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## Article

# Who should make plans for land development?

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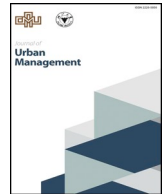
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## Editorial

## Who should make plans for land development?



## 1. Introduction

Before acting in an uncertain world, a rational decision maker needs to gather information about his/her environment in order to guide his or her choices of which actions to take. It is well known that this process can be formulated in a decision tree as an experiment of sampling procedure to explain the value of the information gathered (Raiffa, 1968). Little has been said, however, that the same formulation can be used to explain the value of making a plan (exceptions include Hopkins, 1981 and Schaeffer and Hopkins, 1987). In other words, the value of making plans is equivalent to that of the information sampled in the decision tree. Any information or plan that is made known to the public is a public good. Information can, however, be kept secret or private, and the strategies that information owners use to manipulate the availability and use of such information will yield different outcomes because of how information affects actions. Consider a society formed by a set of developers and a local government, with each individual party within the society making his/her or its own plans aimed at yielding specific benefits, e. g., increased profits. Most planners tend to presume that the local government makes plans so that individual developers will act in light of these plans (Knaap, Hopkins & Donaghy, 1998). There is, however, no theoretical backing for this presumption. Rather, there can be two extremes with respect to the making of plans in such a society. Under one extreme, the local government does not make plans to influence the individual developers' behavior, so the individual developers make their own plans in initiating land development projects, a situation which is reminiscent of a permit system. Under the other extreme, the local government does make such plans and the individual developers are informed of the contents of these plans and act accordingly, a situation which is reminiscent of a zoning system. The immediate question of interest, then, is: Who should make plans for land development? In other words, is it worth it for the local government to make such plans, under the assumption that these plans are usually made public? The distinction between making plans and gathering information is subtle, but they are considered to be equivalent in the present editorial.

Information economics provides a useful analytic tool for formulating these types of situations and, in turn, answering the question posed above. For example, Hirshleifer (1971) compares the private and social value of information using a numerical example based on utility theory, and argues that the social value of information is useless in a pure exchange case. In the context of some nonzero sum games, Levine and Ponssard (1977) classify information into secret, private, and public information, and provide numerical examples to argue that private and public information might be detrimental to the game players' payoffs. Following Levine and Ponssard's classifications, Hopkins (1981) uses games to explain why making plans is like a prisoner's dilemma game, and argues that plans themselves are public goods. Schaeffer and Hopkins (1987) further use information economics as an analytic tool to incorporate rights into their model in order to describe how plans are made by a developer in a land development project. Lai (2002) provides a normative model using the notion of information structures in team theory to prove that the information gathered in making plans should be both payoff relevant and accurate. All these works focus either on the value of information or on individual decision making, but some of them may provide a theoretical basis from which we can investigate whether the making of plans by a local government is desirable.

## 2. The land development model under uncertainty for a single developer

I consider land development to consist of a form of sequential decision making aimed at the manipulation of rights in light of the information gathered in order to gain profit in the process (Lai, 2001). Rights are defined here as economic rights, not legal rights (e.g., Webster and Lai, 2003 and Barzel, 1999). In the exchange and/or improvement of land through construction, a developer is motivated to acquire rights that mainly remain in the public domain. For example, two land owners who develop lands near each

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other would be motivated to negotiate to provide open space, including rights to access which are left in the public domain, but only to their own advantages. Assume that there are  $m$  types of land development for a parcel of land, such as retail, residential, and so on, and, for simplicity, that there is, in addition to the current time period denoted as 0, one future period of concern denoted as 1. Following [Hirshleifer \(1971\)](#), the utility for a combination of the rights acquired in the two periods and the expected utility for the developer taking into account all possible development alternatives are as follows.

$$U = \pi_1 u(r_0, r_{11}) + \pi_2 u(r_0, r_{12}) + \pi_3 u(r_0, r_{13}) + \dots + \pi_m u(r_0, r_{1m}) = \pi_1 (v_0 + \theta v_{11}) + \pi_2 (v_0 + \theta v_{12}) + \pi_3 (v_0 + \theta v_{13}) + \dots + \pi_m (v_0 + \theta v_{1m}) = v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \pi_3 v_{13} + \dots + \pi_m v_{1m}), \quad (1)$$

where  $U$  is the expected utility of the developer;  $\pi_i$  is the probability that the developed land is in use  $i$ ;  $u$  is the sure utility for a combination of the two consecutive periods of rights;  $r_0$  is the right to develop in period 0;  $r_{1i}$  is the right to develop for use  $i$  in the future period of 1;  $v_0$  is the value of the right to develop  $r_0$  in period 0;  $v_{1i}$  is the value of the right to develop  $r_{1i}$  in period 1; and  $\theta$  is the preference parameter for the developer.

Assume further that the value function in relation to the right acquired  $r$  is  $v(r) = \log_e r$ , and that the total wealth of the developer is  $W$ . The utility maximization problem faced by the developer can be formulated as follows:

$$\text{Max } U = v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \pi_3 v_{13} + \dots + \pi_m v_{1m}) \text{ s. t. } P_0 r_0 + P_{11} r_{11} + P_{12} r_{12} + \dots + P_{1m} r_{1m} = W, \quad (2)$$

where  $\theta$  is a constant representing the preference parameter for the developer;  $P_0$  is the price per unit of land right at period 0;  $P_{1i}$  is the price per unit of land right under use  $i$  at period 1;  $W = \bar{W}$  is the total wealth of the developer and thus a constant.

Applying the Lagrangean approach, we can obtain

$$L = v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \pi_3 v_{13} + \dots + \pi_m v_{1m}) - \lambda [P_0 r_0 + P_{11} r_{11} + P_{12} r_{12} + \dots + P_{1m} r_{1m} - \bar{W}] \quad (3)$$

The first derivatives of the Lagrangean formula are:

$$\begin{aligned} \frac{\partial L}{\partial r_0} &= v'_0 - \lambda P_0 = 0 \text{ and } v'_0 = \lambda P_0, \quad \frac{\partial L}{\partial r_{11}} = \theta \pi_1 v'_{11} - \lambda P_{11} = 0, \quad v'_{11} = \frac{\lambda P_{11}}{\theta \pi_1}, \quad \frac{\partial L}{\partial r_{12}} = \theta \pi_2 v'_{12} - \lambda P_{12} \\ &= 0, \quad v'_{12} = \frac{\lambda P_{12}}{\theta \pi_2}, \quad \dots, \quad \frac{\partial L}{\partial r_{1m}} = \theta \pi_m v'_{1m} - \lambda P_{1m} = 0, \quad v'_{1m} = \frac{\lambda P_{1m}}{\theta \pi_m}, \quad \frac{\partial L}{\partial \lambda} = P_0 r_0 + P_{11} r_{11} + P_{12} r_{12} + \dots + P_{1m} r_{1m} - \bar{W} = 0. \end{aligned} \quad (4)$$

Assume that the land right in period 0,  $r_0$ , is known and that  $P_0$ , the price per unit of land right in period 0, is equal to unity, so from (4),  $\lambda = v'_0$ . Substituting this result into the derivatives above, we can obtain

$$v'_{11} = \frac{v'_0 P_{11}}{\theta \pi_1} \text{ and } P_{11} = \frac{\theta \pi_1 v'_{11}}{v'_0}; \quad v'_{12} = \frac{v'_0 P_{12}}{\theta \pi_2} \text{ and } P_{12} = \frac{\theta \pi_2 v'_{12}}{v'_0}; \quad \dots, \quad v'_{1m} = \frac{v'_0 P_{1m}}{\theta \pi_m} \text{ and } P_{1m} = \frac{\theta \pi_m v'_{1m}}{v'_0}.$$

Knowing that  $v = v(r) = \log_e r$ , taking derivatives with respect to  $r$ , we have

$$v'_0 = \frac{\partial v(r_0)}{\partial r_0} = \frac{1}{r_0}; \quad v'_{11} = \frac{\partial v(r_{11})}{\partial r_{11}} = \frac{1}{r_{11}}; \quad \dots, \quad v'_{1m} = \frac{\partial v(r_{1m})}{\partial r_{1m}} = \frac{1}{r_{1m}}.$$

In general terms, the optimal land right acquired for the developer in period 1 should be:

$$r_{1i} = \frac{\theta r_0 \pi_i}{P_{1i}}, \text{ where } i = 1, 2, 3, \dots, m. \quad (5)$$

The land right acquired in the future period 1 for type  $i$  depends on the land right acquired initially in period 0 and the probability that type  $i$  development would be obtained.

### 3. Social utility under four different planning situations

Assume that there are  $n$  developers and that the overall social utility can be derived from the addition of individual utilities across all the  $n$  developers. Four planning situations are considered: (1) neither the developers nor the local government acquire information; (2) some developers acquire information and the local government does not provide information; (3) all developers acquire information but the local government does not provide information; and (4) only the local government provides information.

#### 3.1. Neither developers nor the local government acquire information

Under such a situation, the overall social utility is the sum of the individual utilities as depicted below:

$$\begin{aligned} \sum_{j=1}^n U &= [v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \dots + \pi_m v_{1m})] + [v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \dots + \pi_m v_{1m})] \\ &\quad + \dots + [v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \dots + \pi_m v_{1m})] = n [v_0 + \theta (\pi_1 v_{11} + \pi_2 v_{12} + \dots + \pi_m v_{1m})] \\ &= n v_0 + n \theta \sum_{i=1}^m \pi_i v_{1i} = n \log_e r_0 + n \theta \sum_{i=1}^m \pi_i \log_e \frac{\theta r_0 \pi_i}{P_{1i}} = n \log_e r_0 + \frac{n \theta}{m} \sum_{i=1}^m \log_e \frac{\theta r_0 \pi_i}{P_{1i}} \end{aligned} \quad (6)$$

Note that when there is no information,  $\pi_1 = \pi_2 = \pi_3 = \dots = \pi_m = \frac{1}{m}$ .

### 3.2. $k$ among $n$ developers acquire information

If  $k$  among  $n$  developers can foresee that type 1, or any other of the  $m$  types, for that matter, will obtain, they will invest all their endowment to develop type 1 use. For those who do not have such information, the probability that any of the  $m$  types of use would obtain is  $\frac{1}{m}$ . For the  $k$  developers who acquire the complete information, the individual utility  $U$  is equal to  $v_0 + \theta v_{11}$ , while for those  $m - k$  developers who do not have such information, the individual utility  $U$  is equal to  $v_0 + \frac{\theta}{m} \sum_{i=1}^m v_{1i}$ . The social utility under such a situation is:

$$\begin{aligned} \sum_{j=1}^n U &= (v_0 + \theta v_{11}) + (v_0 + \theta v_{11}) + \dots + (v_0 + \theta v_{11}) + (v_0 + \frac{\theta}{m} \sum_{i=1}^m v_{1i}) + (v_0 + \frac{\theta}{m} \sum_{i=1}^m v_{1i}) + \dots + (v_0 + \frac{\theta}{m} \sum_{i=1}^m v_{1i}) \\ &= k(v_0 + \theta v_{11}) + (n - k)(v_0 + \frac{\theta}{m} \sum_{i=1}^m v_{1i}) = nv_0 + k\theta v_{11} + (n - k)\frac{\theta}{m} \sum_{i=1}^m v_{1i} \\ &= n \log_e r_0 + k\theta \log_e r_{11} + \frac{(n - k)\theta}{m} r_{1i} = n \log_e r_0 + k\theta \log_e \frac{\theta r_0 \pi_1}{P_{11}} + \frac{(n - k)\theta}{m} \sum_{i=1}^m \log_e \frac{\theta r_0 \pi_i}{P_{1i}} \end{aligned} \quad (7)$$

### 3.3. All developers acquire private information

In this situation, all  $n$  developers acquire complete information that type 1 use will obtain. The overall social utility under such a situation is:

$$\begin{aligned} \sum_{j=1}^n U &= (v_0 + \theta v_{11}) + (v_0 + \theta v_{11}) + \dots + (v_0 + \theta v_{11}) = n(v_0 + \theta v_{11}) = n(\log_e r_0 + \theta \log_e r_{11}) \\ &= n \left( \log_e r_0 + \theta \log_e \frac{\theta r_0 \pi_1}{P_{11}} \right) \end{aligned} \quad (8)$$

### 3.4. The local government provides public information

In this case, all  $n$  developers acquire complete information due to the information that is publicly provided by the local government. The overall social utility is the same as that under the situation where all developers acquire private information. That is,

$$\sum_{j=1}^n U = n \left( \log_e r_0 + \frac{\theta}{m} \log_e \frac{\theta r_0 \pi_1}{P_{11}} \right) \quad (9)$$

Note that the social utility in this situation would be different from that in situation 3.1 if information cost is considered, as will be depicted in the next section.

## 4. Conclusions

Based on information economics, we have depicted four planning situations in terms of social utility: (1) no information is acquired or provided by developers or the local government; (2) partial information is acquired by developers although no information is provided by the local government; (3) complete information is acquired by developers even though no information is provided by the local government; and (4) no private information is acquired by developers but they all have complete information due to the information provided by the local government. It is arguably true that, in the real world, all developers acquire information with or without information provision by the local government, a situation which is reminiscent of a mix of permit systems and zoning systems. However, a direct comparison between Eqs. 8 and 9 implies that permit systems would yield more social utility than zoning systems, and indeed, permit systems in which the tit-for-tat strategy might prevail tend to yield higher social welfare (Lai and Chiu, 2017). This implication stands in contrast to the fact that zoning systems prevail in most cities. This contrast might be caused, however, by failing to incorporate planning costs in my analysis. Intuitively, permit systems would give rise to higher planning costs than zoning systems because individual developers would invest more in plan making in the former systems than the latter. Therefore, it would be interesting to incorporate planning costs in the current formulation to make more conclusive claims in the future about who should make plans for land development.

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