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Two new solutions for Sen's impossibility of a paretian libertarian[1]

Mihai Daniel Ungureanu[2]

***Abstract*:**
This article is about Sen's impossibility of a paretian libertarian theorem. First, I make some preliminary considerations and I give the standard social choice definitions. Second, I briefly present Sen's result. Third I review nine of the solutions given for Sen's problem: three restrictions of the weak Pareto condition, three restrictions of the libertarian condition and three restrictions of the universal domain. Fourth I introduce the *ideological fidelity* as an acceptability criterion for any solution of Sen's inconsistency result. I use this criterion for rejecting all restrictions of the libertarian and universal domain conditions. Fifth, I present two new solutions which satisfy ideological fidelity. These two solutions consist in restraining the paretian condition's domain only to those individual preferences which are *a)* minimal-rational libertarian or *b)* single-peaked on *x-aspects* (*a concept introduced in this paper*).

Key words: *social decision function, libertarian paradox, ideological fidelity, efficacity for real societies, minimal-rational libertarian preferences, single peaked preferences*.

Introduction:

In 1951, Kenneth J Arrow set the foundations of the axiomatic Social Choice Theory[3], through his General Possibility Theorem. This result

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[3] Social Choice Theory research doesn't have a clear beginning in Arrow's "Social choice and Individual Values". Before Arrow's work we can identify at least two periods: first, in 1282-1287, 1299 the works of Ramon Lull and in 1431-1434 the work of Nicolas Cusanus; Second, in 1784 the work of Borda, in 1788 and 1792 the works of Condorcet. It worth to be mentioned the works of Lhulier in 1794, Collin and Prosperin in 1867, Dodgson in 1876, Nanson in 1883 and 1900. There is no evidence that those from the second period knew about the works of those from the first period. In

proved that there is no social welfare function which satisfies a few reasonable conditions: unrestricted domain, independence of irrelevant alternatives, non-dictatorship and weak Pareto principle. The significance of Arrow's theorem
was, in a strong interpretation, either the welfare economics is consistent only with dictatorship,
either democracy it's not possible. In a weak interpretation one (or more) condition is not necessary and must be weakened or eliminated. Nineteen years after Arrow's paradigmatic result was published, Amartya K. Sen proposed the impossibility of a paretian liberal theorem. Through this impossibility result, Sen introduced in the social choice theory research the problem of individual rights. This new result appears due to the *a)* relaxing the welfare function to a social decision function (*from social transitivity to social aciclicity*) *b)* introducing the individual rights problem in social choice theory's concerns, through a libertarian condition, *c)* retaining universal domain and weak pareto conditions, *d)* eliminating non-dictatorship and independence from irrelevant alternatives conditions. The importance of Sen's theorem is, in a strong interpretation, either welfare economics is not compatible with individual rights or minimal social rationality, either the libertarian thought is inconsistent. In a weak interpretation, Sen's impossibility result does not express an inconsistency between paretianism and individual rights, but an inconsistency between paretianism and a certain formulation of individual rights, formulation which may be changed into another that is consistent with minimal rationality and paretian principle. Arrow's and Sen's theorems have generated a vast literature in many different paradigms and disciplines. Alternative demonstrations and solutions have been proposed by mathematicians, philosophers, economists and political scientists. In this paper I will only address Sen's result.

Notations and definitions *(d=definition, a=axiom, t=theorem, c=comment)***:**

d1 *(weak preference relation)*: *x* is weakly preferred to *y* if and only if, either *x* is strictly preferred to *y*, either *y* is strictly preferred to *x*: *xRy*

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the same way, there is no evidence that Arrow knew about the works of any of those above mentioned. For more details on SCT history, see Urken *(1991)*, McLean and Hewitt *(1994)* and Montjardet *(2005)*.

$\leftrightarrow (xPy \vee xIy)$

d2 *(strict preference)*: *x* is strictly preferred to *y*, if and only if *x* is weakly preferred to *y* and *y* it is not weakly preferred to *x*: $xPy \leftrightarrow (xRy) \wedge \neg(yRx)$

d3 *(indifference relation)*: *x* is indifferent to *y*, if and only if *x* is weakly preferred to *y* and *y* is weakly preferred to *x*:
$xIy \leftrightarrow (xRy) \wedge (yRx)$

a1 *(reflexivity)*: *x* is in relation of weak preference with himself: $\forall x \in A : xRx$;

a2 *(completitude)*: for all different alternatives *x, y*, either *x* is weakly preferred to *y*, either *y* is weakly preferred to *x*: $\forall x, y \in A : (x \neq y) \rightarrow (xRy) \vee (yRx)$;

a3 *(transitivity)*: for any 3 alternatives, if the first is weakly preferred to the second and the second to the third, then the first must be weakly preferred to the third:
$\forall x, y, z \in A : (xRy) \wedge (yRz) \rightarrow xRz$;

a4 *(acyclicity)*: for any finite number of alternatives, if the first is strictly preferred to the second, the second to the third and so on, then the first must be weakly preferred to the last: $\forall x, y, z,..., v \in A : (xPy) \wedge (yPz) \wedge ,..., \wedge zPv \rightarrow xRv$

d4 *(collective choice):* a collective choice rule (*CCR*) is a functional relation *f*, such that, for any set of *n* individual orderings (transitive, complete and reflexive individual preference relations)
$R_1, ..., R_n$
(one ordering for each individual), one and only one social preference relation R is determined, $R_s : f(R_1, ..., R_n)$

d5 *(choice set)*: an alternative *x* from *A is the best alternative in A with regard to a binary weak preference relation, if and only if it is at least as*

good as any other alternative in A: $\forall y : \big((y \in A) \rightarrow (yRx\big)$. *The set of the best alternatives in A is called choice set of A and it is denoted with* $C(A, R)$.

d6 *(minimal collective rationality): a social decision function* (*SDF) is a collective choice rule f, the range of which is restricted to those preference relation R, each of which generates a choice function C(S,R) over the whole set of alternative X. i.e. reflexive, complete and acyclic social preference relations.*

d7 *(collective rationality): a social welfare function (SWF) is a collective choice rule f, the range of which is restricted to the set of orderings for society. i.e. reflexive, complete and transitive social preference relations.*

t1 *(non empty choice set)*: $C_s(A, R) \neq \varnothing$, if and only if R is reflexive, complete and acyclic. ***t1*** is proved by Sen in *(1970a)*.

t2 SWF → SDF *. i.e. any social welfare function is also a social decision function but not vice versa. From here we must conclude that Sen's result has also validity for social welfare functions.* ***t2*** is proved by Seidl in *(1975)*.

The impossibility of a paretian libertarian[4]

I will first define the conditions and then I will present Sen's demonstration for the theorem with the lewd vs. prude case as an illustration of the inconsistency:

Condition ***L*** *(libertarianism)**:** for each person i, there is at least one pair of distinct alternatives (x,y) such that, he is decisive in the social choice between them in either order: if I prefers x to y then society will prefer x to y and if i prefers y to x, then society will prefer y to x:* $D_i(x, y) \wedge (xP_i y) \rightarrow xP_s y$ *and* $D_i(x, y) \wedge (yP_i x) \rightarrow yP_s x$.

[4] Initially, *(1970a)*, *(1970b)*, Sen named his theorem as "*the impossibility of a paretian liberal theorem*". In *(1976)*, he renamed his result as "*the impossibility of a paretian libertarian theorem*". The justification of this new name is, in Sen's words, that of giving up to the less clear term of liberalism.

*Condition **L*** (minimal libertarianism): ceteris paribus L, but the set of individuals has a cardinality of 2.*
*Condition **U** (unrestricted domain): a social preference function has an unrestricted domain if it admits all and only individual orderings (reflexive, complete, transitive preference relations). Condition **P** (weak pareto)**:** for any two alternatives x, y, if all individuals strictly prefer x to y, then x is socially preferred to y:* $(\forall i : xP_i y) \rightarrow xP_s y$.

***t3** (the impossibility of a paretian libertarian) Sen, (1970a), (1970b). There is no SDF which satisfy U, P, L\L*, when the number of individuals is at least 2 and the number of alternatives is at least 3.*

Proof of t3: from premises $N = \{i, j\}$, and $A = \{x, y, z, w\}$. Suppose there is a *SDF* which satisfy *U, P, L**. We must check three cases: 1). *(x,y)* and *(z,w)* are the same pair. It is obvious, form *L** that we can't give libertarian decisivity for two individuals on the same pair of alternatives, because the choice set would be empty. 2) The pairs have one of the elements in common. Suppose that $x = z$, $xP_i y \wedge yP_i w$, and $wP_j x \wedge yP_j w$. By condition *L**, $D_i(x, y)$ and $D_j(x, w)$, by *P,* we have $yP_s w$, by *U*, any individual rational preference is relevant, and by aciclicity the social choice set must be non empty. Therefore $xP_s y \wedge yP_s w \wedge wP_s x$, but $wP_s x \leftrightarrow \neg[xRw]$ which means that theaciclicity condition is violated and there is no best alternative. 3) Suppose now that all four alternatives are distinct. Assume that $wP_i x \wedge xP_i y \wedge yP_i z$ and $wP_j x \wedge yP_j z \wedge zP_i w$. By condition *L**, $D_i(x, y)$ and $D_j(z, w)$, by *P*, $wP_s x \wedge yP_s z$, by *U*, any individual rational preference is relevant, and by aciclicity the social choice set must be non empty. But $xP_s y \wedge yP_s z \wedge zP_s w \wedge wP_s x$, and $wP_s x \leftrightarrow \neg[xRw]$, though by aciclicity xRw , which means that the aciclicity property is violated and there is no best alternative. The proof works for all cases in which we give one libertarian decisivity to each individual.

Sen, *(1970a)*, *(1970b)*, offers an example for his impossibility result: ***lewd vs. prude case:*** suppose we have two individuals, *prude* and *lewd*, and they must socially decide the reading of a copy of D.H. Lawrence's, "*Lady Chatterly's Lover*". The alternatives are: $x : (1,0)$, *prude* reads the book and *lewd* doesn't read it, $y : (0,1)$, *prude* doesn't

read the book and *lewd* reads it; z : (0,0) , nobody reads the book, where (0) means that *i*-individual doesn't read the book and (1) means that *i*-individual reads the book. Suppose $zP_p x \wedge xP_p y \wedge zP_p y$; meaning that *prude* prefers most that no one reads the book, next that he reads it, and last that impressionable *lewd* be exposed to obscene literature. Suppose also that $xP_l y \wedge yP_l z \wedge xP_l z$. *i.e. lewd* prefers that either of them should read the book, rather than neither, but further he prefers that prude should read the book rather than himself. By *U*, all individual orderings are admissible. By condition *L*,* $D_p(x,z) \wedge (zP_p x) \rightarrow zP_s x$; In the same manner, $D_l(y,z) \wedge (yP_l z) \rightarrow yP_s z$; by ***P,*** $xP_p y \wedge xP_l y \rightarrow xP_s y$; *by A:* $xPy \wedge yPz \rightarrow xRz$, deci, $zPx \leftrightarrow \neg[xRz]$. Though, from *P*,*L** and *U* we have $D_p(x,z) \wedge (zP_p x) \rightarrow zP_s x$, $D_l(y,z) \wedge (yP_l z) \rightarrow yP_s z$ and $xP_p y \wedge xP_l y \rightarrow xP_s y$,so $xPy \wedge xPy \wedge zPx$; but from *A*, $zPx \leftrightarrow \neg[xRz]$. It is clear that acyclicity is violated and the *prude vs. lewd* case is an ilustration of the impossibility of a paretian libertarian.

In (1983) Sen gave another example of his impossibility theorem, ***the work-choice case***. Suppose we have two workers m_1 and m_2 . They have to choose between three possible quantities of work for each: having a full time job, having a part-time job and being jobless. I will denote having a full time job with (1), having a part-time job with (0,5) and being jobless with (0). The alternatives are: a_1 : (0, 5.0) - m_1 has a *part-time* job and m_2 is jobless; a_2 : (1, 0.5) - m_1 has a *full- time* job and m_2 has a *part-time* job; a_3 : (0, 0.5) - m_1 is jobless and m_2 has a *part-time* job, a_4 : (0.5,1) - m_1 has a *part-time* job and m_2 has a *full-time* job. By condition U, *1)* $a_1 P_{m1} a_2 \wedge a_2 P_{m1} a_3 \wedge a_3 P_{m1} a_4 \wedge a_1 P_{m\ 1} a_4 \wedge a_{\ 1} P_{m\ 1} a_{\ 3} \wedge a_{\ 1} P_{m\ 1} a_{\ 4}$ and 2*)* $a_3 P_{m2} a_4 \wedge a_4 P_{m2} a_1 \wedge a_1 P_{m2}\ a_2\ \wedge a_3 P_{m_2} a_2 \wedge a_3 P_{m_2} a_1 \wedge a_4 P_{m_2} a_2$. By condition *L* , $D_{m_1}(a_2, a_3) \wedge a_2 P_{m_1} a_3 \rightarrow a_2 P_s a_3$ and $D_{m2}\ (a_1, a_4) \wedge a_4 P_{m2}\ a_1 \rightarrow a_4 P_s a_1$. By condition *P*, $a_1 P_{m1}$ $a_2 \wedge a_1 P_{m2}\ a_2 \rightarrow a_1 P_s a_2$ and $a_3 P_{m1} a_4 \wedge a_3 P_{m_2} a_4 \rightarrow a_3 P_s a_4$ .By acyclicity we must have $a_1 P a_2 \wedge a_2 P a_3 \wedge a_3 P a_4 \rightarrow a_1 R a_4$. From L^* and P, we have $a_1 P_s a_2 \wedge a_2 P_s a_3 \wedge a_3 P_s a_4 \wedge a_4 P_s a_1$ but $a_4 P a_1$

$\leftrightarrow \neg[a_1 \, R a_4 \,]$. This means that acyclicity is violated and we have an empty choice set.

Solutions given in the SCT literature:

In *(1984)*, Sen argued that if we want to solve the inconsistency between minimal rationality, weak Pareto condition, unrestricted domain and libertarianism, there are at least two ways: either we give up to one of the conditions; either we choose to weaken one of them in a substantial way. I will briefly discuss here three reformulations for each of the three conditions (*U, P, and L*). For restrictions of the libertarian condition I will refer to Hillinger and Lapham's *(1971)*, Gibbard's *(1974)*, and Blau's *(1975)* solutions. For restrictions of the universal or unrestricted domain I willrefer to Fine's *(1975)*, Breyer-Gigliotti's *(1980)* and, Craven's *(1982)* solutions. For restrictions of the weak Pareto condition I will refer to *Sen's (1976), Austeen-Smith's (1980),* and Saari's *(1997)* solutions.

Restraining the weak Pareto condition: In *(1976)* Sen introduced the idea of a rights-respecting individual: *"A person can be described as respecting the rights of others if and only if he wants only a part of his total preference to count such that it can be combined with everyone's preference over their respective protected spheres […] if at least one person respects the rights of others, then there can be no conflict between conditional Pareto principle and the weak libertarian principle no matter what the individual preferences are. […] in this procedure, no one pretends that his preference is, in fact, different from what it actually is, and there is no question of amending preferences"[Sen.1976.p.236].* In *(1982)* Austeen-Smith published a new possibility result by restraining the weak Pareto condition. *„This condition restricts the application of the (weak) pareto principle (on the set S of alternatives) by recognizing Pareto dominance only for those elements in S which have not been vetoed by any individual rights exercising" [Austeen- Smith.1982.p.97]*. In *(1997)* Saari advanced a two folded argument: First, there is an incompatibility between the separability dimension between pairs of the libertarian condition and the connectivity between them presented by the Pareto condition. Second, in Saari's own words, "*if society grants me the right to choose my shirt, why are others*

comparing one of my alternatives with other alternatives?" *[Saari.1997.p.92].* This suggests relaxing weak pareto condition to: "*if an individual is given decisive rights over a pair (x,y), then the pareto condition P does not apply to any pair including either x or y*" *[Saari.1997.p.92]*.

Restraining the libertarian condition: Hillinger and Lapham's *(1971)* considered that *"liberalism may be broadly defined as the desire not to coerce individuals to accept choices they would not have made voluntarily. With this definition it is apparent that when the actions of one individual do not impinge on the welfare of others, then liberalism follows as a special case of the Paretian principle*" *[Hillinger and Lapham.1971.p.1403].* So, an idividual is decisive on a pair of alternatives if and only if there is nobody who opposes his preference on that pair. In *(1974),* Gibbard formulated an alienable rights solution: *"for all individuals, i, if i is decisive on a pair (x,y) and i prefers x to y, then, usually, x will be socially preferred to y. But if there is an alternative z, and i prefers y to z, and there is an individual j who is decisive on the pair (z,x) and j prefers z to x, the right of i on (x,y) is waived*" *[Gibbard.1974.p.400]*. In *(1975)* Blau accused the pathological meddlesome preferences for Sen's inconsistency result: "*an individual i is meddlesome in p if he is not indifferent between the alternatives from his own personal sphere D_i,and, for some j, his opposition against j's preference on D_j is stronger*[5] *than his own preference on D_i. [Blau.1975.p.398].*. From here Blau defines three libertarian conditions: *a)* if all individuals have intrusive preferences then all decisivities are waived; *b)* if some individuals have intrusive preferences then all decisivities are waived; *c)* all decisivities of those individuals with intrusive preferences are waived.

Restraining the unrestricted domain: In *(1975),* Fine wrote: *"to guarantee a liberal society, we need to restrict preferences so that each member of society is indifferent to matters which are none of his business" [Fine.1975.p.1281]. „This means exactly that each individual should be indifferent to other's personal wants" [Fine.1975.p.1280]. In (1982)*

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[5] Here, "*stronger*" means that if we have *x* preferred to *y* and *y* to *z*, then the intensity of preference for *x* against *z* is stronger than the intensity for *x* against ***y***

Craven strengthened the meaning of being liberal: „if i take the view that my neighbor should decide whether he is to read book a or book b, I say in effect that if he prefers a to b, then I too will express a preference for a over b. [...] If individual i is liberal towards individual j over a pair of states (a,b), then aP_j b implies aP_i b and bP_j a implies bP_i a ". [Craven.1982.p.352]. In (1980) Breyer and Gigliotti started from Sen's idea of rights respecting individuals but argued that their empathic individuals are in a way different: *"Sen (1976) first defined a right-respecting individual as one who allows only the part of his preferences that do not contradict the rights of others to count in the social decision process […] An individual with empathic preferences is similar to a rights-respector, but with one important difference. […] an empathetic individual would not disagree with your desire to wear socks that do not match, but would have the same preference as you do" [Breyer and Gigliotti.1980.pp.59,60]*

A criterion for eliminating solutions of Sen's paradox:

As we have already seen, there are three ways of escaping the paradox without getting out from Sen's informational framework[6] . From the previous section, it is clear that the inconsistency has solutions, but we have a problem of telling which solution is the best and by what criteria. Could we find an argument to reject at least one of these solutions? More, could we find an argument to eliminate or to accept a whole set of restrictions? For example could we argue that all solutions by restricting the libertarian condition are not acceptable? I think that the answer is affirmative for all these questions, and we can reject not just one but two sets of solutions. The argument starts from the fact that the whole problem is about introducing libertarian rights in SCT. If we want to do this we must first know what is a system of libertarian rights is. Having a libertarian right, in my view implies a little bit more than being decisive on a pair of states[7]. For example, I think that implies an ethical priority of

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[6] For solutions with other information than individual preferences (for example consent information or liberty information) see Vallentyne (1989) and Hees (1995).

[7] [6] Of course Sen doesn't say that his libertarian condition is sufficient, he only says that it is necessary. In *(1992) Sen wrote that " ML (minimal libertarianism) tries to get a weak condition that is entailed by different fuller formulations of the requirements of liberty, and could thus be seen as a necessary but not sufficient condition for guaranteeing liberty in a society". [Sen.1992.p.140]. The*

libertarianism over all other decision procedures. In another form and with a different scope, a similar idea was stated by Austeen-Smith in (1982): *"RCWP (Rights Constrained Weak Pareto Rule) embodies the idea of the ethical priority of liberal rights over the standard Pareto rule" [Austeen-Smith.1982.p.97]*. My idea implies that of Austeen-Smith's because I think that, in libertarian thought, the libertarian principle has ethical priority against any other principle. If we believe that this is true, then any rights-waiving solution must be rejected. This is not the only implication: having a libertarian right implies the using of a restricted Pareto condition[8]. Having this said, let's look at the unrestricteddomain. Is it acceptable to restrain the function's domain? I agree with Sen's position on this subject: *"When we 'rule out' a preference configuration, that is only a refusal to open out mouth in that case, and obviously has no bearing on whatever that configuration will, in fact, arise or not. If such a preference configuration does, in fact, occur, then to say that it is outside the domain of a procedure is merely an admission of defeat as far as the procedure is concerned" [Sen.1976.p.233]*. Even though I agree with Sen's view, I think there is an even more important argument against domain restrictions: repressing people's view of the world is not something that a libertarian would agree with. If we see the unrestricted domain as reflecting the libertarian value of free speech or free expression of interest, then we can not accept any domain restriction solution. If we look at this argument and at that of ethical priority of libertarian principle over the paretian (*and any other*) principle, we are able to draw the following conclusion: we have ideological reasons to reject two sets of solutions for the libertarian paradox. Therefore, one acceptability criterion for a libertarian paradox's solution is something what I call *ideological fidelity*. In my view, *a)* the ethical priority of libertarianism over paretianism and *b)* the unrestricted domain of whatever function (*preference, consent, liberty etc*) we choose to express individual interest, are both necessary to any libertarian system of rights. I say nothing about sufficiency. If we accept the above given arguments, then we are left with just one set of solutions – those which restricts the

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same idea appeared in Sen (1976): „[...] a denial of condition L (minimal libertarianism) would involve precisely the loss of the guarantee of even a minimal element of individual freedom" [Sen.1976.p227]. „[...] There is no need to deny that libertarian ethics might also involve other elements as long as it incorporates, inter alia, Condition L (libertarianism) or L* (libertarianism minimal)" [Sen.1976.p231].*

[8] For austro-libertarian arguments against the use of an unrestricted Pareto condition see *[Rothbard.1982, 1998.pp.203-204].*

weak Pareto condition. But are these solutions equally good? By what criterion could we say that, for example, Sen's solution is better than Saari's or Austeen-Smith's? I will try to answer in the following lines. Let's start by supposing that I am a libertarian. If I am a libertarian then, probably, I believe that freedom is a universally applicable principle: all humans are self owners, all humans must be protected from aggression, all humans are entitled to their property. If that's so, then a libertarian principle must be able to work for what *I call real societies*. This means that a libertarian principle must work for any finite number of individuals, and any finite number of alternatives. An example of a solution that doesn't satisfy this criterion is Blau's solution which doesn't work for more than two individuals and three alternatives[9]. The problem is that all three restrictions of the weak Pareto criterion work for real societies and we are back to our initial question. Is there any way to discriminate between these solutions? My answer is negative because neither of these solutions presents some necessary feature for any libertarian theory of rights. The conclusion of this section is that we do have arguments for rejecting all solutions which restricts the libertarian and universal domain conditions, but the matter of choosing between the restrictions of the weak Pareto condition is left open.

Two possibility results by restricting the weak Pareto condition:

I will now present my two possibility results. I will first introduce: the notion of *x – aspect*, the notions of simple alternatives and conjunct alternatives, and I will restate the definition given by Gibbard *(1974)* and Breyer *(1977)* to the notion of *x-variant* (*the formalization is mine*)

d8 *(x-aspect's set):* $\forall x, y, z \in A, \forall i, j \in N, x = (x_i, x_j), y = (y_i, y_j), z = (z_i, z_j)$, then $X_a = X_{ai} \cup \cup X_{aj}$ is the set of the *x-aspect's* of A, regarding the individuals *i* and *j*, where $X_{ai} = \{x_i, y_i, z_i\}$ and $X_{aj} = \{x_j, y_j, z_j\}$.

d9 *(x-variant's set):* for $\forall x, y \in A, \forall i, j \in N, x = (x_i, x_j), y = (y_i, y_j)$, if $(x_i \neq y_i) \wedge (x_j = y_j)$, then *x* and *y* are *i-variants*; in the same way, if $(x_i = y_i) \wedge (x$

9 Blau admits this, therefore I don't have to provide a demonstration for my statement.

$_j \neq y_j$), then x and y are j - *variants*. The set of x - *variants* equals the set of x – *aspects* of A from which we substract the set of x - *aspects* which doesn't vary in the way previously defined:

$X_v = X_a \setminus X_{nv}$. Where X_{nv} is the set of x – *aspects* which are not x - *variants*.

c1 an x - *aspect* is something like a simple alternative. To understand what I mean by simple alternative, let's look at the *lewd vs. prude* case: here we have 3 alternatives:

$x : (1,0)$, *prude* reads the book ***and*** *lewd* doesn't read it,

$y : (0,1)$, *prude* doesn't read the book ***and*** *lewd* reads it;

$z : (0,0)$, *prude* doesn't read the book ***and*** *lewd* doesn't read it. If we look to the conjunction ***"and"*** we observe that all alternatives in this case have two members. These are what I call "conjunct alternatives". A simple alternative is a member of a conjunct alternative. So, a simple alternative refers to the action of a single individual and a conjunct alternative refers to the action of two or more individuals

Minimal-rational libertarian preferences:

When I first thought of this solution, I had in my mind the case of austro-libertarianism. The problem is this: if individuals are self-owners, then nobody, other than themselves, could be given decisivity on their behaviors. For example, if I am the only master of my own body, nobody can't have a right which includes the use of it[10]. From here, there is a problem with the way Sen builds his alternatives and his libertarian condition: Sen says that if an alternative is different from another in a way regarding one and only one individual, then he must be given decisivity on those two alternatives. The problem is that each alternative, x - *variant* or not, is in fact a conjunct alternative and, variant or not, there are two bodies used in each. I think an austro-libertarian will never conceive a right in this way. We are all free to choose what to do with our own bodies period. There is no "*and*" involved here. Starting from this observation I had two choices: first is the one presented here: canceling the effects of the problem – giving solutions that doesn't take a

[10] For extensive works on austro-libertarian principles, see Rothbard (1998), (2002)

decisive turn from the way Sen have seen the problem of rights in social choice. The second choice was to use a libertarian condition which gives decisivity only on simple alternatives. I choose the first way because I think that sometimes there is a beauty in taking the hard way. Giving up Sen's informational framework or his way of building alternatives is an easy way out of his problem and maybe not the most elegant way. So I started to look at Sen's alternatives as if they were simple. If we look only to what I called simple alternatives or *x - aspects* then we will see that in those profiles in which the weak Pareto condition is inconsistent with the libertarian condition, a strange thing happen: there is an inconsistency on *x - aspects* . To see why, let's take Sen's *lewd vs. prude* case and *work* case. The alternatives were: *x* : (1,0) , *prude* reads the book and *lewd* doesn't read it, *y* : (0,1) , *prude* doesn't read the book and *lewd* reads it; *z* : (0,0) , nobody reads the book. We have $zP_p x \wedge xP_p y \wedge zP_p y$ and $xP_l y \wedge yP_l z \wedge xP_l z$. Let's split these preferences on conjunct alternatives in preferences on *x - aspects* : Take prude first: he prefers z to x, so we write $z(0,0)P_p x(1,0)$ then he prefers x to y, so we write $x(1,0)P_p y(0,1)$, and finally, he prefers z to y, so we write $z(0,0)\ P_p\ y(0,1)$. Let's eliminate the second digit in each of the six brackets. (*These digits refers to lewd's behavior*). We now have: $z(0)\ P_p\ x(1)$,$x(1)P_p y(0)$ and $z(0)P_p y(0)$ so *prude's* preference on his own behavior is quite strange: first he prefers "*not to read*" the book *"to read it"* second he prefers *"to read it"* to "*not to read it*", and then he prefers "*not to read it*" to "*not to read it*". The same strange pattern of preferences we find when we look at *lewd's* profile: he prefers x to y, so we write $x(1,0)\ P_l\ y(0,1)$, then he prefers y to z, so we write $y(0,1)P_l z(0,0)$, and finally, he prefers x to z, so we write $x(1,0)P_l z(0,0)$. Let's eliminate the first digit in each of the six brackets. (*These digits refers to prude's behavior*). We now have: $x(0)P_l y(1)$, $y(1)P_l z(0)$ and $x(0)P_l z(0)$ so lewd's preference on his own behavior is strange too: first he prefers "*not to read*" the book *"to read it"* second he prefers *"to read it"* to "*not to read it*", and then he prefers "*not to read it*" to "*not to read it*". Let us now take *the work-choice case*: remember that the alternatives were a_1 : (0, 5.0) - m_1 has a *part-time* job and m_2 is jobless; a_2 : (1, 0.5) - m_1 has a *full-time* job and m_2 has a *part-time* job; a_3 : (0, 0.5) - m_1 is jobless and m_2 has a *part-*

time job, $a_4 : (0.5,1)$ - m_1 has a *part-time* job and m_2 has a *full-time* job. Let's take m_1 first: he prefers a_1 $(0, 5.0)P_{m1}a_2$ $(1, 0.5)$, a_2 $(1, 0.5)P_{m1}a_3$ $(0, 0.5)$, a_3 $(0, 0.5)P_{m1}a_4$ $(0.5,1)$, a_1 $(0, 5.0)P_{m1}a_4$ $(0.5,1)$, a_1 $(0, 5.0)P_{m1}a_3$ $(0, 0.5)$, and a_2 $(1, 0.5)P_{m1}a_4$ $(0.5,1)$. We now eliminate the second digit from each of the twelve brackets (*These digits refers to m_2's behavior*): a_1 $(0, 5)P_{m1}a_2$ (1) , a_2 $(1)P_{m1}a_3$ (0) , a_3 $(0)P_{m1}a_4$ (0.5) , a_1 $(0, 5)P_{m1}a_4$ (0.5) , a_1 $(0, 5)P_{m1}a_3$ (0) , and a_2 $(1)P_{m1}$ a_4 $(0, 5)$. So m_1 prefers to have a part-time rather to have a full time, he further prefers to have a full time than being jobless, but then he prefers to be jobless than have a half time (*so we have a clear inconsistency 'till now*), further he prefers having a part-time to having a part-time, then having a part-time to being jobless, and finally having a full time rather than a part-time. The same inconsistency is to be found by looking at m_2 's preferences. He prefers a_3 $(0, 0.5)P_{m2}a_4$ $(0.5,1)$, a_4 $(0.5,1)P_{m2}a_1$ $(0, 5.0)$, a_1 $(0, 5.0)P_{m2}a_2$ $(1, 0.5)$, a_3 $(0, 0.5)P_{m2}a_2$ $(1, 0.5)$, a_3 $(0, 0.5)P_{m2}a_1$ $(0, 5.0)$ and a_4 $(0.5,1)P_{m2}a_2$ $(1, 0.5)$, We now eliminate the first digit from each of the twelve brackets (*These digits refers to m_1's behavior*): $a_3\,(0, 5)P_{m2}a_4\,(1)$, $a_4\,(1)P_{m2}a_1\,(0)$, $a_1\,(0)P_{m2}a_2$ (0.5) , $a_3(0.5)P_{m2}a_2(0.5)$, $a_3(0.5)P_{m2}a_1(0)$ and $a_4(1)P_{m2}a_2(0, 5)$. So m_2 prefers to have a part-time rather to have a full time, he further prefers to have a full time than being jobless, but then he prefers to be jobless than have a half time (*so we have a clear inconsistency 'till now*), further he prefers having a part-time to having a part-time, then having a part-time to being jobless, and finally having a full time rather than a part-time. I will now state my result.

d10 *(minimal-rational libertarian preferences): the preferences of an individual i, are libertarian minimal-rational if and only if* $\forall i, j, (i \neq j), \forall A, A = \{x,, y, z,..., n' \}$, *with* x *- aspects :* $x = (x_i, x_j)$ $y = (y_i, y_j)$, $z = (z_i, z_j)$, $n' = (n'_i, n'_j)$, *then* $C(\{x_i, y_i, z_i, ..., n'_i\}, R) \neq \emptyset$ *for any* $x_j, y_j, z_j, ..., n'_j$ *. i.e. i must have an unempty choice set on the set of his* x *- aspects .*

d11 *(Condition P_{mr}): if all individuals prefer x to y and if all individuals have libertarian minimal-rational preferences on their own x - aspects , then x socially preferred to y.*

***t4** (the possibility theorem of minimal rational libertarianism): there is a SDF which satisfy U,L* and P_{lsp}*

Proof of t4: in order to prove this theorem it must be shown that no inconsistencies could appear when we have minimal rational libertarian preferences. Let's discuss two cases:

case 1: suppose there are two individuals *i, j* and two options for each denoted here by *(0,1)*. We also have four alternatives: A_c=*{x(1,1), y(1,0), z(0,1), w(0,0)}*. Suppose now that *i* and *j* have *minimal rational libertarian preferences* over *A.* By aciclicity and by completitude of his preference relation, each individual has an unempty choice set on his *x - aspects*. We must verify now if there is an unempty choice set. In order to succeed, we must determine all individual decisivities with the help of condition *L*. Therefore, we have, and $D_j(x, y) \wedge D_j(z, w)$. From premises, all individuals are consistent on their $D_i(y, w) \wedge D_i(x, z)$ *x - aspects. This means that when 1 is preferred to 0 in one pair, this preference must be sustained on all x - aspects. It also means that 1 can not be preferred to 1 and 0 can not be preferred to 0.* We have to verify four cases: $0P_i1 \wedge 0P_j1$, $0P_i1 \wedge 1P_j0$, $1P_i0 \wedge 1P_j0$, $1P_i0 \wedge 0P_j1$. Suppose that $0P_i1 \wedge 0P_j1$; in this case $(z_i Iw_i) P_i (y_i Ix_i)$ (*0 must be indifferent to 0 and 1 must be indifferent to 1*) and $(y_j Iw_j) P_j (x_j Iz_j)$, but, by L $(w_i P_i y_i) \wedge D_i(y, w) \rightarrow wP_s y$, $(z_i P_i x_i) \wedge D_i(x, z) \rightarrow zP_s x$, $(y_j P_j x_j) \wedge D_j(x, y) \rightarrow yP_s x$, $(w_j P_j z_j) \wedge D_j(z, w) \rightarrow wP_s z$. *By* P_{mr}, $(w_i P_i x_i) \wedge (w_j P_j x_j) \rightarrow wP_s x$, therefore, $(wP_s y) \wedge (yP_s x) \wedge (wP_s z) \wedge (zP_s x) \wedge (wP_s x)$. From here, a possibility result: $C_s(\{x, y, z, w\}, R) = \{w\}$, *i.e.* everybody gets what they wanted *(0,0)*. For the case in which both prefer 1 to 0 in their decisivity pairs, the situation is the same. I will address now the second case: $0P_i1 \wedge 1P_j0$, therefore $(z_i Iw_i) P_i (y_i Ix_i)$ and $(x_j Iz_j) P_j (y_j Iw_j)$. By L: $(w_i P_i y_i) \wedge D_i(y, w) \rightarrow wP_s y$, $(z_i P_i x_i) \wedge D_i(x, z) \rightarrow zP_s x$ and $(x_j P_i y_j) \wedge D_j(x, y) \rightarrow xP_s y$, $(z_j P_i w_j) \wedge D_j(z, w) \rightarrow zP_s w$. *By* P_{mr}: $(z_i P_i y_i) \wedge (z_j P_j y_j) \rightarrow zP_s y$, so we have: $(zP_s w) \wedge (zP_s y) \wedge (zP_s x) \wedge (wP_s y) \wedge (xP_s y)$. From here, $C_s(\{x, y, z, w\}, R) = \{z\}$, i.e. everybody gets what they wanted *(0,1)*. The other case is the same.

Case 2: suppose now we have three options *(0, 0.5, 1)* and nine alternatives: A_c=*{p.q,r,s,t,u,v,x,y}*. For simplicity i will use the following

table:

Table 1

A	***cod.***	***i-asp.***	***j-asp.***	D_i	D_j
p	*(0.5, 0)*	p_i=0.5	p_j=0	*(p,v)*	*(p,s)*
q	*(1, 0.5)*	q_i=1	q_j=0.5	*(p,x)*	*(p,t)*
r	*(0, 0.5)*	r_i=0	r_j=0.5	*(v,x)*	*(s,t)*
s	*(0.5, 1)*	s_i=0.5	s_j=1	*(q,r)*	*(r,u)*
t	*(0.5, 0.5)*	t_i=0.5	t_j=0.5	*(q,t)*	*(r,x)*
u	*(0, 1)*	u_i=0	u_j=1	*(r,t)*	*(u,x)*
v	*(1, 0)*	v_i=0.5	v_j=0	*(s,u)*	*(q,v)*
x	*(0, 0)*	x_i=0	x_j=0	*(s,y)*	*(q,y)*
y	*(1,1)*	y_i=1	y_j=1	*(u,y)*	*(v,y)*

Table 1 is to be read in the following way: *A* is the set of alternatives on the second column. The codification (*cod.*) is useful in order to distinguish between *x-variants*, and can be exemplified as: (p_i=0) „*i doesn't read the book*"; (q_i=1) „*i reads the book*" and (s_i=0.5) „*i reads half of the book*" or, in the *work-choice case*, *i has no job, i has a full time job and i has a part time job*. Moving on, *(i-asp.)* represents the aspects of individual *i*, and *j-asp* represents those parts of the conjunct alternatives which express individual *j*'s behavior. D_i is the set of libertarian decisivities of individual *i*, and D_j is the set of libertarian decisivities of individual *j*. We can see in the table the following equivalences: for *i:* p_i,s_i,t_i have all *(0.5)*; r_i, u_i, x_i, have all *(0)*; q_i, v_i, y_i, have all *(1)*; for *j*: q_j, r_j, t_j have all *(0.5)*; p_j, v_j, x_j, have all *(0)*; s_j, u_j, y_j, have all *(1)*. Since each of these equivalences shows the same individual behavior, if we ignore the problem of externalities, we can consider that our individuals must be indifferent between the following alternatives: $p_i \wedge s_i \wedge t_i$ (0.5), $q_i \wedge v_i \wedge y_i$ (1), $r_i \wedge u_i \wedge x_i$ (0), $p_j \wedge v_j \wedge x_j$ (0), $q_j \wedge r_j \wedge t_j$ (0.5), $s_j \wedge u_j \wedge y_j$ (1). If this doesn't happen, then they don't have minimal rational libertarian preferences. We are interested only in the cases in where one of the real alternatives dominates the other two; we have, therefore, 9 possible:

$0.5P_i(0,1) \wedge 0.5P_j(0,1)$,

$0P_i(0.5,1) \wedge 0P_j(0.5,1)$,

$0.5P_i(0,1) \wedge 0P_j(0.5,1)$,

$1P_i(0.5,0) \wedge 0.5P_j(0,1)$,

$0.5P_i(0,1) \wedge 1P_j(0.5,0)$,

$1P_i(0.5,0) \wedge 0P_j(0.5,1)$,

$1P_i(0.5,0) \wedge 1P_j(0.5,0)$,

$0P_i(0.5,1) \wedge 0.5P_j(0,1)$,

$0P_i(0.5,1) \wedge 1P_j(0.5,0)$. All these cases must be discussed starting from an observation: all decisivities of one individual are in the equivalence sets of the other. In other words, each individual will be indifferent between all the alternatives from the personal spheres of all others.

Suppose we have a set of four alternatives:

$A = \{a_1, a_2, a_3, a_4\}. \forall D_i(a_1, a_2) : a_1 I_j a_2$

and $\forall D_j(a_3, a_4) : a_3 I_i a_4$. From here, the social preference will be equivalent to the set of each individual's personal choice set. This observation is true for all pairs.

What if we have more than three individuals and more than three alternatives? i.e. what if we have a real society? Suppose this is the case. From premises we know that all individuals have consistent preferences on their own *x - aspects*. This means that I will be always indifferent on other's decisivities. If that's so, then it will never be the case that someone to oppose his preference to an alternative preferred by another in his own decisivity pair. Therefore, no matter the number of individuals and alternatives, there will always be a SDF which satisfies L, U and P_{mr}.

Single peaked libertarian preferences:

I will now impose a stronger restriction of the Pareto condition. I request now that individuals must have single-peaked preferences between their own *x - aspects*. I will give some definitions:

d12 *(single peaked libertarian preference):* a preference is single peaked libertarian if and only if for any *x - aspects coded by (0, 0.1, 0.2,...,1,...,n), then either there is the case of* $(0)P(0.1)P(0.2)P, ..., P(1)P, ..., P(n)$ *or there is the case of* $(n)P, ..., P(1)P, ..., P(0.2)P(0.1)P(0)$*, where de line* $(0)P(0.1)P(0.2)P, ..., P(1)P, ..., P(n)$ *means that there is an increasing quantity of something and the line* $(0)P(0.1)P(0.2)P, ..., P(1)P, ..., P(n)$ *means*

that we are talking about a decreasing quantity of something.

c2. to understand what does this mean, let's go back to the *work-choice case*. We have three possible "values" for each worker. Each of them could have a full-time, a part-time or zero-time job. Having single peaked preferences means that either you want more work, either you wantless. You can't, for example, prefer full time to being jobless and being jobless to having a part-time job. More simple, you can't prefer 1 to 0 but 0 to 0,5 or 0 to 0,5 but 1 to 0. This property is stronger than acyclicity – it implies acyclicity but it is not implied by it; e.g. take a) $(0.5)P_i(1)$ i prefers rather less than more, b) $(1)P_i(0)$ - *i* prefers rather more than less, c) $(0.5)P_i(0)$- *i* prefers rather more than less. It is clear that *i* has an acyclic preference on the*i* - *aspects* but his preference relation is not single peaked because *i* prefers less then he prefers more.

d13 *(Condition P_{lsp}): if all individuals prefer x to y and if all individuals have libertarian single peaked preferences on their own x - aspects , then x socially preferred to y.*

t5 *(the possibility theorem of single peaked libertarianism)there is a SDF which satisfy U, P_{lsp} L^* and*

proof of t5 first we know that in every case discussed by Sen, we have inconsistencies on *x - aspects* . I already showed this and there is no use to repeat it here. We also know that when we have minimal-rational libertarian preferences, there are no inconsistencies between the weak pareto condition and the libertarian condition. Starting from this knowledge it is easy to prove t5. It must be shown that single peaked preferences are always acyclic. And they by definition because cyclic preferences have multiple peaks: suppose I prefer 1 to 0,5 and 0,5 to 0 but 0 to 1. this pattern of preferences are clearly acyclic and also clearly multiple peaked because first I prefer more to less *(1)P(0,5)P(0)* but then I prefer less to more *(0)P(1)*. While single peaked preferences are always acyclic, it must be the case that they are sufficient for having an unempty choice set on all alternatives when we use condition L and P_{lsp}, with an unrestricted domain.

Conclusions

This article had two goals: first, I wanted to find a criterion for choosing

the best type of solutions for Sen's paradox. Second I wanted to find two new solutions for Sen's impossibility result. Regarding my first objective, I argued that if we impose the ideological fidelity criterion, then we are justified to reject as unacceptable two sets of solutions: by restricting the libertarian condition and by restricting the function's domain. I didn't succeed to find a good criterion for selecting the best solution between those which restricts the weak Pareto condition. The ideological fidelity criterion has a good argument in its favor: as long as we want to give formal representation to a libertarian condition, and to introduce it into social choice research domain, we must retain the essence of libertarianism: in libertarian thought, the libertarian principle dominates all other principles or decision rules. In other words, if we retain a notion of rights and we pretend that it is a libertarian notion, then we must make an ethical hierarchy. The consequence of this hierarchy is to consider irrelevant some sorts of externalities. Concerning my second objective, my solution meets both criterions and offers an elegant answer to the impossibility of a paretian libertarian theorem. Regarding my second objective, my strategy to approach Sen's problem was to split all alternatives in separate agendas, one for each individual. I called this agendas *x - aspects* , where *x* is a variable, taking the name of the individual of which *aspects* we are talking about. On these separate agendas I imposed two conditions: individuals must have libertarian minimal rational preferences – they must generate an unempty choice set on their *x - aspects* ; and individuals must have single peaked libertarian preferences – they must have single peaked preferences on their *x - aspects* . I restricted the Pareto condition at a domain limited only to these kind of preferences. When they are absent the Pareto criterion says nothing. Using these two restrictions I proved two possibility results.

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