<NOTE>A Note On The Policy For Health & Community Acceptance Of A LULU : Locally Undesirable Land Use

A Note On The Policy For Health & Community Acceptance Of A LULU (= Locally Undesirable Land Use)*

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Abstract

In this note the model of P.A. Groothuis, G.V. Houtven and J.C. Whitehead (1998) which analyzed the siting of LULU has been generalized. In the model it is assumed that the level of income does not depend on the health status, and medical expenditure in the case of poor health is implicitly neglected in the model. It is also assumed in the model that the siting of the hazardous waste facility effects only on the perceived probability of the poor health. However, it is plausible to suppose that not only the probability of the poor health but also the degree of required medical expenditure in the case of poor health will be affected by the siting of the hazardous waste facility.

In this note labor income which depends on the health status is taken into account. Medical expenditure in the case of poor health is also taken into consideration in generalized model of this note. In addition, the effect of siting the hazardous waste facility on the degree of required medical expenditure is also considered.

§ 1 Introduction

The purpose of this note is to generalize P.A. Groothuis, G.V. Houtven and J.C. Whitehead (1998)'s model which analyzed the siting of locally undesirable land use (LULU). In the model it is supposed that the probability of poor health is greater after the hazardous waste facility is sited. However, in the model it is implicitly assumed that the level of income does not depend on the health status. Medical expenditure in the state of poor health is neglected in the model. However, it is plausible to suppose that not only the probability of the poor health but also the degree of required medical expenditure in the poor health will be affected by

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the siting of the hazardous waste facility.

In the next section the model of P.A. Groothuis, G.V. Houtven and J.C. Whitehead (1998) will be summarized.

In section 3 the model will be generalized by taking not only non-labor income, but also labor income which depends on health status into consideration. In the generalized model the medical expenditure and medical insurance will also be considered.

Concluding remarks will be given in the last section.

§ 2 Groothuis, Houtven and Whitehead's Model

In this section the theoretical model of Groothuis, Houtven and Whitehead (1998) is summarized.

It is assumed that after a hazardous waste facility is sited, households face a perceived probability of good health of p_1. Without the hazardous waste facility, the perceived probability of good health is q_1.

If utility is additively separable in health and income, the utility associated with good health is

$$v(H=1, y) = h(1)+m(y), \qquad (1)$$

where H is exogenous health status, and y is income.
With poor health, the utility level is

$$v(H=0, y) = h(0)+m(y). \qquad (2)$$

The change in the expected utility is

$$\begin{aligned} Dv &= p_1(h(1)+m(y+A))+(1-p_1)(h(0)+m(y+A)) \\ &\quad -q_1(h(1)+m(y))-(1-q_1)(h(0)+m(y)) \\ &= m(y+A)-m(y)+(p_1-q_1)[(h(1)-h(0)], \end{aligned} \qquad (3)$$

where A is the amount of the compensation for the acceptance of LULU.

From (3) the following several important properties were derived in Groothuis, Houtven and Whitehead (1998);

$$\frac{\partial Dv}{\partial y} < 0, \tag{4}$$

if the marginal utility of income is diminishing with additional income, and with respect to the perceived probability of good health

$$\frac{\partial Dv}{\partial (p_1 - q_1)} > 0, \tag{5}$$

with respect to the level of compensation

$$\frac{\partial \mathrm{Dv}}{\partial \mathrm{A}} > 0. \tag{6}$$

Assuming a linear functional form[1)] the equation (3) is rewritten as

$$Dv = a(p_1 - p_2) + BA, \tag{7}$$

where $a = a_1 - a_0 > 0$, $B > 0$, and $p_2 = 1 - p_1$.

Assuming that accepting the WTA (=Willingness To Accept) amount of compensation allows the hazardous waste facility to be sited, the WTA was found[2)] in Groothuis, Houtven and Whitehead (1998) by solving $Dv = 0$,

$$WTA = \frac{(a_1 - a_0)}{B}(q - p_1), \tag{8}$$

which is positive because $a_1 > a_0$ and $q_1 > p_1$.

Hence, WTA does not depend on the income level.

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1) $v(H = 0, y + A) = a_0 + B(y + A)$,
$v = (H = 0, y) = a_0 + By$,
$v(H = 1, y + A) = a_1 + B(y + A)$,
$v = (H = 1, y) = a_1 + By$.

2) Groothuis, Houtven and Whitehead (1998) assumed other functions than (7). However, those functions were not derived explicitly from the analysis.

§ 3 Generalized Model

The model of Groothuis, Houtven and Whitehead which is summarized in § 2 will be generalized in the following. In the Groothuis, Houtven and Whitehead's model it is assumed that only the probability of health is affected by the siting of the hazardous waste facility. However, it is plausible to suppose that not only the probability of poor health but also the degree of required medical expenditure in the state of poor health will be affected by the siting of the hazardous waste facility. Hence, the medical expenditure and medical insurance will also be taken into consideration in the following generalized model.

The assumption that the level of income does not depend on the health status is also unrealistic. Therefore in the following generalized model labor income will also be considered in addition to non-labor income.

Taking labor income, medical expenditure and medical insurance into account, the generalized $\widetilde{WTA}$ can be derived[3] to be

$$\widetilde{WTA} = \left(\frac{a_1 - a_0}{B} + wl + \rho M \right) (q_1 - p_1) + (1 - p_1) \rho \alpha M, \tag{9}$$

where wl is labor income, M is medical expenditure, ρ is the rate of self-payment, α is the degree of increase in medical expenditure due to the hazardous waste facility.

(9) corresponds to (8) when the labor income, wl, is zero and the self-payment of medical expenditure, ρM, is zero.
From(9)

$$\frac{\partial \widetilde{WTA}}{\partial wl} = q_1 - p_1 > 0. \tag{10}$$

Hence, even if linear functional form for utility function is assumed, the $\widetilde{WTA}$ depends on a part of income, i.e., the labor income, though WTA in section 2 does not depend on the income at all.

Several other properties can also be derived.

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3) See Mathematical Appendix 1.

$$\frac{\partial W\tilde{T}A}{\partial \rho} = M(q_1 - p_1) > 0, \tag{11}$$

$$\frac{\partial W\tilde{T}A}{\partial M} = \rho(q_1 - p_1) + (1 - p_1)\rho\alpha > 0, \tag{12}$$

$$\frac{\partial W\tilde{T}A}{\partial \alpha} = (1 - p_1)\rho M > 0, \tag{13}$$

$$\frac{\partial W\tilde{T}A}{\partial q_1} = \frac{a_1 - a_0}{B} + wl + \rho M > 0, \tag{14}$$

$$\frac{\partial W\tilde{T}A}{\partial p_1} = \frac{-(a_1 - a_0)}{B} - wl - \rho(1 + \alpha)M < 0. \tag{15}$$

From (11) and (12) the following results can be obtained. The higher the rate of self-payment with respect to medical expenditure, the higher the $W\tilde{T}A$ amount. The higher the medical expenditure, the higher the $W\tilde{T}A$ amount.

Especially even if $q_1 = p_1$, $W\tilde{T}A$ is positive, though WTA is reduced to zero. The effect of self-payment rate on $W\tilde{T}A$ is similar to that of medical expenditure. However, in a special case where $q_1 = p_1$, the effects of self-payment rate and the medical expenditure are different;

$$\frac{\partial W\tilde{T}A}{\partial \rho} = 0 < \frac{\partial W\tilde{T}A}{\partial M} \quad if \quad q_1 = p_1 .$$

From(13) the effect of the increase in the medical expenditure due to the siting of the hazardous waste facility on $W\tilde{T}A$ is positive regardless of $q_1 > p_1$ or $q_1 = p_1$.

The positive effect of q_1 (i.e. the perceived probability of good health without the hazardous waste facility) on $W\tilde{T}A$ is similar to that of q_1 on WTA.

However, the effect of q_1 on $W\tilde{T}A$ is stronger than that of q_1 on WTA;

$$\frac{\partial W\tilde{T}A}{\partial q_1} = \frac{a_1 - a_0}{B} + wl + \rho M > \frac{a_1 - a_0}{B} = \frac{\partial WTA}{\partial q_1} .$$

In addition the negative effect of p_1 (i.e. the perceived probability of good health with the hazardous waste facility) on $\widetilde{\text{WTA}}$ is also similar to that of p_1 on WTA. The negative effect of p_1 on $\widetilde{\text{WTA}}$ is, however, stronger than that of p_1 on WTA;

$$\frac{\partial \widetilde{WTA}}{\partial p_1} < 0, \qquad \frac{WTA}{\partial p_1} < 0$$

and

$$\left|\frac{\partial \widetilde{WTA}}{\partial p_1}\right| = \frac{a_1 - a_0}{B} + wl + (1+\alpha)\rho M > \frac{a_1 - a_0}{B} = \left|\frac{\partial WTA}{\partial p_1}\right|.$$

The following result can also be obtained.
The effects of q_1 and p_1 on WTA are symmetric in a sense that

$$\frac{\partial WTA}{\partial q_1} = \left|\frac{\partial WTA}{\partial p_1}\right|$$

even though the signs of $\partial WTA/\partial q_1$ and $\partial WTA/\partial p_1$ are reversed, while the effects of q_1 and p_1 on $\widetilde{\text{WTA}}$ are asymmetric since

$$\frac{\partial \widetilde{WTA}}{\partial q_1} < \left|\frac{\partial \widetilde{WTA}}{\partial p_1}\right|.$$

These asymmetric effects of q_1 and p_1 are brought by the consideration that the siting of hazardous waste facility will affect not only the probability of poor health but also the degree of required medical expenditure in the case of the poor health.

From (8) and (9) the following important result is also derived straightforwardly;

$$\widetilde{WTA} > WTA > 0.$$

Hence adding realism to Groothuis, Houtven and Whitehead's model implicates that the policy in order to gain community acceptance of a LULU requires a higher budget than that derived by them.

§ 4 Concluding Remarks

In this note the model of P.A. Groothuis, G.V. Houtven and J.C. Whitehead (1998) which analyzed the siting of LULU has been generalized. In the model it is assumed that the level of income does not depend on the health status, and medical expenditure in the case of poor health is implicitly neglected in the model. It is also assumed in the model that the siting of the hazardous waste facility effects only on the perceived probability of the poor health. However, it is plausible to suppose that not only the probability of the poor health but also the degree of required medical expenditure in the case of poor health will be affected by the siting of the hazardous waste facility. If possible, we should avoid siting any hazardous facility. However, if it is inevitable to site it, undesirable effects on health and welfare should not be overlooked.

In this note labor income which depends on the health status is taken into account. Medical expenditure in the case of poor health is also taken into consideration in generalized model of this note. In addition, the effect of siting the hazardous waste facility on the degree of required medical expenditure is also considered. Adding realism to the Groothuis, Houtven and Whitehead's model has led to the following main results:

(1) the positive effect of q_1 (i.e. the perceived probability of good health without the hazardous waste facility) on $\widetilde{WTA}$ (i.e. Willingness To Accept amount of compensation in the generalized model) is stronger than that of q_1 on WTA (i.e. Willingness To Accept amount of compensation in Groothuis, Houtven and Whitehead's model).

(2) the negative effect of p_1 (i.e. the perceived probability of good health with the hazardous waste facility) on $\widetilde{WTA}$ is stronger than that of p_1 on WTA,

(3) the effects of q_1 and p_1 on $\widetilde{WTA}$ are asymmetric though the effects of them on WTA are symmetric,

(4) $\widetilde{WTA} > WTA$, which implicates that in order to gain community acceptance of a LULU a higher budget is required if the realism is added to the Groothuis, Houtven and Whitehead's model.

Mathematical Appendix 1

Utility possibilities corresponding to the footnote 1) are

$$\tilde{v}\,(H=0,\ y+A-r-\rho(1+\alpha)M) = a_0+B\{y+A-r-\rho(1+\alpha)M\},$$

where r is insurance premium, ρ is self-payment rate of medical expenditure, $\alpha(>0)$ is the degree of medical expenditure increment du to the siting of the hazardous waste facility and M is medical expenditure.

$$\tilde{v}\,(H=0,\ y-r-\rho M) = a_0+B(y-r-\rho M),$$

$$\tilde{v}\,(H=1,\ y+A+wl-r) = a_1+B(y+A+wl-r),$$

$$\tilde{v}\,(H=1,\ y+wl-r) = a_1+B(y+wl-r).$$

$$\begin{aligned} D\tilde{v} = {} & p_1\{a_1+B(y+A+wl-r)\} \\ & +(1-p_1)\,[\,a_0+B\{y+A-r-\rho\,(1+\alpha)M\}\,] \\ & -\ q_1\{a_1+B(y+wl-r)\}\,. \\ & -(1-q_1)\{a_0+B(y-r-\rho M)\}\,. \end{aligned}$$

Solving $D\tilde{v}=0$ yields (9).

REFERENCES

Peter A. Groothuis, George Van Houtven and John C. Whitehead, "Using contingent valuation to measure the compensation required to gain community acceptance of a LULU: the case of a hazardous waste disposal facility", *Public Finance Review*, vol. 26, No. 3, May 1998.