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Co-monotonicity: Toward a utility function capturing envy

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ABSTRACT

Envy affects economic decisions, and can lead to monotonicity violation. We introduce co-monotonicity—a generalization of monotonicity, expected to hold even in the presence of envy. Experimental results and implications for the form of possible utility functions are discussed.

1. Introduction

Classical economic theory assumes rational self-interest behavior. However, many studies have shown that individuals care not only about their own wealth (or consumption), but also about their standing relative to other individuals in their reference group. This can broadly be characterized as "competitive preferences", "envy" or "keeping up with the Joneses", and it affects not only individual welfare, but may also explain consumption patterns, asset pricing, bargaining behavior, within-firm and within-industry wage differentials, and economic growth (see, for example, Abel, 1990; Galí, 1994; Kirchsteiger, 1995; Mui, 1995; Carter and McAloon, 1996; Corneo and Jeanne, 1997; Zizzo, 2003, 2008).

Envy is typically modeled by assuming a utility function that depends not only on the individual's wealth, x, but also on the reference group's wealth, y: $U = U(x, y)$. Preferring more over less implies that $\frac{\partial U}{\partial x} \geq 0$. Envy implies that $\frac{\partial U}{\partial y} \leq 0$, i.e., increasing the other person's wealth makes the individual relatively worse off. While there is general agreement about these two properties, different scholars have assumed different forms for $U(x, y)$. For example, in their classic papers, Abel (1990) and Galí (1994) employ[1]:

$$U(x, y) = \frac{1}{(1-\alpha)} \frac{x^{1-\alpha}}{y^{\gamma(1-\alpha)}}. \tag{1}$$

Other researchers model envy by adding a non-self interest term to the utility function:

$$U(x, y) = u(x) + s \cdot v(y), \tag{2}$$

where $u(x)$ and $v(y)$ are monotonically increasing functions, and $s < 0$ implies envy (see, for example Zizzo, 2008).

Of course, many other forms of $U(x, y)$ that satisfy the basic requirements $\frac{\partial U}{\partial x} \geq 0$ and $\frac{\partial U}{\partial y} \leq 0$ are possible. Obviously, different formulations of $U(x, y)$ may have dramatically different economic implications. The purpose of this paper is to narrow down the possible forms of $U(x, y)$ by imposing another condition on $U(x, y)$, which we term co-monotonicity. Below, we provide the definition and intuition for co-monotonicity, and in the next section we will provide experimental evidence about this property.

First, note that envy implies that the standard monotonicity axiom may be violated. For example, a person with the "keeping up with the Joneses" utility function (1), and $\alpha = 1/2$, $\gamma = 1$, prefers the situation $(x = 3, y = 2)$ over the situation $(x = 4, y = 5)$.[2] Thus, even though the person's consumption is higher in the latter situation, his utility is lower because of the increased consumption of the reference group. This is in clear violation of monotonicity

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[1] With $\alpha > 0$ and $\gamma \geq 0$. While Gali takes y as the same-period consumption, and calls this "keeping up with the Joneses", Abel takes y as the lagged consumption, which is known as "catching up with the Joneses".

[2] $U(3, 2) = 2 \cdot \frac{3^{1/2}}{2^{1/2}} > U(4, 5) = 2 \cdot \frac{4^{1/2}}{5^{1/2}}$.

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(see Kaplanski and Levy, 2011 for a generalization of Stochastic Dominance rules in the presence of envy). This is not surprising, as we know that envy (or unfairness aversion) can lead to refusal of a wealth-increasing offer in the ultimatum game (Kirchsteiger, 1995; Carter and McAloon, 1996), and to "cash burning", as long as the other person loses more than you do (Zizzo, 2003; Abbink and Sadrieh, 2009; Abbink and Herrmann, 2011).

Is there a generalization of the monotonicity axiom that is expected to hold even in the presence of envy? We suggest co-monotonicity as such an axiom:

Co-monotonicity axiom: an identical wealth increase to the individual and to his reference group increases (in the weak sense) the individual's utility. Formally: $U(x+\Delta, y+\Delta) \geq U(x, y)$ *for any x and y, and positive* Δ.

The co-monotonicity axiom is very intuitive, because the identical wealth increase does not alter the individual's relative ranking or the inequality, but does increase the wealth level for all. Note that for infinitesimal Δ co-monotonicity implies:

$$\frac{\partial U}{\partial x} + \frac{\partial U}{\partial y} \geq 0. \tag{3}$$

2. The experiment and results

The experiment is designed to test the three main axioms regarding the utility function $U(x, y)$ capturing envy, namely (i) $\frac{\partial U}{\partial x} \geq 0$, (ii) $\frac{\partial U}{\partial y} \leq 0$, (iii) $U(x+\Delta, y+\Delta) \geq U(x, y)$. While (i) and (ii) are standard in the theoretical competitive preferences literature, the co-monotonicity axiom (iii) is the focus of our attention.

The subjects in the experiment are 54 MBA students who have all completed an introductory course in finance. A prize of $100 was given to a randomly drawn subject who completed the questionnaire carefully. In the last question in the questionnaire subjects were asked to choose between two investment alternatives, where one dominated the other (nontrivially) by FSD. 95% of the subjects chose the dominating alternative, which suggests that the subjects satisfy (i) and paid careful attention to the choices at hand.

The questions that constitute the heart of the questionnaire are all structured in the same way, and are presented as follows:

In each one of the following questions you will be presented with two possible scenarios, A and B. Each scenario describes the rate of return on your investment and the rate of return on the investment of a random group of other investors. In each question please indicate which scenario you would prefer.

Questions 1–4 aim to test axiom (ii). In these questions we keep the subject's rate of return constant across the two scenarios, and only change the return of the reference group. Below are the questions and the responses (in percent, rounded off).

Q1.

Scenario A		Scenario B	
Return on your investment	5%	Return on your investment	5%
Return of reference group	3%	Return of reference group	7%
A: 70%; B: 5%; Indifferent 25%			

Q2.

Scenario A		Scenario B	
Return on your investment	−5%	Return on your investment	−5%
Return of reference group	−2%	Return of reference group	−8%
A: 12%; B: 61%; Indifferent 27%			

Q3.

Scenario A		Scenario B	
Return on your investment	10%	Return on your investment	10%
Return of reference group	2%	Return of reference group	5%
A: 51%; B: 10%; Indifferent 39%			

Q4.

Scenario A		Scenario B	
Return on your investment	10%	Return on your investment	10%
Return of reference group	16%	Return of reference group	19%
A: 65%; B: 6%; Indifferent 29%			

Under pure self-interest subjects should have been indifferent between the two scenarios in all of the above questions. This is clearly not the case. In all four questions subjects showed clear preference for the scenario in which their return exceeded the reference group return. The most pronounced result is obtained in Q1, where the reference group's return is below the subject's return in Scenario A but above it in Scenario B. In this case the ratio of subjects preferring Scenario A to those preferring Scenario B is 14:1. The weakest result is obtained in Q3, where the reference group's return is below the subject's return in both scenarios. In this case the subjects "can afford to be generous".[3] However, even in this case the ratio of the subjects who preferred Scenario A to Scenario B is more than 5:1.[4] These results reflect competitive preferences, or $\frac{\partial U}{\partial y} < 0$, and are consistent with other experimental results reported in the literature. For example, Charness and Rabin (2002) find that approximately one third of the subjects in a two-person dictator game prefer the alternative where the other subject receives the same payoff as they do over the case where the other subject receives more (see Berk29 in their Table 1). Abbink and Sadrieh (2009) report that about 40% of subjects actively chose to destroy some of the other subject's payoff, even though this does not affect their own payoff. Zizzo (2003) and Abbink and Herrmann (2011) find that subjects are even willing to give up some of their own wealth in order to reduce the other subject's wealth by a greater amount.[5]

The main focus of the experiment is the test of the co-monotonicity axiom, $U(x+\Delta, y+\Delta) \geq U(x, y)$, which to the best of our knowledge has not been previously tested. Questions 5 and 6 reported below address co-monotonicity.

Q5.

Scenario A		Scenario B	
Return on your investment	5%	Return on your investment	9%
Return of reference group	3%	Return of reference group	7%
A: 8%; B: 92%; Indifferent 0%			

[3] In this situation the general term "competitive preferences" is more appropriate than "envy", as the subject is better-off than the reference group.

[4] We should note that these results may be somewhat influenced by the experimenter demand effect: even though a subject may be indifferent between the two alternatives, he may feel a pull toward choosing one of the alternatives in order to "please the experimenter". I thank the referee for this point. Note that this effect may create a bias reducing the percentage of "indifferent" answers, but should not systematically bias the results with respect to the hypotheses tested.

[5] There is a subtle difference between these studies and the present experiment: in these studies the subject actively destroys the other subject's wealth, which may involve some guilt feelings, as shown by Abbink and Herrmann (2011). In contrast, here we describe two "states of nature", and ask subjects which one they would prefer.