EXCHANGE DIFFERENCES CAUSED BY THE EMPATHY DEGREES*

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Starting from a definition of cuasi-rational behavior, this essay breaks with some suppositions of the traditional economics, working with unstable preferences modeled from a charm-utility function in a context of bounded information, and with different kind of empathic human relations, it proposes a possible theoretic solution for the *a priori* bargaining problem. To prove the model, was carried out the experiment of ultimatum game with children to reduce the effect of the institution of fairness in culture and detect empathic decisions and preference changes.

KEYWORDS: Bounded rationality, unstable preferences, empathy, learning.

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I. INTRODUCTION

This article starts from a thin difference in the economic approach to human behavior. I will call tradition, to the orthodox approach contained in the microeconomic books, and using the same method of analysis of Menger, Wieser [Pirou 1945], Jevons [1913] and Edgeworth [1881], I will renounce to some of the strongly rooted assumptions of the tradition, just as stable preferences, non satiety in consumption, perfect information and selfishness, to gain a most open analysis scheme.

Turning round to the idea that economics is the science of value, being happiness the expression of the individual valuation for the apprehension of objects or events[1], it will be developed a framework for the analysis of preferences based in the relative difference between charm and utility: the passion!

Coming back to the idea of the comparison of happiness between individuals, and the idea of the moral sentiments personified in the empathy, it is open the way to the study of the social effects of human relations over the resources allocation.

This paper analyses the beginning thinking of an individual, out of the learning context or social moral development, when he/him think "what is the other individual thinking?" or more specifically, "as much as happy is the other individual?"… Biologists remember than altruism is a conduct genetically complicate [Dawkins 2002, Wilson 1998, Boorman and Levitt 1980]; and that some animals have conscience of the other animals [Whiten and Boesch 2001, Blackmore 2000]. Both characteristics, encountered in humans, are necessary condition for the empathic relations between people, which generate a specific allocation behavior towards the others.

Biologists [Audesirk and Audesirk 1996] too, gave us another key in the problem: human's pupil be dilate when the individual look something which causes him/her pleasure, and is contracted when the individual look something which causes him/her pain or displeasure; people know these and try to look the other ones eyes to discover if they like to someone.

In the next part I will explain some elements of bounded rationality [Simon 1997], as the consumption set limit for the knowledge and memory and the unstable preferences. In the third I analyze the model of empathic behavior towards the partition, from the point of view of an individual; in the fourth, based on the thinking of the individuals, if there are or not a solution in a partition problem. In the fifth there is an experimental design of ultimatum bargaining game with repetition, made with kindergarten children to prove the model.

II. ELEMENTS OF BOUNDED RATIONALITY

It is necessary to define two elements to build the model of empathy thinking. The first is related of the influence and the kind of information which impact the individual's preferences and the second is the relation between the charm function, which measures the happiness and the utility function which measures the satisfaction.

II. A. LIMIT *CM* AND THE KIND OF INFORMATION

The first premise is that individual's preferences are continuously modeled by the quantity, the quality and the kind of information which impact the senses.

The quantity of information contained in the memory and remembered in the instant of time defines the limit *CM*, which is the limit of the consumption set. *CM* is the set of consumption in the instant of time and is bounded by the knowledge and the remember of the memorized knowledge of the infinite possibilities of consumption bundles.

Be $\mathbf{X}$ the infinite set of consumption bundle, $\mathbf{x} = \{x_1,\ldots,x_n\}$ where $\mathbf{x} \in \mathbf{X}$,

ASSUMPTION 1. LIMIT *CM* PROPERTIES

1. $CM \subset \mathbf{X}$ and $\emptyset \neq \mathbf{X} \subseteq \Re^n_+$

2. *CM* is closed

3. $\mathbf{0} \in CM$

The consumption bundle of an individual *j* is $\mathbf{c} = \{x_1,\ldots,x_n\}$ where $\mathbf{c} \in CM$. The definition of the limit *CM* is a little different from that of the traditional microeconomics. [Jehle and Reny 2001].

II. B. CHARM AND UTILITY

It is primordial for the reader to understand that I am going to use the methodology of Francis Edgeworth [1881] to make the build of the choice model. The traditional microeconomics uses the methodology of Wilfredo Pareto [1896] who thought that preferences exist and then he could build the utility function. Edgeworth approach is different: he thought that utility function exists and then the preferences were derived from this.

Then I am going to separate the concepts of happiness and utility[2] and I am going to relate these two concepts.

I need to make two definitions to begin,

DEFINITION 1. Charm is the ordinal structure of the happiness which an individual hope receives from the apprehension of a certain quantity of an object or event.

DEFINITION 2. Utility is the ordinal structure of satisfaction which an individual perceives from their present state of the present apprehension of his consumption bundle **c.**

For the beginning of the model, I am going to suppose that both charm curve and utility curve are the same thing, and I am going to start analyzing only one object or event. If k_i is the satiety point for the object or event *i*, or the quantity of the object or event which provides the individual the most happiness, $0 \leq k_i \leq \infty$, the characteristics of the charm curve could be one of:

Let $\varepsilon = f(\mathbf{X})$ be the charm curve, a function continuous and differentiable, $\mathbf{X} \geq 0$ and $\mathbf{X} \in CM$

(1) $\frac{\partial \varepsilon}{\partial \mathbf{X}} > 0 \text{ if } \mathbf{X} < \mathbf{k}$ $\quad \frac{\partial \varepsilon}{\partial \mathbf{X}} = 0 \text{ if } \mathbf{X} = \mathbf{k}$ $\quad \frac{\partial \varepsilon}{\partial \mathbf{X}} < 0 \text{ if } \mathbf{X} > \mathbf{k}$ $\quad \frac{\partial^2 \varepsilon}{\partial \mathbf{X}^2} \leq 0$,

(2) $\frac{\partial \varepsilon}{\partial \mathbf{X}} > 0 \text{ if } \mathbf{X} < \mathbf{k}$ $\quad \frac{\partial \varepsilon}{\partial \mathbf{X}} = 0 \text{ if } \mathbf{X} = \mathbf{k}$ $\quad \frac{\partial \varepsilon}{\partial \mathbf{X}} < 0 \text{ if } \mathbf{X} > \mathbf{k}$

$\frac{\partial^2 \varepsilon}{\partial \mathbf{X}^2} > 0 \text{ if } \mathbf{X} < \mathbf{x_c}$ $\quad \frac{\partial^2 \varepsilon}{\partial \mathbf{X}^2} = 0 \text{ if } \mathbf{X} = \mathbf{x_c}$ $\quad \frac{\partial^2 \varepsilon}{\partial \mathbf{X}^2} < 0 \text{ if } \mathbf{X} > \mathbf{x_c}$

Where $0 < \mathbf{x_c} < \mathbf{k}$,

(3) $\frac{\partial \varepsilon}{\partial \mathbf{X}} > 0 \text{ if } \mathbf{X} < \mathbf{k}$ $\quad \frac{\partial \varepsilon}{\partial \mathbf{X}} < 0 \text{ if } \mathbf{X} > \mathbf{k}$ $\quad \frac{\partial^2 \varepsilon}{\partial \mathbf{X}^2} > 0 \text{ if } \mathbf{X} < \mathbf{k}$ $\quad \frac{\partial^2 \varepsilon}{\partial \mathbf{X}^2} < 0 \text{ if } \mathbf{X} > \mathbf{x_c}$.

And by the supposition, the utility function has the same properties. The three kind of charm curves are shown in Figure I.

There are another two assumptions to continue the model for more than one object or event.

ASSUMPTION 2. To compose the utility function for n objects or events in $\Re^n$, the model needs to take the satiety point and rotate the *n* utility curves by this point as the axle.

The other supposition, I am going to use at the beginning, is that the utility value in the satiety point for the *n* objects or events is the same: $U(k_1^*) = U(k_2^*) = \ldots = U(k_n^*)$. The assumption 2 and the supposition are reflected in Figure II.

As a result of the curves composition I obtain the model of the preferences in the instant of time of an individual given the assumptions. Figure III represents the map of preferences or indifference curves for the $n = 2$ case.

The utility function for this special case, represent a preference relation which in the instant of time carry out with the axioms of completeness, transitivity, continuity and convexity, but no with the traditional one of monotonicity.

Now I am ready to show the reader, the effects of different kind of information over the order of preferences[3]. There exist three kind of information: satiety information, passionate information and structure information. A satiety information impact the perception of an individual, of the quantity of an object or event which gives him/her the most happiness, being more o less than before, if the information is positive or negative respectively (Figure IVa).

Passionate information impacts the perception of the quality of happiness received by each quantity of the object or event; it is to say than passionate information produces a monotonic transformation of the charm curve. It does not change the order of preferences of the object or event itself, but as will be seen next, generates a strong effect in relation with the others objects or events (Figure IVb).

Finally a structure information, causes a very strong effect over the thinking of the individual generating a change of idea, and creating a new object or event in the perception of this specific individual.

Now it is time to eliminate the supposition that charm curve and utility curve are the same, and the supposition that the charm value in the satiety point for all the objects and events in the limit *CM* are the same.

For more than one object or event, the effect of information in the utility function is given by the principle 1.

PRINCIPLE 1. All change in the hope happiness perceived, by an individual, for the apprehension of the quantities of an object or event generated by a passionate information, implies a inverse change of the satisfaction perceived by the apprehension of the quantities of these object or event in relation to the satisfaction perceived the current apprehension of the quantities of the others objects or events, in the limit *CM*.

The principle 1 is shown to a better understand for the reader, in figure V[4].

As a result of these, passionate information generates another kind of utility function as it is shown in Figure VIa. The crest [**c**] over the hill represents the less passion over the object or event x_a. Figure VIb shows the order of preferences if the individual presents different grades of passion for the objects or events. This new preference relation obtained from the charm-utility analysis preserve in the instant of time inside the limit *CM* the axioms of completeness, transivity and convexity. By satiety the utility function has not monotonicity (only in the extreme case than $\forall\ k_i \rightarrow \infty,\ \ i = 1,\ldots,n$ it has strictly monotonicity). There is not continuity in the place of the crest, which present a set of points over a line, points with more utility when they are near the axle, and less utility in the extreme of the crest (only when the passion for all the objects and events are equal the preferences present continuity).

In the time, there is not any one of the axioms that traditionally has been associated with the preferences, because the preferences are instable along the time.

A model of utility function which carries out with the characteristics mentioned before,

(4) $$U_t = f(\mathbf{U}_t), \text{ with } \mathbf{U}_t = (U_{t1}, U_{t2}, \ldots, U_{tn}),$$

where 1 to *n* are the different objects and/or events in the limit *CM* for a specific individual.

And $U_{ti} = U_i(x_i, N_{ti}, k_{ti})$ is the utility function for the object or event *i*, in function of the quantities (x_i), the normal (N_i) at the time *t*, and the satiety point (k_i) at the time *t*, being the normal, the relative proportion of the passion perceived by the individual for the object or event *i*, in relation with the other *n-i* objects or events in his/her limit *CM*. The characteristics of this utility function are described in the appendix A.

III. EMPATHY

One of the objects or events which individuals can insert in their limit *CM* for apprehension is the degree of happiness of some other individuals. The incorporation in the utility function of certain individual, of the perceived charm of another individual is called empathy.

By the way of the incorporation of the charm in the utility function, the empathy could be divided in three: a) spite, b) self-interest and c) sympathy. I am going to begin with the self-interest behavior, because it is the most well-know case for the traditional microeconomic theory, and later I will explain the behavior in the cases of sympathy and spite.

The specifically problem which will be treated next is, what is the behavior of an individual *a priori*, when he/her is facing other individual for the possession of some objects or events, endowed in a finite quantity, with no other restrictions.

III. A. SELF-INTEREST

An individual who in certain moment is self-interested, it is to say in his/her limit *CM* in these determined moment has not incorporated in his/her *n* objects or events any charm of another individual.

The behavior of an individual is described by the theorem 17 of my thesis (Olarte 2003), here the principle 2:

PRINCIPLE 2. An individual has a **cuasi-rational** behavior when he/her maximizes the acquisition of the aims proposed by some set of instructions[5].

Be one the instructions of the daily life, be the most happiness that could be (which does not necessarily is to be with a “happy” face, with the larger convex mouth), it implies that an individual will maximize his/her charm, which is the same to maximize the utility.

Facing the problem defined, the behavior of the individual is,

$$\underset{x_1,\ldots,x_n}{Max} \quad U_t(x_1,\ldots,x_n) = f(x_1,\ldots,x_n) \qquad \text{sa:} \quad 0 \le x_i \le Dx_i \quad \forall\ i = 1, \ldots, n\ ,$$

with n being the number of objects or events in the limit *CM* of the individual at time t. Dx_i being the endowment of the object or event i and U_t is a utility function exactly as equation (4).

The choice for this problem, *a priori*, is $x_i{*} = \begin{cases} Dx_i & if\ \ k_i \ge Dx_i \\ k_i & if\ \ k_i < Dx_i \end{cases}$

So, the individual think in distribute the object i, having for himself the quantity that satiates him/her and leaving the rest for the other individual, if the endowment is more than the satiety quantity. But if not, the individual think, *a priori*, to have all the endowment.

III. B. SYMPATHY

Sympathy relations could be divided in three classes according to the way how the individual see the other individual charm. Sympathy is the case when the charm of an individual increases the charm of us. But it could increase it proportionally, less than proportionally or more than proportionally. Observe than when I talk of sympathy relations, it has not satiety point (or it is in infinite) for the charm of the other in our charm curve. The model, the utility function resulting of compose the utility curves derived from the charm curves is,

(5) $$U^a = f^a\left(g^a\left(U_p^{b,a}\right), h^a\left(\mathbf{x}^a\right)\right).$$

Where U^a is the utility for the individual *a*, $U^{b,a}{}_p$ is the utility of individual *b* perceived by individual *a*, and $\mathbf{x}^a = (x_1{}^a,\ldots,x_n{}^a)$ the vector of objects and/or events in the limit *CM* of the individual *a*. The characteristics of functions $f(\cdot)$, $g(\cdot)$ are described in appendix B, and $h(\cdot)$ is a utility function just as equation (4).

The partition problem of the individual *a*, is to maximize his utility and the utility perceived from individual *b* simultaneously, subject to the endowment, and the limit *CM* of the capacity of perception of individual *a*, from the utility of individual *b*,

(6) $$\underset{U_p^{b,a},\mathbf{x}^a}{Max} \quad U^a = f^a(g^a(U_p^{b,a}), h^a(\mathbf{x}^a)) \qquad \underset{U^a,\mathbf{x}^b}{Max} \quad U_p^{b,a} = f^b(g^b(U^{a,b}), h^b(\mathbf{x}^{b,a}))$$

$$\text{sa: } \mathbf{Dx} \le \mathbf{x}^{\mathrm{a}} + \mathbf{x}^{\mathrm{b,a}} \qquad U^{b,a}{}_p \le CM(U^{b,a}{}_p).$$

The solution of the problem is a result of the different classes of sympathy described next, and the procedure to obtain that result is described in the appendix C.

III. C. FRIENDSHIP

When the happiness of an individual produces in us an increase in our happiness directly proportional, that is to say, the charm of the other individual is added up to our charm, it is called friendship, and we say "he/she is my friend".

So it can be represented by a charm curve $\varepsilon^a = \varepsilon^b$, where *a* is the individual of analysis and *b* the "friend" for *a*; so, it is a special case of the charm curve in (1), just as Figure I (F_1e) but with no satiety, and especially with a degree angle of 45° and only this characteristic is possible. It kind of relation was described before by Edgeworth [1881] and Becker [1987], and the characteristics of the model are described in the appendix D.

Proposition 1 explains the partition behavior of the individual a, starting from the demonstration in appendix E, which is the procedure of solution to the problem in equation (6) given the characteristics in D,

PROPOSITION 1. If in the instant of time, an individual *a*, who see another individual *b* as his friend, have to divide an object or event i endow in a quantity Dx_i, the individual *a* will want take for himself the quantity which make proportional his/her satiety point and passion for the object or event, with the satiety point and passion for the object or event from the individual *b*.

Figure VII, an extended Edgeworth box, show the behavior of the individual *a* about the partition of one object or event *i*.

III. D. COMPANIONSHIP

When the happiness of another individual produces in us an increase in our happiness less than proportionally, he/she is called a companion or partner.

The characteristics of the companionship utility function in the appendix F, and the solution in G, and the axiomatization and an extent work about it has been made by Edgeworth [1881], Collard [1975]) or Ahn [2001]. These characteristics allow me to present the next proposition to establish the *a priori* partition behavior,

PROPOSITION 2. If in the instant of time, an individual *a*, who see another individual *b* as his companion, have to divide an object or event *i* endow in a quantity Dx_i, the individual *a* will want take for himself a quantity *more* than that which make proportional his/her satiety point and passion for the object or event, with the satiety point and passion for the object or event from the individual *b*.

Figure VIII is a representation of this theorem in the extended Edgeworth box. By the implications of Lemma 1 (in appendix C), the red curves (of individual *b* perception) should be taken as any class of sympathy: for simplification I have taken friendship.

III. E. LOVE

True love (in the romantic sense) or the magnanimity (in Adam Smith sense), is characterized because the happiness of the other individuals produces in us an increase in our happiness higher than proportionally. Then we say "I am in love for this person".

Characteristics of this love utility function are in appendix H and the solution of the problem in I, so it allow me present the next theorem which describes the *a priori* partition behavior.

PROPOSITION 3. If in the instant of time, an individual *a*, who see another individual *b* with true love, have to divide an object or event i endow in a quantity Dx_i, the individual *a* will want take for himself a quantity *less* than that which make proportional his/her satiety point and passion for the object or event, with the satiety point and passion for the object or event from the individual *b*.

Figure IX show the proposition 3, in the extended Edgeworth box.

III. F. SPITE

We see another individual with spite if the happiness of these individual reduces our happiness.

Taking the equation (5), as the empathic equation, in spite, the characteristic of $g(\cdot)$ must be,

$\frac{\partial U^a}{\partial g^a(U_p^{b,a})} < 0$ and $\frac{\partial g^a}{\partial U_p^{b,a}} > 0$, just as if $U^{b,a}{}_p$ were a bad thing.

The solution in appendix C indicates us only a course of action wish will be taken by the individual, and I can propose the next theorem to explain a spiteful behavior,

PROPOSITION 4. If in the instant of time, an individual *a*, who see another individual *b* with spite, have to divide an object or event *i* endow in a quantity Dx_i, the individual *a* will want take for himself a quantity *equal or more* than his own satiety point.

Obviously, if the satiety point of *a* is larger than the endowment of the object or event, the individual will want the endow for himself, leaving nothing to the other individual.

IV. PARTITION UNDER EMPATHY RELATIONS

To be short, I can propose the next theorem to show the *a priori* solution in the problem of a partition of certain endowment of objects and/or events by two people. Be λ_j = (Spite, Self-interest, companionship, friendship, true love),

THEOREM 1. A pair of individuals, *a* and *b*, which see one another with a certain empathic relation [λ_a] and [λ_b], if $\lambda_a = \lambda_b$ = friendship, there is a equilibrium solution *a priori* for the partition problem, because both individual are thinking in divide the endow of the objects and/or events Dx_i, making proportional their satiety points and passions for the objects or events.

COROLLARY 1. There is *only* another possibility of *a priori* equilibrium solution if individual *a* see the other with true love, and the individual *b* see *a*, with companionship, but it has very restrictive parameters[6].

COROLLARY 2. There is not equilibrium solution *a priori* to the partition problem if at least one individual is self-interested or spiteful with regard to the other.

Remember the reader, that I am exploring the *a priori* equilibrium solution in a not institutionalized context; there is not here a consideration for other kind equilibrium solutions, as the market, the learning, the habits or the labor introduction as the equilibrium in “rotten kid” theorem of Becker [1987].

V. THE EXPERIMENT

To prove the preceding model I did an experiment of ultimatum game with continuation using kid in ages between three to five years. The idea to do this was that the younger kids do not know prices and are in the beginning of the learning process, so the habits are in formation, and then the children are not socially predisposed to an institutionalized behavior as the reported in the conclusions of different works about experiments made with adult people[7]. This institutional behavior is socially organized and complex, including reciprocity [Rabin 1998, Fehr, Gachter and Kirchsteiger 1997, and Bowles and Gintis 2003] or inequality aversion [Fehr and Schmidt 1999].

The children taken in pairs (experiments 1 to 5) were put face to face, separated by a table where was some object (specifically candies), which in some cases was divisible or not. One kid was questioned with “what quantity of the object, do you want to maintain for you?, and what quantity do you want to give the kid is in front of you?”

After the kid’s answer, the other kid was faced to answer the question “do you accept this?, or do you want another allocation?”.

All the kids knew that their reward would be the candies in the table, and they were convinced after the answer, that if they do not reach an agreement, they have not the reward.

Later the first question was repeated to the second kid, but with a new endowment, a unit more than the beginning, and the first kid had to accept or reject the new allocation. The questions were repeated until they reach an agreement or, the endowment was ten, so the kids received only one unit of the candy.

Other children were putted in a room alone (experiments 6 to 8) and were convinced that in other room was other kid but they do not know who was; then the kids was questioned equal, but they must think how to share with the unknown kid in the other room. Previously (a week before) the kids draw his school mates who they believe was their friends and the school mates they believe was their enemies.

After this, they were questioned “do you think the other kid would accept or reject your allocation?”. And then they do not receive nothing, the endowment was incremented and the initial question was repeated. The process was made again until reach five candies.

It is very important to notice the reader that experiment 8 was made with a kid with some degree of mental incapacity and a strong problem of communication.

The experimental procedure is denoted in table I, indicating the number of participants, the kind of the object (divisible or not, or the beginning quantity), the kind of candy, and the relation of the kids based on the observations from the teachers in the kindergarten and from the children themselves.

The experiment was made in a private kindergarten in Bogota in March of 2003, and was repeated in the same place, with different kids in September of 2003. The results presented next are from the second session because the first session was defined as a calibration session.

V. A. RESULTS AND COMMENTS

Table II show the results of the experiments, as the allocation proposed initially by the first questioned kid, the answer of the second kid and his/her proposition, and the final allocation or situation, after many repetitions.

The test has not statistical value because of the short number of observations. So, there are some indications. Ultimatum game, developed and solved by Ariel Rubinstein [1982] was early proved by experiments [Gütt, Schmittberger and Schwarze 1982, Thaler 1988] which revealed some anomalies in the people's answers, so the individuals not always show a self-interested behavior.

A theory of empathy is an *a priori* explanation for the development of this behavior, and kids were used because they should be self-interested or have a moral development as it has been observed by psychologists [Piaget 1977, Damon 1999].

As the experiment confirmed, 68% of the initial propositions were self-interested behavior, as traditional theory hypothesized. The others were samples of spite or sympathy behaviors (even it could be samples of cooperative behavior through learning from parents), as table III reflects[8].

Fairness behavior were observed in 16% of the cases, but it is important to understand that those results are completely, and do not reflect the beginning thinking of the kids which were chosen to be the individual *B*, so their answer could correspond to the behavior described by Güth, Schmittberger and Schwarze. as spiteful because of the self-interested initial answer of individual *A*.

The final solution, is strongly different, because the fairness partitions (caused by the negotiation) increases to 56%, and the tendency to maintain self-interested behavior decreased to only a 16%; a very interesting observation, because the children preferred have nothing, than share with the other kid.

The experiment is not extensive conclusive, because it needs a sample with more observations to confirm the hypothesis of the different classes of empathy, and some repetitions in different contexts.

VI. CONCLUSIONS

The individuals have unstable preferences modified by information which change the perception of the objects or events in human mind. This information can alter the knowledge and memory and then the consumption set, or the satiety point, or the relative passion or modify completely the idea about one object or event.

Individual present some degree of empathy toward the other ones, if the empathy relation is self-interest *a priori*, the individual will want the quantity that satiates himself; if there is some degree of sympathy, the individual will want share with the others; if there is some degree of spite, the individual will have an incentive to hurt the other one, carry away the other one's allocation.

The experiment conducted to prove the last propositions offer some results not extensively conclusive because of the short sample. Children not always behave as self-interested, so they have some fair attitudes to his "friends" as predicted the model; and more interesting, the most of self-interested children learn the fair allocation during the negotiation.

APPENDIX

A. Characteristics of the utility function

Let $i = 1,\ldots,n$ be one of the n objects and/or events in the limit CM of a certain individual at the time t.

Let N_{it} be the normal of the object or event i at the time t $\qquad 0 < N_{it} < \infty$

Let k_{it} be the satiety point of the object i at the time t. $\qquad 0 \leq k_{it} \leq \infty$

$$\frac{\partial U_t}{\partial U_{it}} > 0$$

$$\frac{\partial U_{it}}{\partial X_{it}} > 0 \text{ if } X_{it} < k_{it} \qquad \frac{\partial U_{it}}{\partial X_{it}} = 0 \text{ if } X_{it} = k_{it} \qquad \frac{\partial U_{it}}{\partial X_{it}} < 0 \text{ if } X_{it} > k_{it}$$

$$\frac{\partial U_{it}}{\partial N_{it}} < 0 \qquad \frac{\partial U_{it}}{\partial N_{jt}} > 0 \quad \forall\, j = 1,\ldots,n \text{ and } j \neq i$$

The second derivative $\partial^2 U_{it}/\partial X_{it}^2$ is less or equal to zero if is the case a) of the charm curve, more than zero if is the case c) of the charm curve.

EXAMPLE

Let $U_{it} = m_{it} - \frac{m_{it}(x_i - k_{it})^2}{k_{it}}$ be the relative utility function for the object or event i at time t.

The complete implicit utility function is $n_{CM} = \sum_{i=1}^{n_{CM}} \frac{m_{it}(x_i - k_{it})^2}{(m_{it} - U(x_1,\ldots,x_n))k_{it}}$

Where $m_{it} = \frac{\sum_{h=1,\, h\neq i}^{n_{CM}} N_{ht}}{N_{it}}$

For the special case of $n = 2$ objects or events, the implicit utility function is

$$2 = \frac{m_{1t}\left(x_1 - k_{1t}\right)^2}{\left(m_{1t} - U(x_1, x_2)\right)k_{1t}} + \frac{m_{2t}\left(x_2 - k_{2t}\right)^2}{\left(m_{2t} - U(x_1, x_2)\right)k_{2t}} \text{ where } m_{1t} = \frac{N_{2t}}{N_{1t}} \text{ and } m_{2t} = \frac{N_{1t}}{N_{2t}}$$

B. Characteristics of the empathic utility function

The utility function in equation (6) is formed by a principal continuous and differentiable function f^a whose principal characteristic is that it provides the same utility participation to $g(\cdot)$ and to $h(\cdot)$.

$$\frac{\partial U^a}{\partial g^a} > 0 \quad \text{and} \quad \frac{\partial U^a}{\partial h^a} > 0$$

$g^a(U^{b,a}_p)$ is the utility function over the utility perceived from the individual *b* by individual *a*. But the specific characteristics depend on the different cases of empathy.

$$\frac{\partial g^a}{\partial U_p^{b,a}} > 0 \text{ for the sympathy function.}$$

$$\frac{\partial g^a}{\partial U_p^{b,a}} = 0 \text{ for the self interested function.}$$

$$\frac{\partial g^a}{\partial U_p^{b,a}} < 0 \text{ for the spite function.}$$

C. *Proof of the Solution of the sympathy utility function*.

The problem in (5) could be solved transforming the second maximization problem in a restriction by clear up the utility of individual *a*:

$$\underset{U_p^{b,a},\mathbf{x}^a}{Max} \quad U^a = f^a(g^a(U_p^{b,a}), h^a(\mathbf{x}^a))$$

sa: $U^{a,b} = g^{b^{-1}}(f^{b^{-1}}(U_p^{b,a}), h^b(\mathbf{x}^{b,a}))$ $\quad \mathbf{Dx} \leq \mathbf{x}^a + \mathbf{x}^{b,a}$ $\quad U^{b,a}_p \leq CM(U^{b,a}_p)$

It is important to clarify that $U^{a,b}$ in the restriction, is the utility of *a*, that individual *a* think that individual *b*, has in his/her utility function, perceived from his his/her own utility. What a headache!

The first order conditions to solve the problem are:

$MRS^a = MRS^{a,b}$ The marginal rates of substitution must be equal, then,

$$\frac{\dfrac{\partial U^a}{\partial U_p^{b,a}}}{\dfrac{\partial U^a}{\partial x_i^a}} = \frac{\dfrac{\partial U^{a,b}}{\partial U_p^{b,a}}}{\dfrac{\partial U^{a,b}}{\partial x_i^a}} \rightarrow \frac{\dfrac{\partial f^a}{\partial g^a}\cdot\dfrac{\partial g^a}{\partial U_p^{b,a}}}{\dfrac{\partial f^a}{\partial h^a}\cdot\dfrac{\partial h^a}{\partial x_i^a}} = \frac{\dfrac{\partial g^{b^{-1}}}{\partial f^{b^{-1}}}\cdot\dfrac{\partial f^{b^{-1}}}{\partial U_p^{b,a}}}{\dfrac{\partial g^{b^{-1}}}{\partial f^{b^{-1}}}\cdot\dfrac{\partial f^{b^{-1}}}{\partial h^b}\cdot\dfrac{\partial h^b}{\partial x_i^{b,a}}\cdot\dfrac{\partial x_i^{b,a}}{\partial x_i^a}}$$

Observe the reader an interesting conclusion obtained from the solution condition: that is, the individual *a* solution *a priori*, depends on his own perspective of the relation given by $\partial g^a/\partial U^{b,a}{}_p$, and never from the perspective of the individual *b*. That is, the solution is basically in the same direction if the individual *a* perceives than the individual *b* look at him/her as his friend, love, companion, enemy or with self-interest.

LEMMA 1. The *a priori* solution of the partition problem under empathy relations, from the point of view of an individual depends on $\partial g^a/\partial U^{b,a}{}_p$ and not strongly on $\partial g^b/\partial U^a$; That is to say, the solution depend of how the individual of analysis see the other individual and does not depend on how the other individual see the individual of analysis.

<u>D. Characteristics of the friendship utility function</u>

Adding to the characteristics described in B, the friendship utility function must be

$U^a = f^a(g^a(U_p^{b,a}), h^a(\mathbf{x}^a))$ so, $g^a(U_p^{b,a}) \Rightarrow g^a(U_p^{b,a}) = U_p^{b,a}$ then, $U^a = f^a(U_p^{b,a}, h^a(\mathbf{x}^a))$

E. *Proof of the solution of the friendship partition problem*

Starting from the condition in C and adding the characteristics in D, the solution is,

$$\frac{\frac{\partial f^{a}}{\partial g^{a}}\cdot\frac{\partial g^{a}}{\partial U_{p}^{b,a}}}{\frac{\partial f^{a}}{\partial h^{a}}\cdot\frac{\partial h^{a}}{\partial x_{i}^{a}}}=\frac{\frac{\partial g^{b^{-1}}}{\partial f^{b^{-1}}}\cdot\frac{\partial f^{b^{-1}}}{\partial U_{p}^{b,a}}}{\frac{\partial g^{b^{-1}}}{\partial f^{b^{-1}}}\cdot\frac{\partial f^{b^{-1}}}{\partial h^{b}}\cdot\frac{\partial h^{b}}{\partial x_{i}^{b,a}}\cdot\frac{\partial x_{i}^{b,a}}{\partial x_{i}^{a}}}\rightarrow\frac{\frac{\partial f^{a}}{\partial g^{a}}}{\frac{\partial f^{a}}{\partial h^{a}}\cdot\frac{\partial h^{a}}{\partial x_{i}^{a}}}=\frac{\frac{\partial f^{b^{-1}}}{\partial U_{p}^{b,a}}}{-\frac{\partial f^{b^{-1}}}{\partial h^{b}}\cdot\frac{\partial h^{b}}{\partial x_{i}^{b,a}}}$$

EXAMPLE 1

As I have defined before, f has the same effect over $g(\cdot)$ and $h(\cdot)$, we can say for example that $\partial f/\partial g = 1$ and $\partial f/\partial h = 1$, then, the maximization condition is reduced to

$\frac{1}{\frac{\partial h^{a}}{\partial x_{i}^{a}}}=\frac{1}{-\frac{\partial h^{b}}{\partial x_{i}^{b,a}}}\rightarrow\frac{\partial h^{a}}{\partial x_{i}^{a}}=-\frac{\partial h^{b}}{\partial x_{i}^{b,a}}$ which imply that the individual makes proportional the satiety point and the passion felt by both individual for the object or event i.

For example, if both individual perceives the same passion and have the same satiety point, for all $x_i^a = x_i^{b,a}$ we have $h^a(x_i^a) = h^b(x_i^{b,a})$, then we have $\partial h^{a}/\partial x_{i}^{a}=\partial h^{b}/\partial x_{i}^{b,a}\ \forall\ x_i^a = x_i^{b,a}$

As the restriction says $Dx_i = x_i^a + x_i^{b,a}$, then $Dx_i = x_i^a + x_i^a \rightarrow x_i^{a}{*} = x_i^{b,a}{*} = Dx_i/2 \quad \forall\ i = 1,..,n$

Then, $(x_i^{a}{*}, x_i^{b,a}{*})$ is a fair allocation.

EXAMPLE 2

Be the utility functions $U^{a}=U_{p}^{b,a}-(x^{a}-k_{t}^{a})^{2}$ and $U_{p}^{b,a}=U^{a,b}-(x^{b,a}-k_{t}^{b})^{2}$

The procedure to find the solution is:

$$\max_{U_{p}^{b,a},x^{a}} U^{a}=U_{p}^{b,a}-(x^{a}-k_{t}^{a})^{2}\qquad \text{sa:}\quad U^{a,b}=U_{p}^{b,a}+(x^{b,a}-k_{t}^{b})^{2}$$

$$Dx = x^a + x^{b,a}$$

Observe the reader that the condition of the limit CM for perception of the utility from b is not necessary in this case, because the solution is always the same.

By the condition of maximization, $MRS^a = MRS^{b,a}$, and using the restriction Dx, we have,

$$\frac{1}{-2(x^a - k_t^a)} = \frac{1}{-2(Dx - x^a - k_t^b)} \rightarrow x^a - k_t^a = Dx - x^a - k_t^b \rightarrow x^a = (Dx - k_t^b + k_t^a)/2$$

The solution of the problem from the point of view of individual *a* is:

$$x^a{*} = \begin{cases} (Dx - k_t^b + k_t^a)\big/2 & if\ \ Dx > k_t^a - k_t^b > 0 \\ Dx \quad if\ \ Dx \le k_t^a - k_t^b & \\ 0 \quad if\ \ k_t^a - k_t^b \le 0 & \end{cases}$$ and $x^{b,a}{*} = Dx - x^a{*}$

Obviously, if $k_t^a = k_t^b$, that is, both individual have the same satiety point (and the same passion), then they are going to divide the endowment of the object or event *x* by the middle.

F. Characteristics of the companionship utility function

Adding to the characteristics described in B, the friendship utility function must be

$U^a = f^a(g^a(U_p^{b,a}), h^a(\mathbf{x}^a))$, and

$$g^a(U_p^{b,a}) \Rightarrow \begin{cases} \partial^2 g^a(\cdot)\big/\partial U_p^{b,a\,2} < 0 & (a) \\ \quad or & \\ G{\cdot}U_p^{b,a} \quad \text{where } 0 < G < 1 \quad \text{is a constant} & (b) \end{cases}$$

G. *Proof of the solution of the companionship partition problem*

As in E, replacing by the last conditions in the relation in C, it is obtained the solution.

EXAMPLE 1

As in E, it can be said for example that $\partial f/\partial g = 1$ and $\partial f/\partial h = 1$, then, the maximization condition is reduced to

$$\frac{\dfrac{\partial g^a}{\partial U_p^{b,a}}}{\dfrac{\partial h^a}{\partial x_i^a}} = \frac{1}{-\dfrac{\partial h^b}{\partial x_i^{b,a}}} \rightarrow \frac{\dfrac{\partial g^a}{\partial U_p^{b,a}}}{1} = -\frac{\dfrac{\partial h^a}{\partial x_i^a}}{\dfrac{\partial h^b}{\partial x_i^{b,a}}}$$

By the condition (a) in F, then $\lim_{U_p^{b,a}\to\infty}\left(\dfrac{\partial g^a}{\partial U_p^{b,a}}\right)=0$

If in the problem defined in (6), $CM(U^{b,a}{}_p)$ = $\overline{U_p^{b,a}}$ → ∞, the maximum level of utility from *b*, which can be perceived by *a*, then the solution of the problem is $\dfrac{\partial h^a}{\partial x_i^a}=0$

And this is the maximization condition of the function $h^a(\cdot)$, the utility function from the object or events, which is made when $x_i^a{*}=\begin{cases}k_{i\ t}^a & if\ k_i^a < Dx_i \\ Dx_i & if\ k_i^a \geq Dx_i\end{cases}$

EXAMPLE 2

Be the utility functions $U^a = U_p^{b,a^{1/2}} - (x^a - k_t^a)^2$ and $U_p^{b,a} = U^{a,b} - (x^{b,a} - k_t^b)^2$

The procedure to find the solution is:

$$\max_{U_p^{b,a},x^a} U^a = U_p^{b,a^{1/2}} - (x^a - k_t^a)^2 \qquad \text{sa:} \quad U^{a,b} = U_p^{b,a} + (x^{b,a} - k_t^b)^2$$

$$Dx = x^a + x^{b,a}$$

$$CM(U^{b,a}{}_p) = \overline{U_p^{b,a}} \qquad \text{with } 0 \leq \overline{U_p^{b,a}} \leq \infty$$

By the maximization condition, $MRS^a = MRS^{b,a}$, and using the restriction *Dx*, we have,

$$\frac{1\big/2U_p^{b,a^{1/2}}}{-2(x^a - k_t^a)} = \frac{1}{-2(Dx - x^a - k_t^b)} \rightarrow \frac{1}{2U_p^{b,a^{1/2}}} = \frac{x^a - k_t^a}{Dx - x_a - k_t^b}$$

Substituting $U^{b,a}{}_p$ by the limit *CM* we obtain,

$$\frac{1}{2\overline{U_p^{b,a}}^{1/2}} = \frac{x^a - k_t^a}{Dx - x_a - k_t^b}$$

$\overline{U_p^{b,a}}$ can be replaced by any value as the restriction offers the conditions. Assuming that individual *a* can perceive completely the utility from *b*, then $\overline{U_p^{b,a}}$ tends to infinitum, and

$$\frac{x^a - k_t^a}{Dx - x_a - k_t^b} = 0 \rightarrow x^a = k_t^a$$

And the solution as it was presented in example 1 is $x_i^a * = \begin{cases} k_{i\ t}^a & if\ k_i^a < Dx_i \\ Dx_i & if\ k_i^a \geq Dx_i \end{cases}$

H. Characteristics of the true love utility function

Adding to the characteristics described in B, the friendship utility function must be

$U^a = f^a(g^a(U_p^{b,a}), h^a(\mathbf{x}^a))$, and

$$g^a(U_p^{b,a}) \Rightarrow \begin{cases} \partial^2 g^a(\cdot) \big/ \partial U_p^{b,a\,2} > 0 & (a) \\ or & \\ G{\cdot}U_p^{b,a} \quad \text{where } 1 < G < \infty \quad \text{is a constant} & (b) \end{cases}$$

I. *Proof of the solution of the true love partition problem*

As in $Ap4_b$, replacing by the last conditions in the relation in Ap3, it is obtained the solution.

EXAMPLE 1

As in E, it can be said for example that *∂f/∂g* = 1 and *∂f/∂h* = 1, then, the maximization condition is reduced to

$$\frac{\dfrac{\partial g^a}{\partial U_p^{b,a}}}{\dfrac{\partial h^a}{\partial x_i^a}} = \frac{1}{-\dfrac{\partial h^b}{\partial x_i^{b,a}}} \rightarrow \frac{\dfrac{\partial g^a}{\partial U_p^{b,a}}}{1} = -\frac{\dfrac{\partial h^a}{\partial x_i^a}}{\dfrac{\partial h^b}{\partial x_i^{b,a}}}$$

By the condition (a) in H, then $\lim_{U_p^{b,a}\to\infty}\left(\frac{\partial g^a}{\partial U_p^{b,a}}\right)\to\infty$

If in the problem defined in (6), $CM(U^{b,a}{}_p) = \overline{U_p^{b,a}} \rightarrow \infty$, the maximum level of utility from *b*, which can be perceived by *a*, then the solution of the problem is $\frac{\partial h^b}{\partial x_i^{b,a}} = 0$

And this is the maximization condition of the function $h^b(\cdot)$, the utility function from the object or events, which is made when $x_i^{b,a}* = \begin{cases} k_{i\,t}^b & if\;\; k_i^b < Dx_i \\ Dx_i & if\;\; k_i^b \geq Dx_i \end{cases}$

And $x_i^a* = \begin{cases} Dx_i - k_{i\,t}^b & if\;\; k_{i\,t}^b < Dx_i \\ 0 & if\;\; k_{i\,t}^b \geq Dx_i \end{cases}$

EXAMPLE 2

Be the utility functions $U^a = U_p^{b,a\,2} - (x^a - k_t^a)^2$ and $U_p^{b,a} = U^{a,b} - (x^{b,a} - k_t^b)^2$

The procedure to find the solution is:

$$\max_{U_p^{b,a},x^a} U^a = U_p^{b,a\,2} - (x^a - k_t^a)^2 \qquad \text{sa:} \quad U^{a,b} = U_p^{b,a} + (x^{b,a} - k_t^b)^2$$

$$Dx = x^a + x^{b,a}$$

$$CM(U^{b,a}{}_p) = \overline{U_p^{b,a}} \quad \text{with } 0 \leq \overline{U_p^{b,a}} \leq \infty$$

By the maximization condition, $MRS^a = MRS^{b,a}$, and using the restriction *Dx*, we have,

$$\frac{2U_p^{b,a}}{-2(x^a - k_t^a)} = \frac{1}{-2(Dx - x^a - k_t^b)} \rightarrow 2U_p^{b,a} = \frac{x^a - k_t^a}{Dx - x^a - k_t^b}$$

Substituting $U^{b,a}{}_p$ by the limit *CM* we obtain,

$$2\overline{U_p^{b,a}} = \frac{x^a - k_t^a}{Dx - x^a - k_t^b}$$

$\overline{U_p^{b,a}}$ can be replaced by any value as the restriction offers the conditions. Assuming that individual *a* can perceive completely the utility from *b*, then $\overline{U_p^{b,a}}$ tends to infinitum, and

$\frac{Dx - x^a - k_t^b}{x^a - k_t^a} = 0 \rightarrow x^a = Dx - k_t^b$ which is the same to say $x^b = k_t^b$

An the solution as it was presented in example 1 is $x_i^a * = \begin{cases} Dx_i - k_{i\ t}^b & if\ k_{i\ t}^b < Dx_i \\ 0 & if\ k_{i\ t}^b \geq Dx_i \end{cases}$

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[1] Recently the economics have returned to the hedonic approach to explain economic behavior of humans. Frey and Stutzer [2002] have made a survey of the applications of this approach in theoretical and empirical economics. The theoretical approach is doubt to Adam Smith [1759] and Jeremy Bentham, as it has been recognized by the behaviorists [Ashraf, Camerer and Lowenstein 2005 and Kahneman, Wakker and Sarin 1997]. In empirical economics the advances are recent in the attempt to make measurements of happiness and use these measurements for extend the analysis of well being [Kahneman and Kruegen 2006].

[2] Frey and Stutzer [2002] make evident that there is a difference between utility, as in traditional economics, and happiness. Even they said that happiness approach on economics provides a largest set of possibilities for an analysis of well being.

[3] Although economic theory has used by a long time the concept of stable preferences, recently the behavioral economists have studied the effects of unstable preferences, a concept taker in the interdisciplinary job with psychology [Kahneman 2003]. The cause of unstable preferences have been analyzed as Lowenstein [2000] shows, by psychologists, as the effect of changes in immediate emotions [Kahneman 1999] or visceral factors as in Lowenstein view; and by economists as changes in anticipated emotions, the emotions “that are expected to be experienced in the future” [Lowenstein 2000]. Here I am taking how information affects immediate emotions, then the satisfaction and then the decision making.

[4] The effect is similar for each kind of charm curves characteristics defined in a), b) and c).

[5] As I defined in my thesis, the instructions could be pure or practical. Pure instructions are the instructions contained in the genetic code, which defines many of our behavior. Practical instructions are those that the individual learn during his/her life.

[6] Theorem 5 and its corollaries has a very easy proof, derived from the solutions obtained from theorems 1, 2, 3 and 4; so it is not in the appendix.

[7] Heirich et. Al. [2006] reported a survey of different experiments of ultimatum game, made with 15 communities around the world, and in the most cases the individuals gave between 25% and 50%. But also in the three party punishment experiments the people show an important willing to punish people’s offers far from the 50%. This reveals different institutional motivations for cooperative behavior.

[8] Particular observation could open us to a special knowledge of the development of the institutions of fairness. Three year old kids acting as the recipients show stress behavior, crying and questioning inquisitively to the instructor because they think, the other kid were not going to gave nothing to they; and they hope that the instructor must be the person who assign the candies. As the game where made in a kindergarten, the psychologist help with the manipulation of the kids.

TABLE I

EXPERIMENT	KIND OF OBJECT	OBJECT	CHILDREN CHARACTER
1. Two kids	1 not divisible	Candy	Children of separated courses who do not play together.
		Candy	Children of separated courses who sometimes play together.
2. Two kids	1 divisible	Cake	Female children of separated courses. Sometimes play together.
		Cake	Female children of the same course, but they do not consider them as friends.
3. Two kids	2 not divisible	Small cookies and marshmallow	Children of separated courses who do not play together and are not friends.
		Small cookies and marshmallow	Child and female child of separated courses, who do not know the one another.
4. Two kids	2 divisible	Big cookie and cake	Children who play together. Very extrovert.
		Big cookie and cake	Children who play together. So shy.
5. Two kids	1 not divisible	Candy	Children who say that they are not friends, but they know one another so good.
		Candy	Female children who sometimes play together.
6. One kid alone	1 not divisible	Candy	He assumed the kid in the other room was a friend.
		Marshmallow	He assumed the kid in the other room was an enemy.
7. One kid alone	2 divisible	Cake and cookie	She affirmed that the kid in the other room were not her friend because he do not leave she play.
		Cake and cookie	He said that he plays with the kid in the other room, and by these reason they was friends.
8. One kid alone (with a problem of communication)	1 not divisible	Candy	The boy presents some degree of mental incapacity, showing difficult for verbal communication and understanding. Exhibits hypotony.

TABLE II

EXPERIMENT	INITIAL PROPOSE (A)	INITIAL PROPOSE (B)	FINAL SOLUTION
1. Given in pairs.	All for himself.	Middle and middle.	Reach 10 units, both divide by the middle.
Given in impairs.	Major middle for him, the minor middle for the other.	Major middle for him, the minor middle for the other.	Major middle for him, the minor middle for the other.
2. One unit.	All for himself.	All for herself.	Divide by the middle.
One unit.	All for herself.	Almost the whole for her, and a little part for the other.	B, weakest character, gave more than the middle to A, who was stronger character.
3. Given in four units to each one.	All for herself.	All for herself.	There is not solution. The children were distracted by the two options.
Given in four units to each one.	All for himself. Latter he tried to hit the girl to rob her part.	All for her.	There is not solution.
4. Given one by one.	All for herself.	All for himself.	When they receive more and more units, they understand that they can divide by the middle.
Given one by one.	All for herself.	All for himself.	There is not solution. They never tried to divide.
5. Increasing one by one.	All for himself.	All for the other kid; nothing for himself.	They accepted after reach 10 units, the middle solution. Out of the room A hit B and robbed his

			candies.
Increasing one by one.	All for herself.	All for herself.	Reach 4 units, they divided by the middle.
6. Increasing one by one.	The first unit for himself. With two units the divide by the middle.		He always divides by the middle when the endowment is pair. Impair endowments are divided, the high middle for himself and the rest for the assumed kid.
Increasing one by one.	All for himself.		Before the satiety point (5 units) he wants all for himself. After 6 units endowment he begins giving the rest to the assumed kid.
7. Increasing one by one.	All for herself.		She does not want to divide. Always want all for her.
Increasing one by one.	All for himself.		Want to divide by the middle.
8. Increasing one by one.	He does not take a decision.		The child does not take some decision. He always accepts any proposal done by the experimenter.

TABLE III

KIND OF SHOWN BEHAVIOR

KIND OF BEHAVIOR	OBSERVATIONS	AVERAGE
Spiteful	1	4%
Self-Interested	17	68%
Companionship	1	4%
Companionship-Friendship	3	12%
Friendship	1	4%
Love? (may be fear)	1	4%

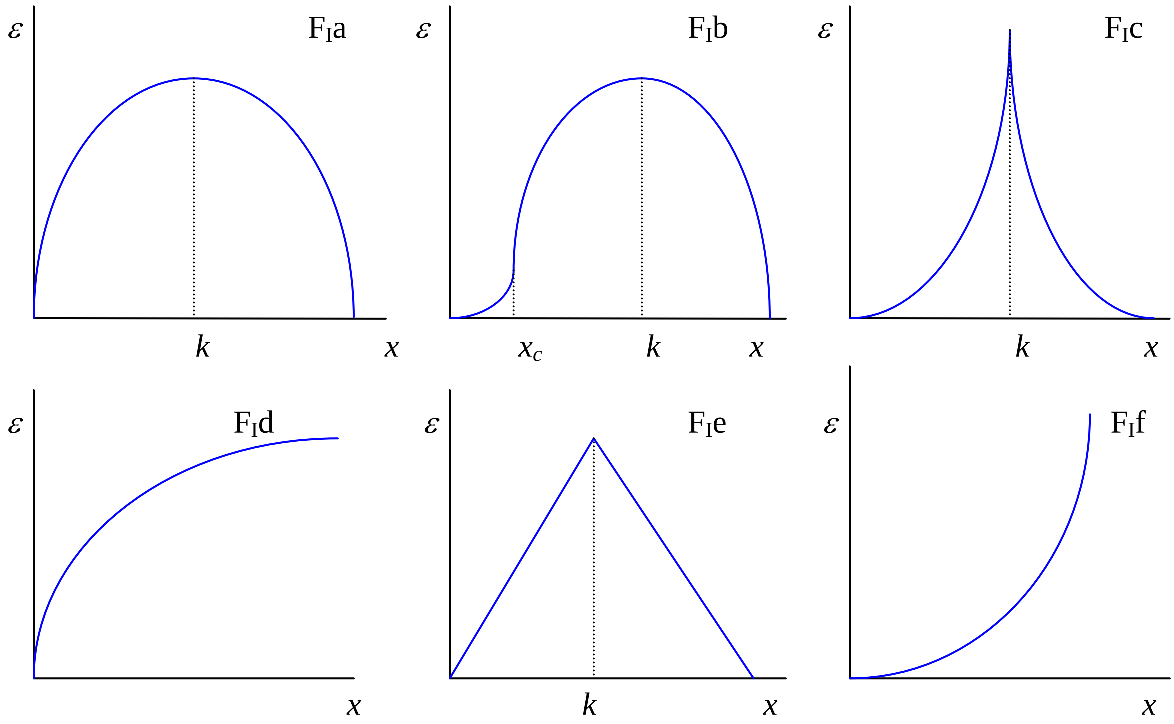

FIGURE I

Six possible cases of charm curves. F_Ia, F_Ib and F_Ic represent the curves of the cases (1), (2) and (3). F_Id, F_Ie and F_If are extreme cases. F_Id is the case (1) when k tends to infinite. F_Ie the case (1) when $\partial^2\varepsilon/\partial x^2 = 0$. F_If the case (3) when k tends to infinite.

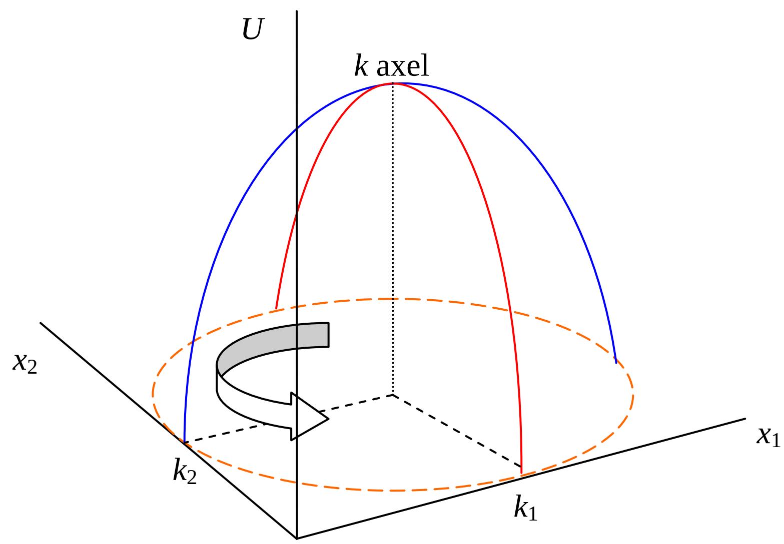

FIGURE II

Figure II shows the assumption 2. Parallel to U-x_2 plan, is the charm curve for the x_2 object or event in red. In blue and parallel to U-x_1 plan is the charm curve for x_1 object or event. Taken the k axel the two curves are composed by rotating them around the k axel. It generates hill form of the utility function.

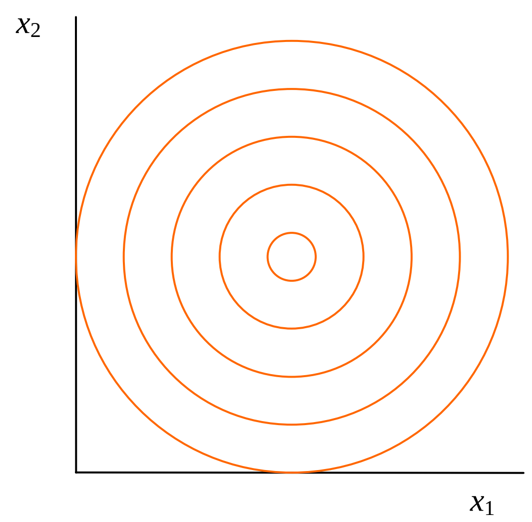

FIGURE III

Figure III shows the indifference curves which represent the preference relation generated by the composition of the utility curves in figure II.

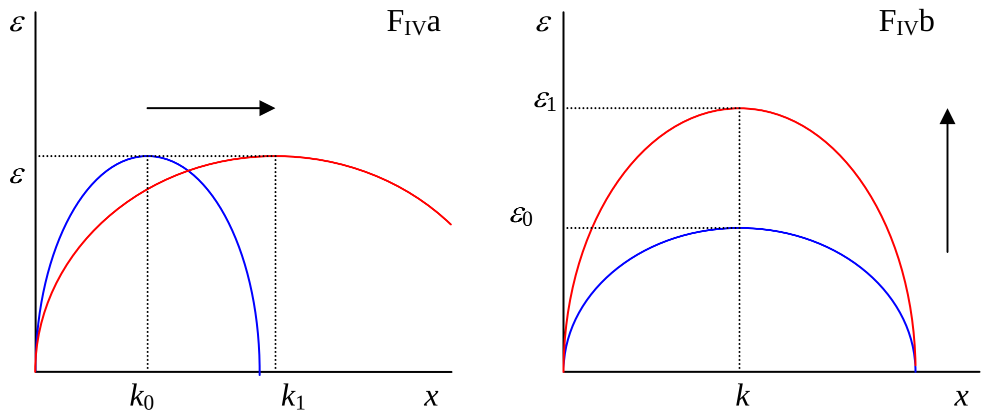

FIGURE IV

Intertemporal effects over the charm curve of: F_4a) a positive satiety information: increases the satiety point from k_0 to k_1, maintaining the charm perceived in both periods by the apprehension of the satiety quantity. F_4b) a positive passionate information: increases the happiness perceived by each quantity. The charm in the satiety point rises from ε_0 to ε_1.

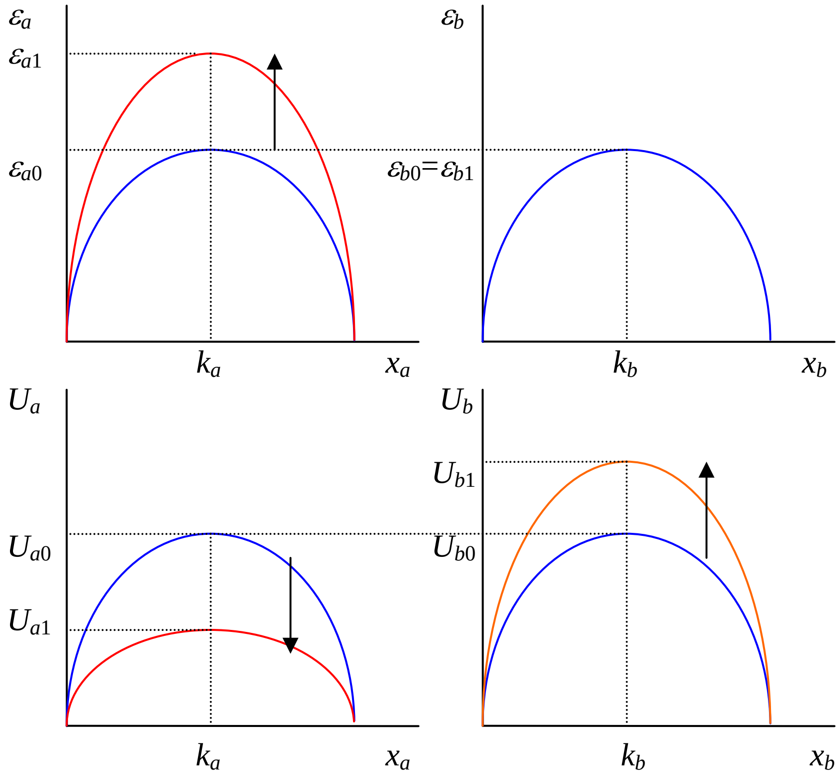

FIGURE V

Figure V show the effect of positive passionate information over the object or event x_a. It increases the charm curve from blue to red, (in k_a, from E_{a0} to E_{a1}) but has not direct influence in the charm curve of x_b. Principle 1 indicates that utility curve of x_a, will decrease, from blue to red (in k_a from U_{a0} to U_{a1}), and/or the utility curve of x_b will rise, from blue to orange (in k_b from U_{b0} to U_{b1}).

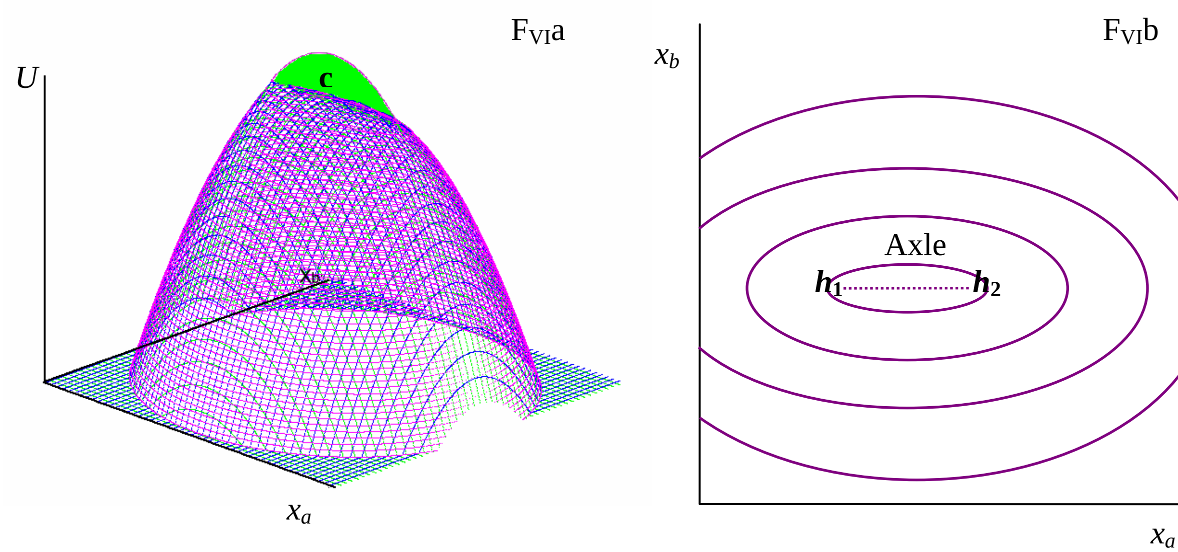

FIGURE VI

F_{IV}a shows the utility function resulting of compose two utility curves, when the utility curve of x_a if higher than the utility curve of x_b, because the individual is more passion for each quantity of the object or event x_b than for x_a. It is to detail the crest in the top of the hill [**c** in green]. F_{IV}b shows the indifference map from the utility function in F_{IV}a: between h_1 and h_2, are the indifference points of the crest. In the axle is the bundle with the most utility. The points h_1 and h_2 has the same utility and the less utility of the points in the crest, but more than the ellipses around the line.

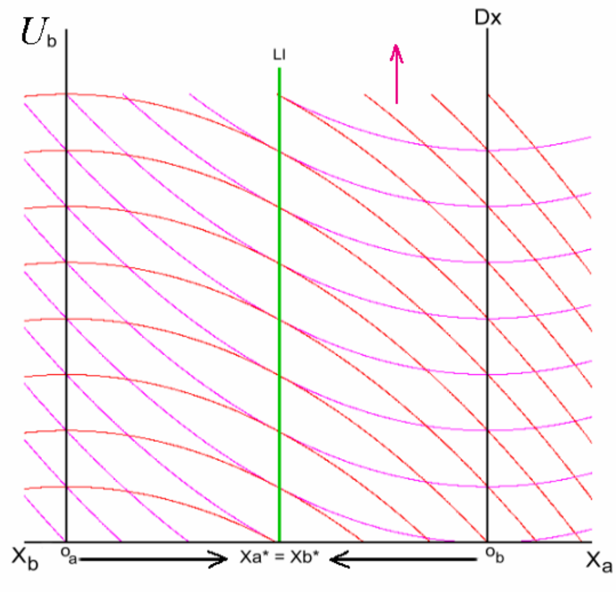

FIGURE VIIa

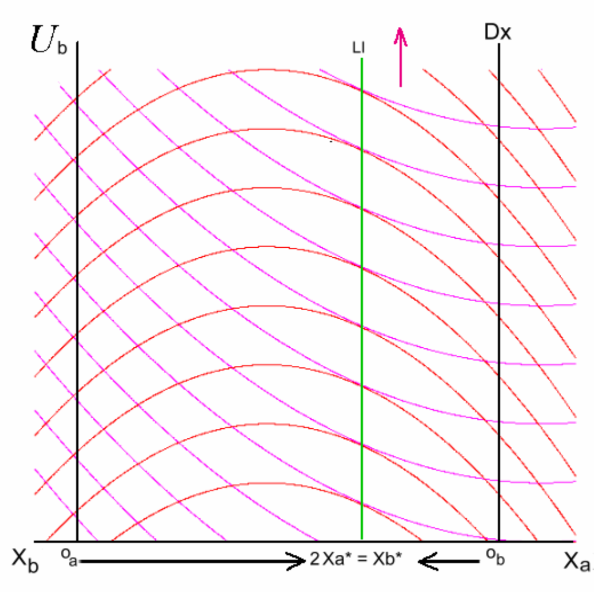

FIGURE VIIb

Figure VIIA: Purple curves, are indifference curves for objective function in example 2 (appendix Ap4b), ($U^{b,a}{}_{p}$;x^{a}), been $k_t^{a} = k_t^{b} = Dx$. Red curves, are the indifference curves for the restriction, using the horizontal axis from right to left ($U^{b,a}{}_{p}$;$x^{b,a}$). *LI* in green, is the partition line formed by the union of the points where the marginal rates of substitution are equal. There is the solution $x^{a}* = x^{b,a}*$, a fair allocation for the friendship with equal satiety point and equal passion.
Figure 7b. It shows the case when $k_t^{a} = Dx$, but $k_t^{b} = Dx/2$. So, as a has a high satiety point, that is, has more necessity for the object or event, the allocation (from the point of view of *a*) will provide *a*, more than *b*: $2x^{a}* = x^{b,a}*$

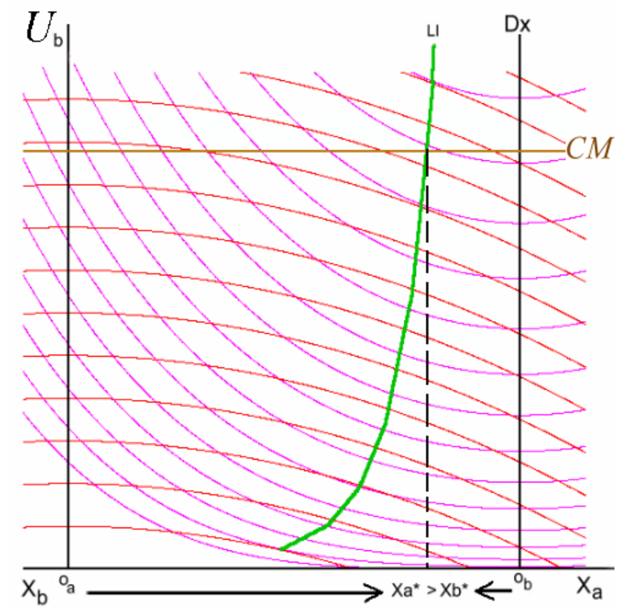

FIGURE VIII

Purple indifference curves form individual *a*, are prominent to the endow *Dx*. By these reason, the partition line *LI* in green is going from the center (down of the picture) to the endow *Dx*. If the perception of individual *a*, for the utility from *b* is denoted by the horizontal brown line *CM*, the individual a solution is $X_a^* > X_b^*$, if both individuals have the same passion and satiety point.

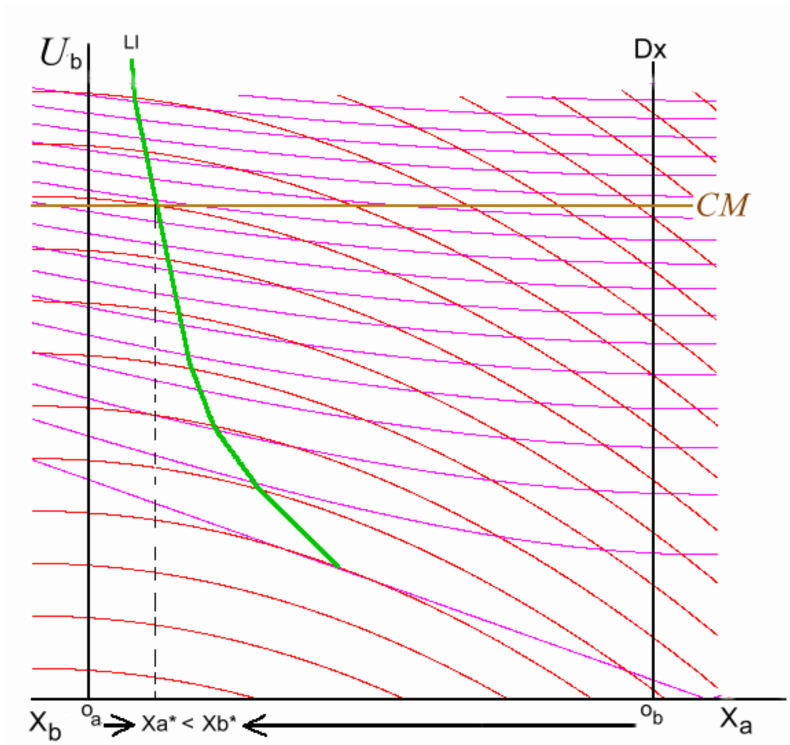

FIGURE IX

Purple indifference curves for the individual *a*, are relatively lay, and by this reason the partition line in green *LI*, begins in the center (down of the picture) and goes to the left near zero. If *CM* horizontal brown line shows the maximum level of utility from individual *b* that can be perceived by *a*, the solution from the point of view of *a* is $X_a^* < X_b^*$, if the passion and satiety point for both individuals are the same.