Nevertheless these results provide strong evidence that groups are not immune from framing effects, but more prone to them. One possible social psychological explanation for this effect is suggested by the authors, namely that individuals when in a group make social comparison with the opinion of others and want to appear “better than average”. If the average is risk oriented individuals may change their original opinion shifting it in order to appear better than average.

Whether social comparison is the process that mediates polarization or not results of this study deserve attention since they show that framing may be even more dangerous for group decision than for individual ones.

3.4 Are groups more (or less) consistent than individuals? Bone, J. , Hey, J. , Suckling J. (1999) *Journal of Risk and Uncertainty*, 8, 63-81.

3.4.1 Aim of the experiment

This paper describes an experimental investigation into collective decision-making under uncertainty with two parallel aims: verifying whether groups violate EUT in the same way and to the same extend as individuals seem to do and testing whether discussion between group members could increase the EU-consistency of the individual members concerned. The particular form of EU- violation examined is the Common-Ratio Effect.

The idea that people might learn to be more EU-consistent is occasionally related to Savage, following his remarks on the Allais paradox (Savage, 1972, pp. 101-104). He believes that EU-violations are faults of some kind and therefore recognizable and rectifiable by individuals (Savage hypothesis).

3.4.2 - The Common-Ratio Effect

The Common-ratio violation derives from the famous Allais paradox (1953; see also Allais & Hagen, 1979; and Prelec, 2000 for a recent discussion), already described above, which I report again here.

Situation A: Choose between:
a) 98% chance to win 500 Million Francs   b) 100 Million Francs with certainty

Situation B: Choose between:
c) 0,98% chance to win 500 Million Francs   d) 1% chance to win 100 Million Francs

Source: Kahneman & Tversky (1979)

Allais found most people preferred b) in situation A and c) in situation B.

Prospect theory explain this "paradoxical choice" saying that increasing the chance of winning from 98 to 100% has greater impact on relative weight than raising the chance of winning from 0,98% to 1%. Kahneman and Tversky (1979) derives from this effect the general principle of subproportionality, according to which "for a fixed ration of probabilities, the ratio of corresponding decision weights is closer to unity when the probability are low than when they are high" (p.282).

3.4.3 - The experiment

The experiment consisted of three different stages where subjects had to register choices from four CR-triplets, providing a total of 12 prospects-pairs in all; at each stage the twelve prospect-pairs were given to each subject, each stage in a separately randomized order. Stage 2 differed from stages 1 and 3 in that the subjects were paired-up. The authors decided to elicit their subjects' preferences both before and after their group encounters in order to obtain not only two standards of comparisons for the group choices, but also information relevant to the Savage hypothesis, since evidence of increased EU-consistency would provide support for the hypothesis (of course, the lack of such evidence would not falsify it as this experiment did not constitute a scientific test).

The paper describes the procedure as follows. At first, each subject was given with the instruction and a booklet containing answer forms for one set of the 12 prospect-pairs where both the order of the prospect-pairs and the order of the two prospects in each pair were individually randomized. During Stage 1 subjects completed these booklets unsupervised and in their own time, before the subsequent meeting for the booklets' submission and for being paired-up by drawing colored counters from an opaque bag for the following stages. At stage 2 each partnership was provided with another booklet containing randomized answers forms for the 12 joint prospect-pairs and the session was located in a large hall to allow a private discussion to each partnership. After the submission of the booklet, the experimenter gave them another booklet for stage 3, containing randomized answer forms for the 12 individual prospect-pairs and the experiment ended with the completion and the submission of this third and final booklet to the experimenter.

3.4.4 - The results

People tested were undergraduate and graduate students at York University, largely but not only economists. There were 46 individual subjects and thus 23 partnerships.

Analyzing first individuals' choices, the three authors record these responses:

1. Only one individual was fully EU-consistent at stages 1 and 3(valuated by EU- consistent responses in n of the four triples) with $n=4$. The mean score of consistency was 0.46 at stage 1 and 0.38 at stage 3.
2. The general level of EU-consistency fell between stages 1 and 3 (there were 17 individuals whose responses deteriorated and only 9 whose their responses improved).

3. The median individual was consistent in two triplets at stage 1 and in only one at stage 3 and the corresponding mean values were 1.83 and 1.52 triples.
4. This overall deterioration in EU-consistency might cover some instances of improvement through group interaction.
5. There was a single case (the fully EU-consistent individual) of EU-consistency improvement which can support the Savage hypothesis.

As far as groups' responses are concerned, the three authors report the following conclusions.

At first, they have been able to verify that groups and individuals were closely comparable regarding their EU-consistency (the average level of EU-inconsistency was at 0.37) and the type of inconsistencies. They found that the most common EU-inconsistency was CR-violation and they also define the General Common Ration (GCR) pattern as the absence of any (re-) switching from different prospects as the probability value falls. Response exhibiting the Common-Ratio effect accounted, on average, for a further 0.52 of partnerships' responses, again just as for individuals. It was also noted that the Common-Ratio effect implies a violation of at least one of the Reduction and Independence axioms of the EUT.

Furthermore the data show that only one of the partnerships was fully EU-consistent (*n=4*) and this was the partnership of the only fully consistent individual mentioned above.

3.4.5 - Conclusions

Apart from one solitary exception already cited, the authors found no evidence showing that individuals learn to be more EU-consistent either through discussion or through repetition, even if the data suggest that individuals' and partnerships' choices are far from arbitrary. They also noted that the incidence of both EU and GCR response patterns is very similar for partnerships and individuals, although there are some differences by triple.

Conclusion

A central feature of mainstream twentieth century economics is the fact that it relies on models of individual rational decision-making. As we have seen, criticism of economics focus on empirical evidence (mostly coming from cognitive psychology or behavioral science) showing that such models do not provide an accurate description of how people actually make their decisions.

However, both mainstream economics and its critics share a common problem, namely the exclusive focus on rational individual agents. This does not appear to fit everyday economic life in which most important decisions (economic, political, cultural, military, and so forth) are made by groups. This decision making groups have several different forms: Juries, families, central bank boards, and several types of committees.

This attribution of decision responsibility to groups is usually done both because it may be that different people may bring together useful pieces of information not available to single persons, and because it is assumed that groups are more rational than individual decision makers.

While in social psychology there has been a long tradition of research on group decision making (see Kerr et al. 1996 for a review) only recently research in experimental economics has began to give attention to this issue.

In this recent economic literature on group decision making can be distinguished two lines of research: one focus on decisions concerning strategic interactions with reference to Game theory, while the other one focus on whether groups make decision that are more in line with EUT.

In my work I limited my attention to recent articles belonging to this last line of research.

The experiment presented address the common issue of whether groups are more rational than individuals, but do so with more or less different task (lottery choice, lottery bid decisions, investment decisions and common ratio choices) using both within and between subjects designs.

On the whole, results of these experiments, do not provide a coherent pattern and suggest that the answer to our starting question is not going to be given in terms of a true/false answer.

So, Shupp & Williams (2008) point out that using three person groups instead of individuals appears to bring about more complex effects than was anticipated, since these effects are moderated by inherent riskiness of the property right being considered for acquisition. Nevertheless it is possible to conclude that group discussion induce a significant increase of risk aversion in case of high risk lotteries, while individuals and groups do not differ and are both more risk neutral in the lowest risk lotteries.

Baker et al. (2008) find risk aversion at the individual and at the group level, as well as a significant interaction between decision maker (individual vs. group) and winning probability.

Cheng & Chiou (2008) provide clear evidence that groups are not immune from framing effects, but more prone to them, as a consequence of group polarization and social comparison processes.

Finally, Bone et al. (1999) do not find any evidence that individuals learn to be more EU-consistent either through discussion or through repetition, even if the data suggest that individuals' and partnerships' choices are far from arbitrary.

Even though the above results do favor a negative answer to the opening question, I think that, given the contemporary state of the art, it may be more useful mention some of the suggestions for further studies given by Baker et al. (2008).

According to these authors, beyond replications with larger samples new, studies are needed in order to clarify remaining problems concerning, among other things, artifacts due to order effects; the impact of dimension of group and of decision rules (unanimity vs. majority); learning process and stability of the various risk preference measures. Beyond these suggestions, I think that is also needed to look at the impact of group composition in terms of both demographic features (such as gender), social status (power), and expertise. Finally, contextual variables, such as time pressure and or intergroup competition, are likely to affect group discussion and the processes of aggregation or polarization of individual preferences.

Taking into account most of these variable would help to provide an answer based on a more systematic research project potentially able to show not only if and to what extent groups differ in EUT inconsistency from individuals, but also when and how group decision can be induced to be more rational and more useful to individual and group well-being.

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