Economics Bulletin

Volume 34, Issue 3

Do students recognize an opportunity cost when they see one? Evidence from introductory economics

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Abstract

The well-known study by Ferraro and Taylor (2005) on the understanding of opportunity cost has sparked considerable debate. This paper addresses one specific aspect of the question, namely the issue of units of measurement when converting goods to dollars for comparison purposes. Results strongly suggest that the source of difficulty with the original question stems from the confusion over units of measurement rather than with the concept of opportunity cost itself.

The author wishes to thank Kayla Duley, Jessica Harriger, Warren Jones, and Tara Westerhold for their assistance in administering the survey to their classes. All errors are my own.
Citation: William Polley, (2014) "Do students recognize an opportunity cost when they see one? Evidence from introductory economics", *Economics Bulletin*, Vol. 34 No. 3 pp. 1550-1556.
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Submitted: March 16, 2013. **Published:** July 17, 2014.

1. Introduction

In a well-known study, Ferraro and Taylor (2005) surveyed approximately 200 economists at the 2005 Allied Social Sciences Association (ASSA) meetings in Philadelphia. The purpose of the survey was to assess the respondent's understanding of opportunity cost. One common textbook definition of opportunity cost is "the value of the next-best alternative that must be foregone to undertake the activity."

The survey consisted of a single question:

> You won a free ticket to see an Eric Clapton concert (which has no resale value). Bob Dylan is performing on the same night and is your next-best alternative activity. Tickets to see Dylan cost $40. On any given day, you would be willing to pay up to $50 to see Dylan. Assume there are no other costs of seeing either performer. Based on this information, what is the opportunity cost of seeing Eric Clapton?
>
> A. $0
> B. $10
> C. $40
> D. $50

The results from Ferraro and Taylor's (2005) survey were as follows:

	Number of Observations	Frequency (percent)
Answer A	199	50 (25.1%)
Answer B	199	43 (21.6%)
Answer C	199	51 (25.6%)
Answer D	199	55 (27.6%)

Ferraro and Taylor (2005) report that even among academic economists and graduate students (many of whom identified themselves as having taught introductory economics) there appears to be a lack of understanding of the concept of opportunity cost. The correct answer, according to Ferraro and Taylor (2005), is "B" or $10.

A number of papers have followed which discuss the question and the results from different points of view. Becker (2007, p. 10) writes,

> Could it be that the old idea of opportunity cost is too simplistic to have any true meaning in real decision making? Could it be that the science of economics has moved beyond this simplistic bivariate relative pricing idea? Could it be that graduate textbooks, as in my presentation on the shadow prices of teaching and research, have correctly given up on the introductory economics course idea of an opportunity cost in favor of more useful measures of price? Alternatively, why is there such a divide between undergraduate and graduate education in economics?

> Could it be that those at the forefront of research in economics and teaching in prestigious graduate programs are misleading their students? These are not rhetorical questions -- I seriously do not have the answers.

O'Donnell (2008) argues that the concept of opportunity cost and a correct understanding of the above question is not necessary for success as an economist. Margolis (2007) discusses the fact that the Ferraro and Taylor question seems to cause people to give illusory responses. To be sure, it is not necessary to understand the Dylan/Clapton question to be able to solve complex mathematical (i.e. calculus based) problems like those seen in graduate level economics. Nor is this question unique in the fact that the way that it is worded may cause students to answer incorrectly. As anyone who teaches introductory economics will readily admit, the wording of a question can be critical to eliciting the correct response.

Potter and Sanders (2012) take the critique a step further by suggesting that any of the four answers to the question are defensible and that the different accounting methodologies to arrive at those answers are equally valid. Such an assertion calls into question the use of opportunity cost in basic economic instruction. Such criticism begs the question of whether the Ferraro and Taylor question is poorly constructed or inconsistent with the way that opportunity cost can or should be taught. If Potter and Sanders are correct, that would suggest that there is a serious problem with the concept of opportunity cost, namely that it is an arbitrary concept and not well-defined.

In an attempt to identify the source of the confusion over this question, I consider an alternative version of Ferraro and Taylor's opportunity cost question. The alternative was designed to be as similar to the original in every respect except that the alterative is more transparent about the unit of measurement. Specifically, everything is stated in terms of dollars, not concert tickets. The alternative question and the original were given to introductory economics students and the results from the different questions compared. The use of an alternative question with an obvious parallel to the original question of Ferraro and Taylor will allow us to discern whether it is the concept of opportunity cost that troubles students or something else entirely.

2. Methodology

I propose the following alternative question:

> Suppose you are given a box with an unknown amount of money inside. You can walk away with this "mystery box" or you can give that box back and pay $40 to obtain a different box which you know with certainty to contain $50. What is the opportunity cost of walking away with the mystery box?
>
> A. $0
> B. $10
> C. $40
> D. $50

Comparing this question with the original question reveals that the “mystery box” represents the Eric Clapton concert (the dollar value is not given in the problem and is not

necessary for the answer). The box that contains $50 which can be purchased for $40 represents the Bob Dylan concert for which the subject in the question is willing to pay $50 to obtain but has a market price of $40. The essential features of the problem are the same. The only real difference between the two versions has to do with the units of measurement. This is a critical difference. In the original problem, the respondent has to perform the additional step of converting "one unit of Bob Dylan" (which is literally what is being foregone) into its value in terms that facilitate comparison with other things of value. This conversion of some abstract good into units of value for the purposes of comparison is the backbone of economic analysis (i.e. marginal rate of substitution), but it is not a trivial step. By asking the simplified question which keeps everything in terms of dollars, we may better determine the extent to which this measurement issue confounds student understanding of the question.

Note also that the alternative question does require students to think about opportunity cost as a "net" concept. That is, that the decision to see Bob Dylan includes both a cost and a benefit and thus the opportunity cost should be expressed as the benefit minus the cost of seeing Dylan. This is more transparent in the mystery box question as it is immediate that the decision to give up the mystery box yields a net $10 ($50-40). This is an important observation as one of Potter and Sanders's (2012) critiques of opportunity cost and the Ferraro and Taylor question is the "net" interpretation.

The questions were posed to 134 students at the author's university in a variety of economics courses. The breakdown was as follows.

Two sections of a 100 level general education economics course (25 students)
Three sections of a 200 level principles of macroeconomics course (50 students)
Three sections of a 200 level principles of microeconomics course (51 students)
One section of a 300 level intermediate microeconomics course (8 students)

As this involved the use of human subjects in a survey question, the questions and the methodology were reviewed and approved by the Institutional Review Board at the author's institution. In each class, half of the students received the original Ferraro and Taylor question, and half received the "mystery box" question. Students were not prepped for the question in any way. The instructors of the 100 and 200 level courses had covered opportunity cost in the first few days of the semester each in their own way consistent with the textbook of their choosing which did not involve these questions. As the intermediate level course does not focus on opportunity cost as much as the introductory courses, no special coverage of the topic took place. Students were told that this was a survey to help improve the teaching of economics, that their participation was optional, and that it did not affect their grade in any way. All students who were present on the day the survey was given participated. Students did not see the other version of the question, and the answer was not discussed afterwards in order to minimize any influence on classes that were surveyed later in the day.

3. Results

Table 1 reports the responses from each course as well as the overall responses. The Pearson's chi-square statistic is computed for each pair of results as a test for independence. The p-values for each statistic are reported as well. In all cases, there are 3 degrees of freedom, and the critical value for the chi-square statistic at the 95% (99%) level is 7.815 (11.345). Rejection

of the null hypothesis that the distribution of answers was the same for each question is indicated by **, and *** at the conventional 5%, and 1% levels, respectively.

Class	A	B	C	D	Total	χ^2	p-value
100 level Dylan/Clapton	5	4	3	1	13	12.98	0.005***
Mystery Box	0	12	0	0	12		
Prin. Macro Dylan/Clapton	9	2	13	1	25	23.64	<0.001***
Mystery Box	3	14	2	6	25		
Prin. Micro Dylan/Clapton	8	6	9	3	26	10.31	0.016**
Mystery Box	1	11	5	8	25		
Int. Micro Dylan/Clapton	1	2	1	0	4	2.12	0.549
Mystery Box	1	3	0	0	4		
Total Dylan/Clapton	23	14	26	5	68	39.27	<0.001***
Mystery Box	5	40	7	14	66		

Table 1. Distribution of answers for the two questions with χ^2 test.

The results show that in the 100 level course and for principles of macroeconomics the distribution of responses was statistically different with greater than 99% confidence. For principles of microeconomics, the distribution of responses was statistically different with greater than 98% confidence. Due to the small class size (N=4 for each question), meaningful inference could not be drawn for the intermediate level course though the mystery box question was answered correctly by one more student than the original question. Combining all the sections we have greater than 99% confidence that the distribution of responses to the two questions are statistically different.

Overall, the response to the original question is not tremendously different from what Ferraro and Taylor (2005) found. The responses of A and C were somewhat more common and D was somewhat less common than in Ferraro and Taylor (2005), but the percentage of correct responses was almost identical at about 21%. This gives us a good baseline for comparison with the alternative wording and suggests that the ability of the population of undergraduate

economics students to answer this question is comparable to the ability of the professional economists surveyed by Ferraro and Taylor. Yet the undergraduate economics students are significantly better at answering the question when it is expressed only in terms of a single unit of measurement, dollars. Overall, over 60% of students who received the "mystery box" question answered it correctly—a vast improvement over 21%. Notably, in the general education (100 level) course, all of the students who received the "mystery box" question answered it correctly. The 100 level course proceeds a bit more slowly than a traditional principles course and spends a bit more time on the concept of opportunity cost, though this class had not seen either question during their class's coverage of the topic.

These results suggest that the simplification of this measurement issue matters for student understanding. When students do not have to convert from an abstract unit (concert ticket) to something that allows its value to be compared to other items of value (dollars), the students were able to correctly apply the definition of opportunity cost.

4. Conclusion

The results of this survey of introductory economics students make a significant contribution to the line of research on the understanding (or lack thereof) of opportunity cost begun by Ferraro and Taylor (2005). By surveying a group of students in a variety of economics courses and randomly giving them either Ferraro and Taylor's question or the "mystery box" question we are able to observe whether the conversion of units from tickets to dollars presents a barrier to applying the definition of opportunity cost. The results show that a statistically larger percentage of students answer the question correctly when the question is stated simply in terms of dollars and no unit conversion is necessary.

This has important implications for teaching introductory economics. One of the most fundamental tasks in economics is the comparison of different goods or bundles of goods in terms of their value. The Ferraro and Taylor question requires the respondent to consider the value of a concert ticket in terms of a willingness to pay for the ticket in dollars. This is not unlike the calculation, familiar in upper level economics, of equating marginal utility per dollar (MU/P) across all goods. The Ferraro and Taylor question invokes a numeraire good (dollars) which facilitates the comparison of value, but the question does not fully develop or explain the reasoning behind the use of a numeraire. The results of this survey suggest that students (and perhaps the professional economists surveyed by Ferraro and Taylor) find this conversion nonintuitive. When the conversion is not necessary because of a common unit throughout the problem, the answer is much more intuitive.

These results address some of the questions addressed by other researchers on the subject. Regarding Becker's (2007) questions, these results suggest that opportunity cost does have a true meaning in decision problems and that students do understand that meaning intuitively. What students find less intuitive is how to deal with a problem where quantities of different goods must be compared. These two survey questions provide an opportunity to make that connection explicit and thus improve understanding of the more advanced concepts.

Regarding Margolis's (2007) critique the results suggest that the source of the illusion may be the need to convert units of measurement. Understanding the source of the illusion is the key to helping people see the correct answer more clearly.

Finally, this calls into serious question the claim by Potter and Sanders (2012) that any of the answers are defensible. These results show quite definitively that students are able to understand the concept of opportunity cost as a net concept (i.e. pay 40 to get something with a

value of 50 yields a 10 unit surplus) when the units are clear. When unit conversion is not necessary, students have much less difficulty finding the correct answer which is consistent with the version of opportunity cost they have been taught. The problem is not with opportunity cost, which these results show is well-defined and well-understood. The problem is specifically in dealing with a change of units, which is something that can be explained in the context of comparing the marginal rate of substitution to the relative price—which is perhaps one of the most fundamental concepts of microeconomics at any level.

The primary implication is that instructors of introductory economics should be extremely careful in developing the framework for analysis to include special attention to the comparison of values and the conversion to common units of measurement. It is not the concept of opportunity cost that students misunderstand, but rather the process of comparing the values of different consumption bundles with different units. Given the importance of these concepts throughout economic theory, more careful attention to this may pay large dividends in advancing the quality of economic instruction at all levels.

5. References

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