<ARTICLE>Health & Siting Of Locally Undesirable Facility Under A Given Budget

Health & Siting Of Locally Undesirable Facility Under A Given Budget*

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§ 1 Introduction

The purpose of this paper is to examine the policy of siting of hazardous waste facility under a given budget. Groothuis, Houtven and Whitehead (1998) have analyzed the siting of locally undesirable land use (LULU). However, in the model it is assumed that the level of income does not depend on the health status. In addition, medical expenditure in the case of poor health is implicitly neglected in the model.

In Watanabe (1999) labor income which depends on the health status and the medical expenditure due to poor health have been taken into consideration in order to generalize the model of Groothuis, Houtven and Whitehead (1998). Generalizing the model has yielded the following result : in order to gain community acceptance of a LULU a larger budget is required when realism is added to Groothuis, Houtven and Whitehead's model. In addition it has also been derived that the effects of q_1 ((i.e.) the perceived probability of good health without the hazardous waste facility) and p_1 ((i.e.) that of good health with the hazardous waste facility) on the amount of compensation required for the siting of the hazardous waste facility, though symmetric in Groothuis, Houtven and Whitehead's model, are asymmetric in the generalized model.

In the next section I will examine a model to allocate a given budget between the compensation and the expenditure for lowering the probability of poor health as well as reducing the increase in medical costs due to the siting of the hazardous waste facility.

Concluding remarks will be given in the last section.

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§ 2 Compensation and Variable Probability of Poor Health

In this section allocation of a given government budget, G, between the compensation, A, and the expenditure, R, for lowering the probability of poor health and for reducing the increase, $\alpha(R)$, in medical costs, M, due to the siting of the hazardous waste facility will be analyzed.

Supposing that the perceived probability of good health with a hazardous waste facility can be reduced by government expenditure, then the perceived probability (P_1) of good health with the hazardous waste facility is

$$P_1 = P_1(R), \tag{1}$$

where R is the preventive expenditure by the government, $dP_1/dR > 0$ and $dP_1^2/d^2R < 0$ are assumed.

Assuming a similar linear functional form for utility function as Groothuis, Houtven and Whitehead (1998) in combination with previously mentioned relation (1) yields the following expected utility :

$$\begin{aligned} E = {} & P_1(R)\{a_1 + B(y + wl - r + G - R)\} \\ & + (1 - P_1(R))[a_0 + B\{y - r + G - R - \rho(1 + \alpha(R))M\}], \end{aligned} \tag{2}$$

where y is the non-labor income, w is the wage rate, l is the labor time, r is the insurance premium, G is the given budget, R is the expenditure for lowering the probability of poor health as well as reducing the increase in medical costs due to the siting of the hazardous waste facility, ρ is the self-payment rate of insurance, α is the degree of increase in medical expenditure due to the hazardous waste facility which is dependent on R, and M is medical costs.

The equation (2) is reduced to

$$\begin{aligned} E = {} & B(y - r + G - R) + P_1(R)(a_1 + Bwl) \\ & + (1 - P_1(R))\{a_0 - B\rho(1 + \alpha(R))M\}. \end{aligned} \tag{3}$$

Differentiating (3) with respect to R yields

$$\frac{dE}{dR} = -B+P_1'(R)(a_1+Bwl)-P_1'(R)\{a_0-B\rho(1+\alpha(R))M\}$$
$$-(1-P_1(R))B\rho\alpha'(R)M$$
$$= 0. \qquad (4)$$

Second order condition is satisfied,

$$\frac{d^2E}{dR^2} = E_{RR} = P_1''(R)\{a_1-a_0+Bwl+B\rho(1+\alpha(R))M\}$$
$$+2P_1'(R)B\rho\alpha'(R)M$$
$$-(1-P_1(R))B\rho\alpha''(R)M<0, \qquad (5)$$

where $a_1 > a_0$, $P_1'(R)>0$, $P_1''(R)<0$, $\alpha'(R)<0$ and $\alpha''(R)>0$ are assumed.

From (4) the following important properties with respect to labor income and medical costs can be derived ;

$$\frac{\partial R}{\partial wl} = \frac{-E_{Rwl}}{E_{RR}} > 0, \qquad (6)$$

where $E_{RR}<0$ from (5) and

$$E_{Rwl} = \frac{\partial^2 E}{\partial R\partial wl} = P_1'(R)B>0 \text{ since } P_1'(R)>0 \text{ is assumed,}$$

$$\frac{\partial R}{\partial M} = \frac{-E_{RM}}{E_{RR}} > 0, \qquad (7)$$

where $E_{RR}<0$ from (5) and

$$E_{RM} = \frac{\partial^2 E}{\partial R\partial M} = P_1'(R)B\rho(1+\alpha(R))$$
$$-(1-P_1(R))B\rho\alpha'(R) > 0, \text{ since}$$

$\alpha'(R)<0$ and $P_1'(R)>0$ are assumed, and

$$\frac{\partial R}{\partial \rho} = \frac{-E_{R\rho}}{E_{RR}} > 0, \qquad (8)$$

where $E_{R\rho} = P_1'(R)B(1+\alpha(R))M-(1-P_1(R))B\alpha'(R)M>0$, since $P_1'(R)>0$, $\alpha'(R)<0$ are assumed and $E_{RR}<0$ from (5).

Hence, the following results have been derived from (6), (7) and (8) ; R, which maximizes the household utility with hazardous waste facility

under the condition of a given budget, increases when there is an increase in labor income, medical costs, or the self-payment rate of insurance.

Similarly from the assumption of a given budget the following properties will also be derived ; from (6)

$$\frac{\partial A}{\partial wl} = \frac{\partial [G-R]}{\partial wl} < 0, \tag{9}$$

where G is the given budget, and from (7)

$$\frac{\partial A}{\partial M} < 0, \tag{10}$$

where $A = G-R$, and from (8)

$$\frac{\partial A}{\partial \rho} < 0, \tag{11}$$

where $A = G-R$ and G is the given budget.

Hence from (9), (10) and (11) it can be derived that an increase in the labor income, medical costs, or the self-payment rate of insurance will decrease the amount of compensation allocated from a given budget.

P_1 is an increasing function of R, but α is a decreasing function of R. Therefore the effects on P_1 and α of wl, M and ρ can also be obtained straightforwardly ;

$$\frac{\partial P_1}{\partial wl} > 0, \quad \frac{\partial \alpha}{\partial wl} < 0, \tag{12}$$

$$\frac{\partial P_1}{\partial M} > 0, \quad \frac{\partial \alpha}{\partial M} < 0, \tag{13}$$

and

$$\frac{\partial P_1}{\partial \rho} > 0, \quad \frac{\partial \alpha}{\partial \rho} < 0. \tag{14}$$

Hence the perceived probability of good health will be increased by an increase in R caused by the increase in the labor income, the medical costs, or the self-payment rate of insurance. In addition, the degree of increase in medical costs due to the hazardous waste facility can be

decreased.

With respect to the non-labor income, y, and the insurance premium, r, it can also be derived straightforwardly that they do not affect R which maximizes the utility of household with hazardous waste facility under a given budget. Hence, the perceived probability of good health, P_1, and the degree of an increase in medical costs, α, which depends on R will not be affected by the non-labor income and the insurance premium.

Therefore the optimal allocation of a given budget between R and A will not depend on the non-labor income and the insurance premium, though it depends on the labor income, medical costs and the self-payment rate of insurance.

The results derived in this section can be summarized in the following Table 1.

TABLE 1

	R	A	P_1	α
wl	[+]	[−]	[+]	[−]
y	[0]	[0]	[0]	[0]
M	[+]	[−]	[+]	[−]
r	[0]	[0]	[0]	[0]
ρ	[+]	[−]	[+]	[−]

§ 3 Concluding Remark

In this paper the policy to allocate the given budget between the compensation and the expenditure in order to raise the perceived probability of good health and reduce the increase in medical costs due to the siting of the hazardous waste facility has been analyzed.

The main results are :

(a) in order to maximize the utility of households with hazardous waste facility under a given budget, the expenditure (to raise the perceived probability of good health and reduce the degree of an increase in medical cost due to the siting of the hazardous waste facility) must be increased when there is an increase in labor income, medical expenditure,

or the self-payment rate of insurance,

(b) on the other hand, the allocation to the compensation, A, from the given budget, G, must be decreased if the labor income, the madical costs, or the self-payment rate of insurance increases,

(c) the variation in non-labor income or insurance premium will not affect the optimum allocation of the given budget between the compensation and the expenditure for decreasing the probability of poor health and reducing the increase in medical expenditure due to the siting of the hazardous waste facility.

Needless to say, if possible, we should avoid siting any hazardous facility. However, if it is inevitable to site the hazardous facility under a given government budget, the allocation of the given budget between the compensation and the expenditure in order to decrease the probability of poor health and reduce the increase in medical costs due to the siting of the hazardous waste facility will be important.

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