Caspian J. Environ. Sci. 2015, Vol. 13 No.4 pp. 417~425

CJES
Caspian Journal of Environmental Sciences

[Report and Opinion]

When Do We Feel Sorry for Others? : An Externality of Lake Use as an Example

Y. Kawata

Faculty of Economics, Kindai University, Japan (The research was conducted in the Department of Animal and Food Hygiene, Division of Food Hygiene, Obihiro University of Agriculture and Veterinary Medicine, Japan).

E-mail: ykawata@kindai.ac.jp

(Received: Sept. 08.2011 Accepted: July. 29.2015)

ABSTRACT

The purpose of the study was to verify, through the use of an experimental method, the assumption that the 'economic human' pays more attention to the externality he/she causes as the strength of externality increases. We used a social-experiment design within an undergraduate classroom to test assumptions, using statistical method. A lakeside plant was used as an example. Our results confirmed the following: (1) 66% of subjects behaved altruistically, while the remainder (34%) behaved selfishly, suggesting that the assumption of mainstream economics may not be appropriate; (2) when we compared situations in which the plots with the natural resource (e.g. the plant) to which the economic human had property rights were large or small in number, those who possessed larger plots tended to be more conservative in resource use; and (3) when we compared situations where the economic human's extent of influence on natural resources was large or small, those with greater influence tended to be more conservative in resource use. Although mainstream economics assumes a rational economic human—who is supposedly selfish—our results suggest that altruistic behaviour dominates selfish behaviour, and that altruistic behavior should be taken into greater consideration when making policy.

Key words: altruism, environmental issues, experimental economics, externality, homo economicus, lake

INTRODUCTION

Mainstream economics assumes the so-called rational economic human ('homo economicus'), who supposedly ignores externality. Thus, it follows that the behaviour of the rational economic human will remain the same, whether or not there is any externality. The above explanation is provided in standard textbooks of mainstream economics, under the assumption that there is no social penalty for generating externality.

However, is it truly realistic to assume that externality is not considered by the economic human? It might be more natural to suppose that we feel sorry for others if we cause some externality, even when there is no social penalty. The assumption might be especially questionable when the behaviour of a rational economic human brings to bear substantial negative external effects on society as a whole. It seems more realistic to assume that each economic human pays some attention to others when his/her behaviour bears substantial negative effects on society as a whole. Besides, recently, doubts have been raised whether sustainable development can be achieved under the assumption of 'homo economicus' (Becker 2006). Kahneman (2003) suggests that economic agents are bounded rational and a series of results of ultimatum games seems to support his suggestion. The purpose of this paper is to verify, through the use of an experimental method, the assumption that the economic human pays more attention to the externality he/she causes as the strength of externality increases. Specifically, we examined the following two assumptions. In the first examination, we compared situations where the extent of natural resources to which the economic human had property rights was large or small; we expected that as the extent of

natural resources to which the economic human had property rights became larger, the economic human would exert a greater effort to reduce externality (hypothesis 1). In the second examination, we compared situations where the extent of natural resources to which the economic human exerts influence is large or small; we expected that as the extent of natural resources to which the economic human exerts influence grew, the economic human would exert greater effort to reduce externality (hypothesis 2).

MATERIALS AND METHODS

The subjects were undergraduate students who attended the lecture 'Agriculture and Economics', delivered by the author. In all, 196 students took part, of whom 94% were first-year students. The lecture and therefore the experiment took place on 17 June 2011. The 75-min lecture was followed by the 15-min experiment. In the lecture, students were provided explanations of the mechanisms underlying environmental issues in the field of agriculture; the information provided to the students in this lecture gave them the knowledge needed to understand the experiment and answer questions pertaining to it. The following scenario was assumed in the experiment. There is a scenic lake, and there are one or more landowner(s) who possess (es) lakeside property, which is divided into 100 m × by 100 m plots. In each lakeside plot, a plant with some economic value grows wild, and each landowner (in the experiment, each subject is assumed to be a landowner) harvests this plant to sell it in the market and gain income each year. The price of the plant is constant and does not depend on the total amount of harvest by all landowners. The lakeside area where the plant grows wild is also an important site for the growth of larval fish and the habitat of migratory birds. In the experiment, we supposed three types of lake area, with boundary lengths of 10 km (100 plots), 50 km (500 plots), and 100 km (1,000 plots). The subject assumed to be the landowner was assigned lakeside plots. The number of plots assigned to each subject accounted for 1%, 10%, 25%, 50%, or 75% of all lakeside plots. It followed, therefore, that there were 15 cases (i.e. 3 cases of lake area × 5 cases of plot assignment). Boundary length was set based on that of the largest lake in Japan—Biwa, whose boundary length is 241 km. The subject was posed the following conditions. First, if the subject were to harvest the plant in his/her plots, his/her income would vary according to the amount harvested; however, the amount of harvest would not influence the volumes of fish caught or the number of water birds visiting the lake of that year (i.e. there is no externality for fishermen and visitors within a year). Second, however, if the landowner were to harvest the plant this year, doing so may cause an externality *after* the next year; Fig. 1 provides the assumed influences of the harvest of one year on the harvest, fish catches, and number of water birds of the next year. As seen in Figure 1, a change of a few percentage points of harvest can prompt drastic changes in subsequent harvests, fish catches, and numbers of water birds. It was explained in the lecture that regime shifts can bring about such drastic changes (Thom, 1975; Scheffer *et al.*, 2001; Scheffer & Carpenter, 2003).

Each subject was posed with the total lake area (e.g. boundary length of the lake is 100 km and the number of plots is 1,000) and the rate of plot assignment (e.g. subject had 500 of 1,000 plots). The subject was also asked how many plots he/she would harvest this year; for the sake of simplicity, we supposed that if the subject decided to harvest, he/she would harvest all the plants in each plot. It was assumed that the subject had little knowledge of the behaviour of other landowners. Next, the rate of plot assignment was changed (e.g. subject had 750 of 1,000 plots), and the subject was once again asked how many plots he/she would harvest this year.

As stated above, the purpose of this paper was to examine, through the use of an experimental method, the hypothesis that the economic human pays greater attention to the externality that he/she causes as the strength of the

externality increases. The background of this hypothesis and the method of verification are provided below. Roughly speaking, there are two types of landowner: one type is selfish, and the other is altruistic. Here, 'selfish' and 'altruistic' suggest that externality towards other economic humans (e.g. fishermen and visitors) is ignored and considered, respectively. For the sake of simplicity, each subject expects all other landowners to be either selfish or altruistic. If the subject supposes all other landowners to be altruistic, he/she will expect all other landowners to harvest 30% their plots (i.e. 30% is the largest percentage, under the constraint of no externality towards others). If the subject supposes that all other landowners are selfish, he/she will expect all other landowners to harvest 50% of their plots (i.e. 50% is the largest percentage, under the constraint of no loss in the subject's future income). Here, we ignore the possibility of myopic decision making. As we will see later in the paper, less than 1% of subjects were classified as showing myopic (i.e. unreasonable) decision-making; therefore, it should be appropriate to assume that the other landowners will not show myopic decision-making, either. Each subject is assumed to be risk-neutral.

Under the aforementioned scenario, it follows that the rate of plot use varied between 0% and 100%, depending on the subject's expectations vis-à-vis the typology of the other landowners. Besides, as shown in Table 1, there were ranges of reasonable rate of plot use for the subject, and each rate depended on the type of subject and the subject's expectations vis-à-vis the typology of the other landowners. For example, when the subject was altruistic and the subject expected the other landowners to be selfish, and if the subject's rate of plot assignment was 50%, the rate of plot use by subject should have been less than 10%, as shown in Table 1. Unreasonable cases are those that do not 'fit' with the above cases, where subjects and other landowners are selfish and/or altruistic. A unreasonable case would not occur when the subject's rate of plot assignment was 1%, 10%, or 25%. A unreasonable case happened when the subject's rate of plot assignment was 50% or 100%, *and* where the total rate of plot use was greater than 50% if the subject's rate of plot use was between 71% and 100% and 58% and 100%, respectively. As a result, although it was possible for the subject to realise a rate of plot use less than 50%, the subject would use more than 50% and reduce the income of both the subject and the other landowners in the next year. However, it is still possible to explain such cases. For example, one possibility might be the case where the subject substantially discounts the present value of profits from the plant harvest, because the subject's subjective discount rate is high. (There is another, similar situation, where the subject expects the subjective discount rates of other landowners to be substantially high, and he/she also sets his/her subjective discount rate high.) In such cases, if the subject's rate of plot assignment were 50%, the rate of plot use would be between 71% and 100%; if the rate of the subject's rate of plot assignment were 75%, plot use would be between 58% and 100%, as shown in Table 1. Next, we examined the two hypotheses of this paper. First, let us examine hypothesis 1. (We compared situations where the extent of natural resources to which the economic human had property rights were large or small; we expected that as the extent of natural resources grew, the economic human would exert a greater effort to reduce externality). Based on Table 1, we expected that if the subject were altruistic and the other landowners selfish, then the following statement would hold: as the rate of assignment of subject grew, the rate of plot use would also grow. However, for this statement to hold, it was necessary that this scenario (i.e. where the subject and other landowners are altruistic and selfish, respectively) represent the majority of cases; therefore, it is expected this statement will not hold. In addition, we can point out the following.

(1) As the number of plots increases, the amount of subject income will increase, and the

subject can then more readily consider his/her impact on the environment.

This logic is the same as that of the Environmental Kuznets curve (Grossman & Krueger, 1991; Shafik & Bandyopadhyay, 1992), where as the per-capita GDP exceeds some limit, one can consider environmental issues more seriously. In a related move, Johansson-Stenman (2005, p. 101) states in the abstract of his study that 'this paper shows that rich countries in a free unregulated market may still undertake globally efficient abatement investments [for global environmental problems], given the existence of limited non-paternalistic altruism'. (2) The impact of one plot harvest would be the same when this plot belonged to those who were assigned many plots, versus those who were assigned few plots. However, the subject may think that his/her impact on harvest per plot will be insignificant, if he/she had few plots. On the other hand, the subject may think that his/her impact on harvest per plot will be high, if he/she had many plots. This is the same logic used in the Tragedy of Commons (Hardin, 1968). (3) If the rate of plot assignment is large, the subject will lessen the uncertainty caused by other landowners' behaviour. In such a situation, the subject's effort to conserve will be effective (i.e. the subject's altruistic behaviour can become more effective).

Therefore, there is a good possibility that hypothesis 1 holds.

Total harvest of the plant, of entire lakeside (sum of all landowners)	**Subject's income in the next year**	**Influence on the fish catches in the next year**	**Influence on visitors in the next year**
In total, 0–30% of plots are harvested	No influence	No influence	No influence
In total, 31–50% of plots are harvested	No influence	Fish catches reduced by 31–50%	Visitors reduced by 31–50%
In total, 51–80% of plots are harvested	Income reduced by 51–80%	Fish catches reduced by 51–80%	Visitors reduced by 51–80%
In total, 80–100% of plots are harvested	Closed after next year	Closed after next year	Closed after next year

Fig. 1. Influence of harvest of one year on the harvest, fish catches, and the number of water birds in the next year.

Second, let us examine hypothesis 2. (We compared situations where the extent of the natural resources over which the economic human exerts influence was large or small [e.g. lake size]. We expected that as the extent of natural resources grew, the economic human would exert a greater effort to reduce externality.) In general, externality will grow as the scale of the object becomes larger. If the behaviour of the subject were not economically rational and externality were considered, it seems appropriate to hypothesise that externality will be considered more seriously as the size of the lake grows.

Table 1. Expectations vis-à-vis the rate of plot use.

Subject	Altruistic	Altruistic	Selfish	Selfish	
Other landowners†	Selfish	Altruistic	Selfish	Altruistic	Nonreasonable
1%	0%	1〜30%	31〜50%	51〜100%	–
10%	0%	1〜30%	31〜50%	51〜100%	–
25%	0%	1〜30%	31〜50%	51〜100%	–
50%	10%	11〜30%	31〜50%	51〜70%	71〜100%
75%	23%	24〜30%	31〜50%	51〜57%	58〜100%

†1% to 75% in the leftmost column is the rate of assignment for subject.

RESULTS

Table 2 provides the average rates of plot use, which were calculated based on the replies of subjects, for 15 cases. On average, 25 subjects provided an answer for each case. When we compared within the 10-km, 50-km, and 100-km rows, in order, the average rate of plot use decreased as the rate of plot assignment increased. Suppose the null hypothesis was that there was no difference in harvest rate among the cases; also suppose an alternative hypothesis that the average rate of plot use depends on the rate of plot assignment. Applying the Friedman test for 10 km, 50 km, and 100 km, the χ^2 values were 44.5, 75.1, and 42.0, respectively; for these three cases, the null hypothesis was rejected at the 1% significance level. Therefore, hypothesis 1 was verified empirically—that is, as the extent of natural resources for which the economic human had property rights grows, the economic human would exert greater effort to reduce externality. There was one caveat: the 10 km–1% pair had a rate of 83.3%, which was substantially higher than those of the others. This was because subjects were asked to answer with an integral number (e.g. 1% of 100 plots is one plot; therefore, in the case of the 10 km–1% pair, subjects had to select either zero plots or one plot).

Next, we compared within the 1% to 75% columns; the average rate of plot use decreased as the rate of plot assignment increased in the case of the 1% column. For the 25%, 50%, and 75% cases, the average rate of plot use took a minimum value when the boundary length was 50 km.

It followed that we could not verify hypothesis 2, based on this examination. We conducted an additional examination. Under hypothesis 2, it was expected that as the number of plots grew, subjects would tend to be altruistic, and that whenever the rate of assignment were small, subjects would tend to be selfish (hypothesis 2′). Table 2 classifies harvest rates based on subject typology and on the type of other landowners expected by the subject. For example, in the case of the 500 plots–75% pair, based on Table 1, if a subject were to reply with some rate between 0% and 23%, that subject must regard him/herself as altruistic and others as selfish (see the 75% case in Table 1). As shown in Table 2, 39% of the subjects expect the case involving the 500 plots–75% pair. When the number of plots was 100, 500, and 1,000 and other landowners were selfish, 7%, 9%, and 6% of subjects were altruistic, respectively. When the number of plots was 100, 500, and 1,000 and other landowners were altruistic, 45%, 54%, and 66% of subjects were altruistic, respectively. We confirmed the tendency that as the number of plots grew, so too did the proportion of altruistic subjects. On the other hand, when the number of plots was 100, 500, and 1,000 and other landowners were selfish, 25%, 24%, and 20% of subjects were altruistic, respectively. When the number of plots was 100, 500, and 1,000 and other landowners were altruistic, 22%, 11%, and 8% of subjects were selfish, respectively. We confirmed the tendency that when the total number of plots was small, there was a greater proportion of selfish subjects. Although we could not conduct statistical tests for

Table 2. Results of the average rate of plot use.

Boundary length	Number of plots		Hypothesis 1	Hypothesis 2									
		Subject:		Altruistic		Altruistic		Selfish		Selfish		Unreasonable	
		Other landowners:		Selfish		Altruistic		Selfish		Altruistic			
		Rate of plot assignment		Result	Average	Result	Average	Result	Average	Result	Average	Result	Average
10 km	100	1%	83.3%	17%		–		–		83%		–	
		10%	37.8%	0%		59%		33%		7%		–	
		25%	36.9%	0%	7%	46%	45%	38%	25%	15%	22%	–	1%
		50%	32.3%	0%		77%		19%		4%		0%	
		75%	31.3%	19%		44%		33%		0%		4%	
50 km	500	1%	42.1%	0%		43%		29%		29%		–	
		10%	38.1%	0%		64%		21%		14%		–	
		25%	33.0%	0%	9%	64%	54%	29%	24%	7%	11%	–	1%
		50%	29.6%	7%		64%		18%		7%		4%	
		75%	25.1%	39%		36%		25%		0%		0%	
100 km	1,000	1%	40.0%	0%		67%		15%		19%		–	
		10%	35.8%	0%		65%		27%		8%		–	
		25%	34.1%	0%	6%	80%	66%	12%	20%	8%	8%	–	0%
		50%	32.8%	0%		72%		24%		4%		0%	
		75%	26.0%	30%		48%		22%		0%		0%	

Hypothesis 2′, we can indirectly suggest that hypothesis 2′ holds.

DISCUSSION

If the assumption of the rational economic human ('homo economicus') is true, externality will be ignored. However, this study's results suggest that 66% (=7% + 59%) of subjects behave altruistically, while the remaining 34% (=25% + 9%) behave selfishly—that is, only one-third of subjects behave in a manner consistent with the assumptions of mainstream economics, with the majority of subjects behaving quite differently. In this paper, we provided two hypotheses and empirically examined them through the use of an experimental economic method. The results showed that hypothesis 1 holds and is statistically confirmed. On the other hand, the results vis-à-vis hypothesis 2 were ambiguous: we provided the modified hypothesis 2′, and our results showed that while hypothesis 2′ may hold, it is not statistically verified. The above results show that, unlike the assumptions inherent in mainstream economics, many people may behave altruistically, and that as the extent of externality increases, people tend to be more altruistic. There are some existing examples that suggest that textbook approaches to environmental management are not appropriate for resolving real-world problems (see for example, Howarth, 1996, p. 31); our case provides another such example. Venkatachalam (2008) states that, in the real economic activities, experimental and behavioural economic studies have revealed that rational behaviours are not necessarily observed. These results seem to accord with real-life environmental issues. For example, in the case of greenhouse gases such as CO_2, there are a number of sources of generation. In such cases, the externality effect of each source of generation should be substantially small, and so that effect would not be considered in that source's decision-making. This is the same phenomenon as seen with the *food basket*, described by Hardin (1968) in the Tragedy of Commons. If we consider sound the assumption of the rational economic human, the results of this paper are perverse indeed. However, if we assume that externality can happen when the effect of each subject is substantially small, then the results of this paper are fairly appropriate. The fallacy of composition is well-known within the basic theory of economics, where what is true for one subject may not true for all subjects as a whole. The same logic can be applied in cases of natural resource use, as described in this paper. Even when the external effect of each subject is substantially small, the total effect is no longer insignificant, but we often misunderstand this fact. Thus, it is reasonable to conclude that when the externality that a subject exerts is large, the subject will tend to behave in a more altruistic manner. When planning policy, it is essential to consider the existence and effect of the altruistic economic human. The proportion of altruistic economic humans within a given society may depend on the condition of that society. For example, Wildmana and Hollingsworth (2009, p. 502) examined blood donation and state that 'we find no empirical evidence of pure altruism. Rather donation appears more a consequence of social norms and societal embeddedness'. In addition, Grolleau *et al.* (2009) theoretically show that, under some conditions, altruism can be rather harmful for the environment. Thus, it is necessary to investigate and accumulate knowledge on the altruistic economic human.

REFERENCES

Becker, C, 2006, the Human Actor in Ecological Economics: Philosophical Approach and Research Perspectives. *Ecological Economics*, 60: 17 – 23.

Grolleau, G, Ibanez, L & Mzoughi, N, 2009, Too much of a good thing? Why altruism can harm the environment? *Ecological Economics,* 68: 2145 – 2149.

Grossman, GM & Krueger, AB, 1991, *Environmental Impacts of a North American Free Trade Agreement.* National Bureau of Economic Research Working Paper 3914, NBER, Cambridge MA.

Hardin, G, 1968, The Tragedy of the Commons. *Science,* 162: 1243 – 1248.

Howarth, RB, 1996, Status effects and environmental externalities. *Ecological Economics,* 16: 25 – 34.

Johansson-Stenman, O, 2005, Global environmental problems, efficiency and limited altruism. *Economics Letter*, 86: 101 – 106.

Kahneman, D, 2003, Maps of Bounded Rationality: Psychology for Behavioral Economics. *American Economics Review,* 93: 1449 – 1475.

Scheffer, M & Carpenter, SR, 2003, Catastrophic Regime Shifts in Ecosystems: Linking Theory to Observation. *Trends of ecology & evolution,* 18: 648 – 656.

Scheffer, M, Carpenter, S, Foley, JA, Folke, C, and Walker, B, 2001, Catastrophic Shifts in Ecosystems. *Nature,* 413: 591 – 596.

Shafik, N & Bandyopadhyay, S, 1992, *Economic Growth and Environmental Quality: Time Series and Cross-Country Evidence.* Background Paper for the World Development Report 1992. The World Bank, Washington DC.

Thom, RF, 1975, *Structural Stability and Morphogenesis: An Outline of a General Theory of Models,* Reading: Massachusetts (Firstly published in French 'Stabilité Structurelle et Morphogénèse: Essai D'une Théorie Générale des Modèles' in 1972; translated by D.H. Fowler into English).

Venkatachalam, L, 2008, Behavioral economics for environmental policy. *Ecological Economics,* 67: 640–645.

Wildmana, J & Hollingsworth, B, 2009, Blood donation and the nature of altruism. *Journal of Health Economy*, 28: 492 – 503.

چه زمانی برای دیگران احساس تاسف می‌کنیم؟ استفاده از وضعیت ظاهری یک دریاچه به عنوان نمونه

ی. کاواتا

گروه بهداشت دام و مواد غذایی، دانشگاه کشاورزی و دامپزشکی اوبیهیرو، دانشکده اقتصاد، دانشگاه کیندای، ژاپن

(تاریخ دریافت: ۹۳/۱۱/۲۶ تاریخ پذیرش: ۹۴/۵/۷)

چکیده

هدف از این مطالعه، از طریق استفاده از یک روش تجربی، این بود که این تصور را تایید کند که انسان مقتصد توجه بیشتری به ظاهر بیرونی از خود نشان می‌دهد که خود ایجاد کرده است و هر چه این تظاهر افزایش می‌یابد، توجه بیشتری به آن معطوف می‌شود. ما از یک طرح تجربی - اجتماعی در یک کلاس درس لیسانس استفاده کردیم تا این ذهنیت را با استفاده از یک روش آماری آزمایش کنیم. فضای سبزی نزدیک دریاچه به عنوان یک نمونه مورد استفاده قرار گرفت. نتایج ما موارد زیر را تایید کرد: ۱) در ۶۶٪ موارد و موضوعات نوع دوستانه رفتار شد، در حالی که باقیمانده (۳۴٪) خودخواهانه بود و نشان داد که تصورات اقتصادی ممکن است درست نباشد. ۲) هنگامی که این وضعیت در قطعات منابع طبیعی (برای مثال، فضای سبز) مورد بررسی قرار گرفت، انسانهای مقتصد ذی حقی که دارای پلات‌های بزرگتر بودند، در استفاده از منابع محتاط‌تر بودند. ۳) هنگامی که وضعیت‌های مختلف مقایسه شد، در جایی که وسعت تاثیر انسان مقتصد بر روی منابع طبیعی بزرگ و کوچک بود، آنهایی که تاثیر بیشتری داشتند، در استفاده از منابع محتاط‌تر بودند اگر چه علم اصلی اقتصاد اصلی فرض را بر این می‌گذارد که در مواردی که قرار است یک انسان مقتصد منطقی خود خواه باشد، رفتار نوع دوستانه بر رفتار خودخواهانه غالبیت پیدا می‌کند و اینکه این رفتار نوع دوستانه در هنگام سیاست‌گذاری باید مورد توجه بیشتری قرار گیرد.