Economics Bulletin

Volume 37, Issue 1

Correlates of Multiple Switching in the Holt and Laury Procedure

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Abstract

This paper addresses inconsistent choice behavior in the Holt and Laury (2002) procedure. Instead of simply dropping inconsistent subjects, we may be able to learn something from their behavior. It appears that the more the subjects assess themselves as being risk-averse, the less likely they are to violate expected utility theory. Similar patterns are found for experimental subjects with a major in economics.

I would like to thank John P. Conley, the editor of Economics Bulletin, as well as the anonymous reviewers for their comments, ideas, and criticism.
Citation: Sven Grüner, (2017) "Correlates of Multiple Switching in the Holt and Laury Procedure", *Economics Bulletin*, Volume 37, Issue 1, pages 297-304
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Submitted: December 02, 2016. **Published:** February 22, 2017.

1 Introduction

It is well known that experimental subjects in the Holt and Laury (2002) procedure, which aims at eliciting an individual's risk attitude, may behave inconsistently with expected utility theory. Holt and Laury (2002) argue that their results remain almost unchanged if they drop inconsistent subjects. Hirschauer et al. (2014) address the problem of dropping inconsistent subjects from the sample. They conclude that in addition to a reduction in the sample size, problems also arise if there is a systematic deviation between consistent and inconsistent subjects. According to Andersen et al. (2006), inconsistent choice behavior may be due an indifference toward the available options. Moreover, the authors discuss the switching multiple price list (sMPL), a modification of standard multiple price lists, in which the experimental subjects are required to choose the row in which they switch. This sMPL is monotonicity-enforcing, i.e. it does not allow for violations of expected utility axioms.

Other approaches deal with errors methodically. According to Goeree et al. (2016), boundedly rational people are not best responders, but rather are better responders. For example, quantal response equilibrium assumes people to select: (i) better alternatives with higher probability than worse alternatives, and (ii) best alternatives with probability under 100%, i.e., people do make erroneous decisions. In the literature, there are several stochastic error specifications, most notably those of Luce and Fechner. The 'Fechner' or 'white noise' approach proposes that the individual maximizes some form of utility function which includes a stochastic disturbance term (Fechner 1860, 1966; Hey and Orme 1994). Broadly speaking, the mathematical psychologist Luce (1959) proposed a rule in which choice frequencies are proportional to intensities.

In the rest of the paper, I shall illustrate violations of expected utility theory using student behavior in an Internet-based Holt and Laury (2002) procedure. I attempt to find reasons for erroneous behavior and make some suggestions for further research.

2 The Holt and Laury procedure (2002)

The lottery to elicit an individual's risk attitude according to Holt and Laury (2002) is depicted in Table 1.[1] In a sequence of 10 lottery pairs, experimental subjects must choose between the "safe" options A and the more risky options B. Following Holt and Laury (2002), the individual's risk attitude is defined by the number of A-choices: 1–3 (risk-loving), 4 (risk-neutral), and 5–10 (risk-averse). For one randomly-selected experimental subject, the random lottery incentive system (Wakker 2007; Lee 2008) is applied, i.e., a lottery pair is randomly selected and the decision of the subject within this lottery is played for real.

[1] The experimental instructions can be found in Appendix 1 at the end of the paper. The data of the experiment and stata codes are available on request.

Table 1 Experimental design of Holt and Laury (2002) procedure with high stakes

	Lottery pairs		
	Option A	Option B	Expected payoff difference [(a)]
1	1/10 of €100, 9/10 of €80	1/10 of €192.50, 9/10 of €5	58.25
2	2/10 of €100, 8/10 of €80	2/10 of €192.50, 8/10 of €5	41.5
3	3/10 of €100, 7/10 of €80	3/10 of €192.50, 7/10 of €5	24.75
4	4/10 of €100, 6/10 of €80	4/10 of €192.50, 6/10 of €5	8.00
5	5/10 of €100, 5/10 of €80	5/10 of €192.50, 5/10 of €5	-8.75
6	6/10 of €100, 4/10 of €80	6/10 of €192.50, 4/10 of €5	-25.5
7	7/10 of €100, 3/10 of €80	7/10 of €192.50, 3/10 of €5	-42.25
8	8/10 of €100, 2/10 of €80	8/10 of €192.50, 2/10 of €5	-59.00
9	9/10 of €100, 1/10 of €80	9/10 of €192.50, 1/10 of €5	-75.75
10	10/10 of €100, 0/10 of €80	10/10 of €192.50, 0/10 of €5	-92.5

(a) The last column was not shown to the experimental subjects.

3 Experimental Results

3.1 Description of the experimental subjects

In total, 300 experimental subjects studying agricultural and nutritional sciences in Halle (Germany) were recruited (cf. Table 2). About half of them (51.67%) were male. The subjects were on average 24.81 years old. A major in agriculture was indicated by 7.67% of the subjects, while 24.00% had their major in economics. About one-sixth of the experimental subjects had experience of farming, and 34.00% had already joined earlier experiments. Experimental subjects were asked "to assess their basic risk attitude in dealing with unknown aspects or new issues." They indicated the statement from a list of five which best fitted their preferences, ranging from "If I have the chance of a high profit, I am also willing to take very big risks." (= 1) to "If I have the chance of a high profit, I am willing to take very low risks." (= 5). On average, the individuals' "Self-assessment risk attitude" (3.42) favors risk-aversion. This is in line with the revealed coefficient of risk attitude according to the Holt and Laury procedure, which on average indicates (6.24) individuals being risk-averse.

Table 2 Description of the experimental subjects (N=300)

	Mean	Standard deviation
Gender male (in %)	51.67	–
Age (in years)	24.81	4.40
Agriculture major (in %)	7.67	–
Economics major (in %)	24.00	–
Experience in farming (in %)	16.00	–
Experience with experiments (in %)	34.00	–
Self-assessment risk attitude	3.42	0.84
Risk attitude (HL)	6.24	2.11

3.2 Revealed bounded rational behavior and explanations

Two types of inconsistencies with rational choice theory can be observed: multiple switching (switching back and forth between the two options) and choosing A in the 10^{th} lottery. These individuals are revealed to have bounded rationality. Other experimental subjects who do not violate the monotonicity axiom of expected utility theory are '*as if'* rational, since we know that people are restricted in their cognitive abilities and information available about their relevant environment (Simon 1957).

Table 3 Violations of rational choice (0 = No, 1 = Yes)

		A in 10^{th} lottery		
		0	**1**	Total
Switching back and forth	**0**	261	10	271
	1	19	10	29
	Total	280	20	300

In the experiment, 261 subjects (87% of the sample) did not switch back and forth nor choose A in the 10^{th} lottery. In total, 39 out of 300 people (13% of the sample) revealed to be boundedly rational. While 19 subjects switched back and forth between the two options but did not choose A in the 10th lottery, 10 subjects chose A in the 10th lottery but did not switch back and forth between the two options. Both types of violation were made by 10 subjects.

Using a logit regression can explain what determinants made violations of expected utility theory more likely (cf. Table 4). The endogenous variable "Revealed boundedly rational" is a binary one, with 1 for violations of expected utility theory. The main results can be summarized as follows:

i. Experimental subjects with a major in economics are less likely to violate expected utility theory.

ii. The more the subjects assess themselves to be risk-averse, the less likely they are to violate expected utility theory.

iii. Although the exogenous variable, “Experience with experiments” is not statistically significant (p-value = 0.143), its positive sign is quite interesting. Subjects who had already attended experiments seemed more likely to make inconsistent choices.

Table 4 Results of the logit regression to explain “Revealed boundedly rational” choice behavior (300 observations) [(a), (b)]

Endogenous variable Revealed boundedly rational (yes = 1; no = 0)	Coefficient	Standard error	p-value
Exogenous variables			
Gender (male = 1; female = 0)	-0.362	0.382	0.343
Age	-0.005	0.045	0.911
Agriculture major (yes = 1)	0.855	0.636	0.179
Economics major (yes = 1)	-1.096	0.546	0.045 **
Experience in farming (yes = 1)	-0.184	0.520	0.722
Experience with experiments (yes = 1)	0.584	0.399	0.143
Self-assessment risk attitude	-0.829	0.212	0.000 ***
Constant	1.019	1.291	0.430

(a) The null hypothesis that all coefficients in the regression model (except the coefficient of the constant) are zero is rejected by a likelihood ratio test ($p = 0.0016$). The Pseudo R^2 is 0.0999.
(b) * (p-value < 0.1), ** (p-value < 0.05), *** (p-value < 0.01)

4 Discussion

Erroneous choice behavior was interpreted as a source of information. The Holt and Laury (2002) procedure is based on probabilities and corresponding monetary consequences. The example above illustrated that a major in economics and a self-assessed risk attitude may influence an individual’s behavior in the experiment. Mathematical abilities and familiarity with probabilities may swap the individual’s actual risk attitude. In line with Gigerenzer (2002), people may have difficulties dealing with probabilities if they are unfamiliar with them. The correlation between self-assessment of the subjects’ risk attitude and inconsistent choices may be due to the optimism of the subjects. People who describe themselves as cautious might think more intensively about the decision problem of the lottery. Further research needs to be undertaken to further elaborate both the major of the subjects and especially the self-assessment of their risk attitude.

Because there are some systematic correlations in the regression, dropping inconsistent subjects might bias the average risk attitude. However, the number of inconsistent choices is low. But if there are plenty of people switching back and forth or choosing option A in the 10th lottery, the experimenter should use another, cognitively less-challenging, instrument to elicit risk attitudes. For a survey of methods to elicit risk aversion in the laboratory see Harrison and Rutström (2008).

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Appendix: Experimental Instructions (provided to experimental subjects)

You can see a list of 10 lottery pairs. Please choose one of the two options A or B each time. In total, one randomly selected participant receives a monetary prize. Please note that the numbers mentioned equal the actual possible monetary prize, i.e. you can win a prize money up to €192.50.

How does the lottery work?

Let us look at the following lottery pair example:

	Option A	Option B	Option A	Option B
1	with 10% gain of €100 with 90% gain of €80	with 10% gain of €192.50 with 90% gain of €5	○	○

In the lottery pair example above, you need to decide between option A, where you can win either €100 with a probability of 10% or €80 with a probability of 90%, and option B, where you can win either €192.50 with a probability of 10% or €5 with a probability of 90%.

How will the prize money be calculated for the randomly chosen participant?

	Course of Action		Your Choice	
	Option A	Option B	Option A	Option B
1	with 10% gain of €100 with 90% gain of €80	with 10% gain of €192.50 with 90% gain of €5	○	○
2	with 20% gain of €100 with 80% gain of €80	with 20% gain of €192.50 with 80% gain of €5	○	○
…			○	○
10	with 100% gain of €100 with 0% gain of €80	with 100% gain of €192.50 with 0% gain of €5	○	○

The table above shows an excerpt of the selection alternatives between option A and option B. In the following you decide between option A and option B. Your prize money will be calculated according the two-step procedure:

1. Selection of the relevant lottery pair

Ten plastic capsules, each containing a number from 1 to 10, are placed in a box. One of them is randomly selected and removed from the box. This represents the relevant lottery pair.

Suppose a 2 is drawn. Then the 2nd lottery pair is relevant to you. Subsequently, the plastic capsule is returned to the box.

2. Prize money

Then, another plastic capsule, and thus a number, is randomly selected and retrieved from the box. Note that option A of the second lottery pair provides a 20% probability to win €100 and an 80% probability to win €80. If a 1 or 2 is now taken from the box, then you win €100. For other numbers, you win €80. If you instead chose option B, then there is a 20% probability to win €192.50 and an 80% probability to win €5. If a 1 or 2 is now taken from the box, then you win €192.50, and for numbers 3 to 10, you win €5.

Next

Now you need to make your decision. Please select either option A or option B in each of the lottery pairs.

	Course of Action		Your Choice	
	Option A	Option B	Option A	Option B
1	with 10% gain of €100 with 90% gain of €80	with 10% gain of €192.50 with 90% gain of €5	○	○
2	with 20% gain of €100 with 80% gain of €80	with 20% gain of €192.50 with 80% gain of €5	○	○
3	with 30% gain of €100 with 70% gain of €80	with 30% gain of €192.50 with 70% gain of €5	○	○
4	with 40% gain of €100 with 60% gain of €80	with 40% gain of €192.50 with 60% gain of €5	○	○
5	with 50% gain of €100 with 50% gain of €80	with 50% gain of €192.50 with 50% gain of €5	○	○
6	with 60% gain of €100 with 40% gain of €80	with 60% gain of €192.50 with 40% gain of €5	○	○
7	with 70% gain of €100 with 30% gain of €80	with 70% gain of €192.50 with 30% gain of €5	○	○
8	with 80% gain of €100 with 20% gain of €80	with 80% gain of €192.50 with 20% gain of €5	○	○
9	with 90% gain of €100 with 10% gain of €80	with 90% gain of €192.50 with 10% gain of €2	○	○
10	with 100% gain of €100 with 0% gain of €80	with 100% gain of €192.50 with 0% gain of €5	○	○

[Next Part: Personal Information]

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