TRANSITIVITY AND THE MONEY PUMP

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ABSTRACT: Transitivity in economics maintains that if *a* is preferred to *b*, and *b* to *c*, then *a* must also be preferred to *c*. The problem with this is that these three decisions are made at different points of time, and tastes may have changed in the interim. The difficulty with a rejection of transitivity (which underlies indifference curve analysis) is a *reductio ad absurdum*, based upon the "money pump." The present paper rejects this attempt at a *reductio*.

KEYWORDS: transitivity, indifference, preference, choice, methodology, time

JEL CLASSIFICATION: B25, B40, B41

I. INTRODUCTION

The present paper is devoted to an examination of transitivity. In section II we discuss the case for this concept, including the "money pump," a *reductio ad absurdum* of the critique of transitivity. Section III is devoted to a critique of this money pump. We conclude in Section IV.

II. TRANSITIVITY

Transitivity of strict preference[1] may be denoted by equation 1:

(1) $A > B$; $B > C$; therefore, $A > C$.

If A represents 70 miles per hour, B is 60 miles per hour and C stands for 50 miles per hour, or if A indicates 7 feet tall, B 6 feet tall and C 5 feet tall, then (1) is unobjectionable. If each of the first two constituent parts of (1) is true, and each is, then the truth of the conclusion follows ineluctably.[2]

However, difficulties arise when the constituent elements of the argument are not objective dimensions, but rather preferences. Interpret (1), now, as follows: a given economic actor, Jones, prefers an Apple to a Banana at time t_1, a Banana to a Carrot at time t_2 and an Apple to a Carrot at time t_3. In this context, both the Austrians and the neo-classicals would accept the veracity of (1). They part company, however, in their interpretation of this statement. For the mainstream economist, this example of transitivity is necessary,[3] at least if rationality is to be preserved; for the praxeologist, in sharp contrast, it constitutes, only one of several options, all of which may be characterized as "rational."

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[1] Our use of such nomenclature stems from Stanford (2006).

[2] The truth of the premises is entirely separate from the validity of the argument. Even if the premises are false, the transitivity relationship can still constitute a valid argument. For example, consider these claims: $7 > 8$, $6 > 7$, therefore $6 > 8$. All three statements are false, yet the argument is a valid one: the conclusion follows logically from the premises.

[3] This may well be the single exception where conventional economists veer from their otherwise very strong adherence to empiricism. Here, then, they are acting as praxeologists, but the deductive method is no guarantee of success. It, too, can fail, as in the present case; this method provides no warranty against logical error.

Things become different when we contemplate (2); here, the difference between the two schools of thought becomes even more stark.

(2) $A > B$ (t_1); $B > C$ (t_2); $C > A$ (t_3).

The reaction of the Austrian to (2) is a big "so what."[4] These three separate and independent events occur at entirely different times,[5] and, as a logical necessity, need have nothing whatsoever to do with one another.

Matters are very different for the commanding heights of the economics profession. Its reaction to (2) is that it bespeaks nothing less than "irrationality" on the part of the person making these three subsequent choices. Why? This is due to the fact that (2) is an example of intransitivity, and that, as is well known, at least in those quarters, is equivalent to irrationality.

Defenders of this viewpoint have three arguments to support it: 1) the money pump; 2) the fact that indifference curves are compatible only with transitivity, not its denial; 3) the claim that transitivity is required for empirical research. Let us consider each of these in turn.

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[4] States Mises (1998), p. 430 (emphasis added by present authors):

> The advantages and disadvantages derived from cash holding are not objective factors which could directly influence the size of cash holdings. They are put on the scales by each individual and weighed against one another. The result is a subjective judgment of value, colored by the individual's personality. Different people and *the same people at different times value the same objective facts in a different way*. Just as knowledge of a man's wealth and his physical condition does not tell us how much he would be prepared to spend for food of a certain nutritive power, so knowledge about data concerning a man's material situation does not enable us to make definite assertions with regard to the size of his cash holding.

We owe this citation to our Loyola University colleague Stuart Wood. As for cash holdings, also as for apples, bananas, carrots and indeed, all else. See also Barnett and Block (2008); for an alternative view, see Stigler and Becker (1977).

[5] States Mises (1998), p. 103: "The attempt has been made to attain the notion of a nonrational action by this reasoning: If *a* is preferred to *b* and *b* to *c*, logically *a* should be preferred to *c*. But if actually *c* is preferred to *a*, we are faced with a mode of acting to which we cannot ascribe consistency and rationality. This reasoning disregards the fact that two acts of an individual can never be synchronous." We owe this citation to Gordon (2003).

1. The money pump

According to this argument,[6] anyone who exhibited the choice preferences depicted in (2) would be victimized[7] by a loss of his entire wealth. This is interpreted as proof positive that intransitivity is irrational.

How does this work?

Given (2), let us assume that Jones starts out with a *C*. Since he prefers *B* to *C*, he would be willing to pay some amount, over and above *C*, to attain a *B*. Stipulate that this amount is $1. So Jones is now the proud owner of a *B*, and his dollar holdings are reduced by $1, after he purchases a *B* with his *C* and $1 at t_1. Next, since our economic actor also regards *A* as preferable to *B*, and we are still assuming he would be willing to pay $1 over and above a *B* in order to attain an *A*, we posit that he does precisely that at t_2. Now, he is in possession of an *A*, but is minus a total of $2. Whereupon the third trade occurs, at t_3. Here, he relinquishes his hard earned[8] *A* in favor of a *C*, since he now regards the *C* as higher in his ranking scale than an *A*, so much so that he is willing to proffer yet another $1 in order to make this third commercial transaction. Thus, he arrives precisely back at the point he started, with a *C*, only he has lost $3 in so doing. This is supposedly the knockout blow against the Austrian contention that there is nothing irrational about non-transitivity.

But it fails. Consider the following examples. First, Smith goes to Harrah's gambling establishment. He loses $3, precisely the same amount as Jones. Is Smith thereby rendered "irrational?" Not a bit of it. Smith can "defend" himself, or at least his "rationality" on the ground that he enjoyed the gambling process itself, including the chance to come away from the tables a winner, more than the $3 he lost. So, as with all commercial interaction in the ex ante sense, although he is out of pocket by $3, he is not at all "irrational." Rather, he benefited to the extent of the difference between the $3 he paid, and the pleasure for him of gambling, plus the ex ante

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[6] Ramsey (1928a), p. 182; Davidson et al. (1955); Hansson (1993). See also http://www.answers.com/topic/preference.

[7] Hirshleifer, et al. (2005), p. 71, go so far as to accuse the so-called victimizer of this little exercise of being a "clever swindler."

[8] Hard traded, that is.

prospect of wining, even though he knew that the house odds were set against him.

Second, let us focus on equation (3). Here, we cut out the middleman, C in this case, and view a simpler example.

(3) $A > B$ (t_1); $B > A$ (t_2)

   $A = \$100\text{Cdn}$

   $B = \$100\text{US}$

What are the specifics? The Canadian and the U.S. dollar are trading at par. Green, an American, wants to travel to Canada; he needs Canadian currency. He starts out with B, in this case $100US. He prefers A, which is in our example $100Cdn, so much so that he is willing to pay $5US in order to obtain A. He makes this transaction at t_1, and ends up with $100Cdn or A. (We are assuming a transactions cost of $5). But, then, Green *changes his mind* about his trip to Canada. He decides to call it off. The $100Cdn now does him no good. So, at t_2, he trades his A back for U.S. currency, at the cost to him of another $5.[9] Just as in the money pump story, Green ends up precisely where he began, at B, which, here, is $100US. However, for his pains, he has had to relinquish $10. This is irrational? Which of us, gentle reader, has not gone through precisely this transition,[10] or at least one closely analogous? If this is irrational, we are *all* irrational. Those of us, in any case, who have ever changed our minds about value rankings.

What has happened here? It is simple. Green *changed* his rank orderings between t_1 and t_2. This led him to avail himself of not one but two trades. Transactions are not free.[11] Our economic actor utilized the market not once but twice; he was forced to expend $5 on both occasions. *Each time* he did so in a completely rational manner. At t_1 he *preferred A to B*; at t_2 he made the reverse evaluation.

That is, the apparent irrationality of the money-pump problem arises because of a fundamental problem with neoclassical

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[9] It matters not whether this is in US$ or Cdn$, they trade at par; but to keep things simple, we assume that he pays $5US for each of his two transactions, or $10 for the both of them.

[10] This is why department stores have return policies: people change their minds.

[11] Coase (1960).

economics—its failure to account for the fact that real individual human beings act in real historical time, not in timeless neoclassical economic models.[12] Of course, in an imaginary world in which an individual can engage in truly simultaneous[13] acts of choice the money-pump would present a major, perhaps fatal, problem for Austrian economics. However, in the real world actual people *necessarily* act sequentially, not simultaneously. And, of course, preferences can, and do, change through time. That, of course, is why neoclassical economics *assumes* individuals' preferences are stable,[14]

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[12] Models in which a time index is attached to some variables in order to allow the variables to change value in accord with some predetermined relationship to "time" have nothing to do with real historical time. An example of such simplistic models is one in which the value of some variable, say labor (L), at any point in "time" in a growth model is given $L_t = L_0 e^{kt}$, L_0 is the initial value of L at 0, and k is the (constant) continuous growth rate per continuous period, t. Models with such features can be found in virtually any issue of the *American Economic Review* in the last few decades.

[13] See Sears, et al. (1987), p. 958, for a fascinating account of why simultaneity is highly problematic in physics, too. See also in this regard the mathematical concept "cone of light": http://www.phy.syr.edu/courses/modules/LIGHTCONE/introduction.html.

[14] According to Pejovic (2001) (emphasis added): "The basic assumptions of neoclassical economics include unbounded rationality, exogenously determined and *stable preferences*, exogenerously [sic] determined technical knowledge, maximizing behavior, and market equilibrium." See Nicolaides (1988); Hosseini (1990); see also http://en.wikipedia.org/wiki/Neoclassical_economics.

In the view of Rosen (1997), p. 147 (emphasis added):

…having observed choices in different price and income configurations, we can invert the process and infer what those underlying preferences must have been, as long as preferences are reasonably *stable* and the source of variation is sufficient to achieve identification.

Many Austrians hold to the view that quantitative empirical work in economics is infeasible or uninteresting because the world is changing so much that "behavioral relationships" inherently are *unstable* and it is fruitless to estimate them. An unwillingness to pursue the consequences of "given conditions" greatly limits the empirical scope and consequences of Austrian economic theory. The paucity of quantitative empirical work in the Austrian tradition accounts for why so few Austrians are found in the professional economics community today.

For support of Rosen, see Laband and Tollison (2000); also see rejoinders to Rosen by Anderson (2000), Block (2000), Thornton (2004); Yeager (1997, 2000).

in the face of constant daily evidence to the contrary. It is interesting, is it not, that neoclassical economics which claims to be an empirical science in which theory is used to generate hypotheses, that are then tested against the data, usually using very sophisticated econometric techniques, does not test one of the fundamental assumptions used to develop its theory; to wit: the stability of individuals' preferences and its offspring, transitivity of preferences?

Let us consider this as a possible objection[15] to the foregoing: "The author is right that losing money need not show irrationality, but I don't think that this suffices to blunt the force of the money pump argument. The argument is that someone with intransitive preferences will lose *all* his money through repeated trades. The claim isn't that doing so will demonstrate that the person is irrational, because all cases where money is lost show irrationality. Rather, the claim is that the chooser won't be able to avoid an outcome, the loss of *all* his money, which he may be taken not to want."

Suppose that someone lost *all* of his money in a casino. Would this prove that he is irrational? Certainly not, at least not from an Austrian perspective. Why should the difference between the loss of some money, and all of it, be determinative? If spending some money in a manner compatible with the economic actor's goals is rational, there is no reason why doing so for all of it would not also be characterized in this manner.

Of course, the economic actor "may be taken not to want… the loss of *all* his money" In a sense this is certainly true. No one wants to lose any of his money, let alone all of it. But the implication of this critique is that it is irrational to go to a casino, gamble, and then lose *all* of one's money. We find it difficult to reconcile this with what we know of Austrian economics. Suppose, instead of losing some or all of one's money on gambling, or via the money pump, or by changing one's mind regarding a visit to Canada, a man spent it on the proverbial "wine, women and song." Would this be irrational? Not according to Kirzner (1973): "The man who has cast aside a budget plan of long standing in order to indulge in the fleeting pleasure of wine still acts under a constraint to adapt the means to the new program. Should a fit of anger impel him to forgo this

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[15] This objection was suggested to us by a referee of this journal.

program as well and to hurl the glass of wine at the bartender's head, there will nonetheless be operative *some* constraint—let us say the control required to ensure an accurate aim—which prevents his action from being altogether rudderless."

In any case, if the economic actor is so worried about losing some or all of his money, he can cease and desist from currency exchanges, from gambling, and, get off the money pump. All he need do in any of these cases is change his rank preference orderings. If he does not, then this demonstrates[16] he prefers losing some or all of his money to any other alternative.
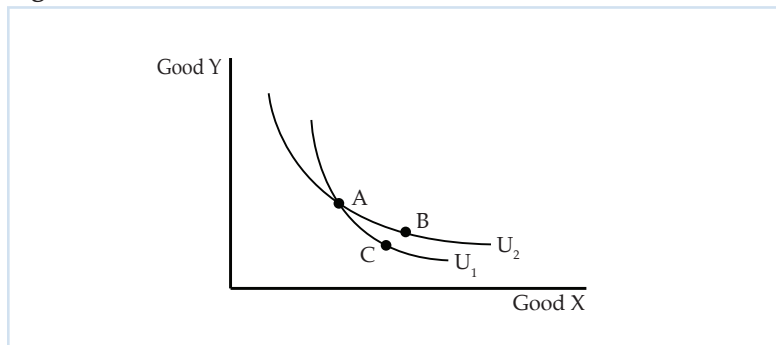
2. Indifference curves[17]

Transitivity is not limited to strong preference; it also includes weak preference, where *A* is preferred to *B* or there is no preference between *A* and *B* (*A* and *B* are indifferent), where *B* is preferred to *C* or there is no preference between *B* and *C* (*B* and *C* are indifferent), and, thus, where *A* is preferred to *C* or there is no preference between *A* and *C* (*A* and *C* are indifferent). A third type of transitive relationship is one of pure indifference: there is no preference between *A* and *B* (*A* and *B* are indifferent); there is no preference between *B* and *C* (*B* and *C* are indifferent); and, thus, conclusion, there is no preference between *A* and *C* (*A* and *C* are indifferent). This latter relationship is of particular importance to neoclassical economists, as it underlies the logic of their indifference curves; to wit, it can be used to demonstrate that indifference curves can never cross, a mainstay of this analysis.

For, if indifference curves did, perish the thought, cross, this would logically imply the denial of transitivity. And that, simply, cannot be borne.[18] To illustrate this point, consider Figure 1.

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[16] Rothbard (1956).

[17] For a mainstream defense of indifference, see Caplan (1999, 2001, 2003); for an Austrian critique, see Block (1999, 2003, 2005, 2007), Hoppe (2005), Hülsmann (1999).

[18] Who says that modern mainstream economics is purely an empirical science? Not so, not so. Just as the Austrians do, the neoclassicals adhere to praxeological insights, albeit incorrect ones in this case; for example, transitivity. They do not at all embrace philosophical notions of falsifiability (Carnap [1950], Ayer [1952], Popper [1959, 1969], Hempel [1970], Nagel [1961], Kaufmann [1944]) as

Figure 1.

Here,[19] the consumer is indifferent between market baskets *A* and *B*; we know this since both lie on indifference curve U$_2$. But, he is also indifferent between points *A* and *C*, since both comprise different parts of indifference curve U$_1$. By the "law" of transitivity, things indifferent to the same thing are indifferent to each other. Well, *B* and *C* both bear the relationship of indifference to *A*. So, *B* and *C* must bear the same relationship to each other, namely, indifference. But, as can clearly be seen in the diagram, *B* lies above and to the right of *C*, and we are assuming we are in the realm where more of a good is preferred to less. Thus, *QED*, indifference curves cannot cross one another.

In the view of Hirshleifer, et al. (2005, p. 80): "By transitivity, the consumer must therefore be indifferent between *C* and *B*. But *B* represents more of both commodities than *C*. Since *X* and *Y* are both

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far as transitivity is concerned. Rather, they see this doctrine as one of apodictic certainty. If so, then in Friedman's notion, whenever two neoclassical economists disagree about matters of indifference, or transitivity, or any other matter that they regard in a non empirical manner, they can only engage in a fist fight with each other. States Friedman (see Long [2006], p. 19; Ebenstein [2001], p. 273): "That methodological approach, I think, has very negative influences.... [It] tends to make people intolerant. If you and I are both praxeologists, and we disagree about whether some proposition or statement is correct, how do we resolve that disagreement? We can yell, we can argue, we can try to find a logical flaw in one another's thing [sic], but in the end we have no way to resolve it except by fighting, by saying you're wrong and I'm right." The obvious rejoinder is that mathematicians and logicians rarely resort to fisticuffs over matters of this sort, and therefore neither are praxeologists compelled to do so.

[19] Hirshleifer (2005), diagram 3, p. 80; we owe this citation to David Schap.

goods, more is preferred to less, and the consumer must prefer *B* over *C*. But these two implications contradict one another. So the initial assumption is invalid: indifference curves cannot intersect."[20]

But this goes too fast. If premises *J* and *K* contradict one another, why do we so quickly assume that *J* is correct, and *K* incorrect? Yes, crossed indifference curves and transitivity cannot both be true, they do indeed contradict one another, but why does it follow that we accept the latter and not the former? Why not invert matters?

As we have seen, transitivity is a week reed upon which to hang anything, let alone indifference curve "analysis." If transitivity fails, according to this logic, then so must indifference curves.[21]

3. Empirical research[22]

Bradbury and Ross (1990) show a negative correlation between age and transitivity "violations": children display fewer intransitive choices as they grow older; adults exhibit hardly any.[23] Hirshleifer et al. (2005, p. 71) comment on these findings as follows:

> At very low ages, transitivity failures might arguably be due to the limited reasoning abilities of young children. As another possible explanation, what appear to be intransitivities may only reflect that [sic] fact that younger persons are still exploring their needs and tastes… Although the tabulated percentages of intransitive choices

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[20] We owe this citation to David Schap. (The nomenclature has been slightly changed regarding the identification of the points on the indifference curve map.)

[21] Also at risk for neoclassical economics are utility functions for a preference relation can be represented by a utility function only if it is complete and transitive. See on this Mas-Colell (1995), p. 9. We owe this point to Patrick McAlvanah. Also see Gendin (1996).

[22] Nick Sanchez has alerted us to the fact that there is an extensive literature in decision science indicating that transitivity is normally violated in many experiments; for example, Bradbury and Ross (1990). Chuck Anderton has pointed out to us that the game "rock, paper, scissors" violates transitivity (see: http://andreality.wordpress.com/2007/03/04/transitivity/; http://newbricks. blogspot.com/2007/07/tipping-point-concept-of-non.html) and that voting can also do so. See on this latter point Arrow (1951), Black (1948), Kaneko (1975), and Feld and Grofman (1990).

[23] Ages (percentage of intransitive choices made): 4(83), 5(82), 6(82), 7(78), 8(68), 9(57), 10(52), 11(37), 12(23), 13(41), adults(13).

steadily decrease with rising age, there is one exception: the sudden sharp increase at age 13. Perhaps the onset of puberty opens up new types of novelties calling for exploration.

We have a far simpler explanation.[24] People sometimes *change their minds* in their rank orderings of preferences. All of these choices are made at *different times*. Thus, there is *no* anomaly to be explained. Moreover, they change their minds in ways that are difficult if not impossible to account for, given that they have free will. Given the Hirshleifer account, however, all sorts of anomalies rise up: why is it that adults, who are supposedly so much more "rational" than children still defect from the transitive stance to the tune of 13 percent? Why that sudden jump at 13? Do not some children reach puberty at 12 years of age? Yet they seem curiously unafflicted by the break in the correlation that appears one year later.

IV. CONCLUSION

Transitivity is an economic travesty. Its adherents simply do not recognize, nor appreciate, that decisions can only be made one at a time, and that people can change their rank order preferences from the time that they make the first choice in a series to the time they make the third. There is thus nothing irrational about non-transitive preferences. If transitivity is needed for indifference curve (and utility function) analysis, then so much the worse for indifference (and utility function) curve analysis.[25]

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[24] Where, oh where is Occam's Razor when we need it?

[25] For more on problems with utility function analysis, see Barnett (2003).

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