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**Economics of Vested Rights: Designing a Mechanism for Reallocating Land
by means of Insurance, Compensation and Supply-Price Revelation**

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I. Introduction

This paper deals with a category of vested rights: land ownership. We will attempt to design an economic mechanism to reallocate land for the benefit of the society without excessively hurting or benefiting the owner of the land to be reallocated and with relatively low transactions cost. Reallocation of land for the benefit of the society executed by the government is called *taking* or *forced acquisition* of land. We propose a mechanism which is formed by combining a scheme of insurance and compensation and a scheme of supply-price revelation. The mechanism can bring forth a way to achieve forced acquisition of land through economic means, that is, without exercising a direct administrative power. It may be considered as a price mechanism for reallocating land for the benefit of the society.

In the following section (Section II), a summary of the background and the motivation of this paper is given. Section III is devoted to describing the mechanism to be proposed in this paper. The mechanism will be called in this paper “System for Reallocating Land by means of Insurance, Compensation, and Supply-Price Revelation,” to be abbreviated as “**RIC-L**.” In Section IV, we propose to establish public agencies of which the main objective is to run a RIC-L. Section V summarizes the expected outcome of implementing a RIC-L, and the last section (Section VI)

discusses briefly about what would be the process of transition from the current state to the state in which a RIC-L prevails.

II. Background

We begin with considering the economic characteristics of land. We then summarize the outcomes from the current system for forced acquisition of land and those from the current system of land zoning, which is a way of reallocating land and has a close relation to forced acquisition.

Land is an economic resource. It is a non-reproducible, non-depleting natural resource with limited supply. A lot or a block of land has boundaries and size. As such, land may be considered to be of a category of *space resources*. Land can be an object of market transactions as other goods and services are; it can be bought, sold, rented, or leased. For this matter, the principle of demand and supply holds with transactions of land.

Land can be used, as other economic resources, for various purposes. The value of land depends on how and for what purposes it is used. To use it, we need to make investment such as construction or cultivation. The (physical) capital formed from such investment may not be recovered fully and becomes a *sunk cost*, although a portion of money spent on the investment may be recovered if the land is sold together with the capital.

As we know well, the value of land depends not only on how and for what purposes it is used but also on where it is located, i.e., on the state of other blocks of land located, and the economic activities conducted, near to it. This is called “externality” in determining the value of land. For this reason, there is no perfect substitute for any piece of land, and its value may increase or decrease despite that the way it is used is unchanged. Further, it is possible that a specific piece of land happens to be located in a strategic position to some project so that whether that piece of land can or cannot be used for the project is crucial to its success or failure. The issue of forced acquisition

arises when such a project is considered to bring a significant benefit to the society and promoted by the government.

In Japan, as in other countries, the private ownership of land is protected constitutionally to the extent that it is consistent with “the public interest.” This means that a privately owned piece of land may be legally *taken* by the government (*forced acquisition*), if justified by a public interest and if the owner of the land is “compensated properly”. There is no simple rule or criterion, however, as to determining the extent of justifiable forced acquisition of land by the government and the extent of a proper compensation.

Thus, when the need for acquiring a piece of land by the government arises, we almost always see a direct confrontation between the owner of the land and the government. The owner tends to claim compensation as high as possible, insisting that the land is valuable to him/her for various reasons. Nobody knows to what extent the owner is honest in doing this. The government, representing the interest of the general public, attempts to acquire the land at a cost as low as possible. Negotiations between the two are difficult and take a long time; the process of forced acquisition of land by the government thus incurs a large amount of transactions cost, not to mention other undesirable outcomes from long and difficult confrontation. Further, because of such difficulties, the government obtains an incentive to avoid from attempting forced acquisition of land and to choose an alternative way, even if it is more costly to the society, for an important public project.¹

The objective of this paper is to propose a mechanism by means of which, when forced

¹ A typical example was the construction of metropolitan airports in Japan. The construction of the New Tokyo International Airport (Narita) started in the 1960's; it is still not completed in 2007 because of the severe confrontation between the Japanese government and a few number of Narita farmers (and their allies) who own pieces of land located within the area designated for the airport. After this failure, the Japanese government chose to construct two metropolitan airports (Kansai and Chubu) both on reclaimed land near to the seashore, not by taking land from private owners.

acquisition of land is attempted, both the owner of it and the government can save from such transactions cost. It is expected that, once RIC-L is implemented, the barriers to forced acquisition of land will be removed; it will become possible for the government to promote public projects, large or small, which bring forth benefits to the society but only with reallocation of privately-owned land.

Zoning of land is closely related to forced acquisition of land. Zoning regulations restrict, for the benefit of the society (or the community), the way in which a block (zone) of land is used; for example, a block may be designated for residential use, another for commercial use, and so on. The need for zoning arises from the externalities among land blocks located closely; zoning is useful more in urban areas than in rural areas and usually zoning regulation is a part of city or metropolitan planning.

From the standpoint of landowners, zoning may be regarded as a partial restriction of the right of using land, whereas forced acquisition is a total restriction (i.e., taking) of the right. For this reason, we intend in this paper to design a mechanism dealing with the issues of forced acquisition and zoning simultaneously.

Land ownership is a category of vested rights. In general, when an economic agent, individual or group, holds a vested right on some object, the agent is entitled to enjoy some net benefit from holding that object. The agent, then, has an incentive to keep the vested right with it, and tends to act, economically or otherwise, to protect it.

There are many categories of vested rights as characterized above. Land ownership is but one of them. When the object of a vested right is a portion of some *space* so that the object has boundaries and size, such vested right shares many characteristics of the vested right on the land space, i.e., the land ownership. In that case, it is possible to apply at least the main principles underlying the mechanism to be proposed in this paper to reallocate such a vested right. An

example is the right to use radio spectrum (for telecommunications, broadcasting, and others).

Spectrum right (terrestrial spectrum right, to state more precisely) is the right to use a portion of the surface of the earth electromagnetically, whereas land ownership is the right to use a portion of the surface of the earth physically. Thus, for reallocating spectrum, one may consider spectrum spaces in as much the same way as one considers land spaces, and may use a mechanism similar to the one proposed in this paper.²

There are vested rights of which the object is not a physical space with boundaries and size but an abstract one. Some mechanism similar to the one proposed in this paper may still be, but not always, applied for “reallocating” such vested rights. Since the mechanism uses the principle of insurance and compensation, we should state the following to be necessary conditions for this: (1) that the number of the holders of the vested right in question is large, and (2) that the intended reallocation is directed only to a small number of the holders.

An example of the above is “layoff” of a portion of the labor force (reallocation of workers), temporary or permanent, within a large organization. In Japan, the practice of life-long employment prevails so that reallocation of workers in a business firm or in a government organization is extremely difficult. This may be a cause of low productivity of labor observed with business and governmental organizations in Japan during recent years. Introduction of a mechanism similar to the one proposed in this paper may contribute to conducting reallocation of workers in such organizations so as to improve labor productivity.

III. Mechanism for Reallocating Land by means of Insurance and Compensation (RIC-L)

A. Basic framework

In this section, we explain the basic framework of RIC-L. We first present it in its simplest

² See Oniki [2004].

setting, assuming that the landowner considered in this subsection uses the land by himself/herself.

In the following subsection, we deal with cases in which the land is used, sometimes indirectly, by parties other than the landowner. Further, the landowner to be considered in this subsection may be an individual person, a legal person such as an incorporated company, or a government organization.

We also assume that the time at which forced acquisition is executed is fixed from the beginning.

In one of the following subsections, we introduce a RIC-L which takes into account the issue of timing for executing forced acquisition.

To explain the operation of RIC-L, we present a set of behavioral rules for the landowner and also a set of behavioral rules for a government agency responsible to run it. For simplicity, we write down in this section the behavioral rules for the landowner and the government agency only to the extent that is needed to specify an abstract economic model of RIC-L; some of the details, particularly the matters which arise at the time of implementation, will be discussed later.

First of all, to a landowner, RIC-L is nothing but a mandatory insurance with compensation in regard to an event that the land is taken by the government agency. Each landowner declares an *amount of compensation* to be paid to him/her by the government agency if forced acquisition of the land takes place. The landowner pays an *insurance premium* (R) annually to the government agency, which is equal to the amount of compensation declared (C) multiplied by the rate of compensation premium (r) to be determined by the government agency. That is,

$$R = r \cdot C. \tag{3a.1}$$

We formalize the above for later reference:

RIC-L(1) (simple case):

The landowner declares compensation C and enters into an insurance contract with the government agency so that the landowner receives C if and only if the event of forced acquisition takes place. The landowner pays the insurance premium R annually for this. ■

The above setting implies that RIC-L(1) is a casualty insurance plan to the landowner, where a casualty in this case is the event that the ownership of the land is taken by the government agency. Figure IIIA.1 shows the transactions between the government agency and landowners before forced acquisition takes place, and Figure IIIA.2 shows those in which a small number of landowners are chosen as the target of forced acquisition.

As in ordinary insurance plans, the landowner faces a tradeoff in choosing an amount of compensation; to declare a large amount of compensation means that the owner will be benefitted if forced acquisition takes place with him/her, but the owner needs to pay a high insurance premium each year for this (and vice versa). The actual choice of compensation, of course, depends on the decision to be made by the landowner. In general, the compensation is equal to the amount of money with which the utility of the landowner without the land taken will be at least as great as the utility with the land, where the utility without the land depends on the landowner's choice of a plan for the future. For example, the landowner may choose to purchase a new piece of land for continuing his/her activities as without forced acquisition. The landowner may wish to lease land instead of purchasing one. Or, the landowner may plan to start a new business on the money paid as compensation. And so on. What we state at an abstract level is that the landowner will choose a plan for the future out of the set of possible plans on some principle of optimization. It is known in theory, however, that, given a *fair* insurance program in which the premium rate (r) is equal to the probability (π) of the event that forced acquisition takes place, a rational risk-averse landowner will choose a *complete* insurance plan in which the utility in the event of forced acquisition be equal to the utility in the event of no forced acquisition.³

It is seen that, in this system, the government plays the role of an insurance company. First, the government agency determines a rate of compensation premium, r . The principle according to

³ See, e.g., Mas-Colell, et al. [1995], pp.187-188.

which the government agency chooses \mathcal{F} need to be discussed; we will do this in the following section. Second, the government agency maintains a budget of which the annual income is the sum of the insurance premiums paid by the landowners and the outlay is the sum of compensations paid to those landowners of whom the land is taken by the government agency. We will discuss later about the balance of the budget in relation to the behavioral rules for it.

We state that the government agency also performs a role which is not shared by an ordinary insurance company: reallocation of land. That is to say, the agency forms a plan of forced acquisition and executes it, i.e., makes a decision as to which land lot(s) should be taken for the public benefits. Needless to say, forced acquisition of land is done for some specific objective; examples are construction of a public school, expansion of a road, and so on. We again postpone the discussion of the rules which the government agency should follow in doing this. At this point, we only state that, given a particular objective of forced acquisition of land, the government agency should first form a set of alternative plans of forced acquisition satisfying the given objective (the set \mathcal{A} of admissible plans) and should then choose one from it so as to minimize the total amount of compensations (\mathcal{R}) to be paid to landowners (optimal plan \mathcal{B}).

Observe that, in an ordinary casualty insurance, a casualty is a random event on which either the insurer or the insureds have no control at all. In RIC-L, however, a forced acquisition of land is not a random event but an event controlled by the government agency. Some of the implications of this, including the possibility of speculation, will be discussed later.

Observe further that an amount of compensation declared by a landowner for an event of forced acquisition is the “supply price” of land in the sense that it is the least amount of money for which the landowner is willing to surrender the ownership of it. The collection of such supply prices may be regarded to form a supply schedule of land; we may state that RIC-L is a system in which the landowners reveal their supply prices of land.

Note that, in ordinary market transactions, not all supply prices are revealed; usually, only those prices near to the actual price used for transactions are revealed. In other words, we do not observe the entire supply schedule; what is observed is a portion of it near to the point at which actual transactions are conducted. In contrast to this, RIC-L is a system in which the entire supply schedule becomes observable to the government agency (and to the society, as will be discussed later). A small portion of the schedule is then designated by the government agency as the target for forced acquisition.

The reader may argue that the task of collecting, and operating on, the supply prices of land by the government agency for the use of forced acquisition is similar to the task of the government running a centralized economy in a socialist state without market mechanism; the transactions cost (administrative cost) to operate RIC-L will be quite high.⁴ The author agrees with this at least theoretically, but would like to point out that social systems of which the administrative cost is comparable to that of RIC-L are already at work in Japan and in other countries such as the health insurance system and the public pension system. Further, because of the rapid development of information technology in recent years, the cost of running such a social system is decreasing continuously and is expected to decrease further in the future; the matter of the cost of running RIC-L is important but does not seem to be a factor which makes its implementation difficult at the present time.⁵

⁴ Lange & Taylor [1938], Hayek [1945], and Hurwicz [1973]. Also see Oniki [1986] for an attempt to “measure” such cost.

⁵ In 2007, it was reported that the Japanese Pension Bureau had failed in keeping the data of the pension subscribers intact and had “lost” a significant portion of it at the time the Bureau introduced new information devices, was a couple of decades ago. The volume of the data in the pension system may be comparable to that in a RIC-L. Needless to say, the cause of the failure with the Bureau may not be limited to the volume of data; we will not step into such points here. We can state, at least, that information technology today can handle data of which the volume is far greater than of twenty years ago.

B. Extensions and variations of RIC-L

1. Joint ownership

In this subsection, we extend RIC-L(1) to a number of cases in which the assumption that the landowner uses the land by himself/herself is removed. We first deal with the case in which there are more than one owners of a piece of land, the case of joint ownership.

The typical form of joint ownership of land in Japan may be characterized as follows: (1) Each owner has a share on the land according to which the incomes earned, and the outlays paid, in relation to the land shall be distributed between the owners. (2) A decision to change the state of the land such as selling or leasing shall be made upon unanimous agreement by the owners; that is, any one of the owners has a right to veto.

Since forced acquisition changes the state of the land in the most serious way, RIC-L with joint ownership should be designed, in view of (2) above, in such a way that each owner be treated, in respect to changing the state of the land, as if he/she were a non-joint owner with exclusive property right on the land, as written below.

Let the joint owners be indexed by $n = 1, \dots, N$, where N is the total number of the owners.

We write:

RIC-L(2) (joint ownership):

The owner n declares an amount C_n as the compensation to be paid by the government agency to him/her in case of forced acquisition, and pays the annual compensation premium rC_n to the government agency, where r is the rate of compensation premium, $n = 1, \dots, N$. ■

From the standpoint of the government agency, the total payment needed to take the land is

$$C = \sum_{n=1, N} C_n. \quad (3b.1)$$

and the total premium income for this is

$$R = rC = r \sum_{n=1, N} C_n. \quad (3b.2)$$

In other words, the government agency can work on the land as if it were possessed by a single owner with the declared compensation C and the annual premium payment R .

From the standpoint of owner n of the land, he/she can declare compensation C_n by paying annual premium rC_n as if he/she were the sole owner of the land in regard to changing the state of it, $n = 1, \dots, N$.

Therefore, RIC-L(2) should be the system which best fits to the framework of joint ownership.

2. Leasing and renting

We next deal with the case in which the landowner leases (rents) the land, directly or indirectly, to a third party (to be called tenant(s) here). For example, the land may directly be leased to a tenant who builds a house on it for residence or an office for business use. Another example is that the landowner himself/herself builds an apartment house with rooms on the land and rent them to tenants; in this case, we state that the land is leased to tenants indirectly. In any case, if the land is taken by the government agency, the tenant(s), leasing the land directly or indirectly, must give up using it even in the middle of the lease contract. Compensations should be considered in such a case. For this purpose, we write down a RIC-L, which is an insurance contract between the landowner (i.e. the landlord) and tenant(s).

Let the tenants of a piece of land be indexed by $n = 1, \dots, N$, where N is the total number of the tenants. We write down a system in which the landowner plays the role of an insurance company and the tenants the role of insureds:

RIC-L(3) (leasing and renting):

The tenant n declares an amount C_n as the compensation to be paid by the landowner in case the lease contract is terminated because of forced acquisition of the land, and pays the compensation premium rC_n to the landowner annually, where r is the rate of compensation premium to be determined by the government agency, $n = 1, \dots, N$. The landowner, who enters into a RIC-L with

the government agency, is obliged to declare an amount C satisfying

$$C = \sum_{n=1}^N C_n + C, \quad C \geq 0, \quad (3b.3)$$

as the total compensation to be paid to him/her by the government agency in case of forced acquisition, and pays the total compensation premium

$$R = r \sum_{n=1}^N C_n + rC \quad (3b.4)$$

annually to the government agency, where C stands for the net compensation that the landowner receives in case of forced acquisition, and rC is the net premium payment that the landowner pays.

■

Figure IIIB.1 illustrates the relations among the government agency, the landowner, and tenants. The lower half of the figure illustrates RIC-L(3), an insurance contract between the landowner and the tenants. The upper half illustrates the RIC-L between the government agency and the landowner.

Observe that, as illustrated by Figure IIIB.2, a part of the RIC-L in Figure IIIB.1 may be considered as a reinsurance of the RIC-L(3), which is entered by the landowner with the government agency. In other words, the first part of the RIC-L is composed of the pair $(\sum C_n, r \sum C_n)$ for reinsuring the RIC-L(3), and the second part of the RIC-L is composed of the pair (C, rC) for insuring the landowner himself/herself. We may state that, with regard to the first part of the RIC-L, the role of the landowner is “transparent” between the government agency and the tenants.

It is evident that RIC-L(3) makes it possible for the government agency to work on a piece of land with tenants in the same way that it works on a simple case, RIC-L(1), since the preferences of the landowner and the tenants are aggregated into the pair (C, rC) .

From the standpoint of the landowner and the tenants, RIC-L(3) and RIC-L together, as illustrated in Figures IIIB.1 and 2, work as an insurance to protect their vested rights on the land against forced acquisition, since the landowner and each of the tenants can choose to declare an

amount of compensation for possible forced acquisition by paying an annual insurance premium.

One may argue that it might be better to let the tenants deal directly with the government agency for RIC-L(3), rather than through the landowner as proposed above. At the theoretical level, this does not matter. In practice, however, it should be more convenient to let the tenants deal with the landowner, not with the government agency, despite that the role of the landowner is transparent between the government agency and the tenants. The main reason for this is that, in practice, RIC-L(3) will likely be included in a lease contract. The compensation C_n may be mentioned in the contract as “the amount of money to be paid to the tenant in case the lease is broken by the landowner before its termination.” The premium payment will likely be included in the annual or monthly fee of the lease.

That is to say, if, on the one hand, the original lease contract has an article dealing with premature termination of the lease, then adding a RIC-L(3) to this contract will be straightforward; it only increases the amount of compensation and the lease fee by a certain amount, respectively, as indicated in the RIC-L(3). If, on the other hand, the original contract does not consider premature termination, then a new article has to be added to it to handle the possibility of lease termination due to forced acquisition. This, however, may serve to remind the landowner and the tenants of the need to prepare for premature lease termination due to a cause other than forced acquisition. The contract thus extended can cover more cases than the original one does, contributing to decrease transactions cost such as the one arising from litigation in the absence of the added article. In short, RIC-L(3) should be implemented in association with the ordinary lease contract between the landowner and tenants to save transactions costs.

3. Commons and clubs

We now turn to considering how RIC-L can be applied to the case in which land is used collectively such as in commons or a club. Examples of land used as commons are city parks,

community playground, avenues and streets in a city, highways and toll-ways, and so on.

Commons can be accessed by the public freely with or without fees. We use the term “club” when access to the land is limited through, say, a membership system. For our purpose here, it does not matter whether the land under consideration is provided as commons or a club; further, it does not matter either whether the land is used with or without fees. All we assume here is that the land is not under exclusive use, i.e., the land is more or less open to the public.

A piece of land used as commons or a club is usually owned and managed by a public entity such as a local or a prefectural government, a public corporation, or the government of Japan, which we call here the public owner of the land. Note that land may be owned and managed by a public entity exclusively, i.e., not as commons or a club. In the following, we are concerned mainly with the public owner of land used as commons or a club; further, we consider the public owner of land as such and the public agency responsible to run a RIC-L for reallocation of land (i.e., forced acquisition) as two distinct government organizations.

For a reason stated later, we propose that the public owner of land must accept the possibility of forced acquisition by the public agency and enter into a RIC-L with it in the same way that a (private) landowner does, regardless of whether the land is used exclusively or open to the public. Thus, the public landowner declares an amount of compensation and pays the annual insurance premium to the government agency. In order to do this, the public landowner needs to determine a “proper” amount of compensation and raise the annual premium to be paid to the government agency, in one way or the other. If the land is used exclusively, the public owner should determine the amount of compensation by itself, and pay the compensation premium out of the budget supporting its activities. If, however, the land is open to the public, it is appropriate to let the users, not the public owner, determine the amount of compensation and receive it if the land is taken, and also to let the users pay the compensation premium. In this subsection, we introduce a RIC-L for this.

Let N represent the set of users of a piece of land used as commons or a club. A user is a member of this set, $n \in N$. We postulate:

RIC-L(4) (commons and clubs):

Each user n of the land used as commons or a club declares an amount C_n as the compensation to be paid by the public landowner to the user in case the land is taken by the government agency, and pays the compensation premium rC_n to the public landowner annually, where r is the rate of compensation premium determined by the public agency, $n \in N$. The public landowner should declare an amount C satisfying

$$C = \sum_{n \in N} C_n + C, \quad C \geq 0, \quad (3b.5)$$

as the total compensation to be paid to it by the government agency in case of forced acquisition, and pays the total compensation premium

$$R = r \sum_{n \in N} C_n + rC \quad (3b.6)$$

annually to the government agency, where C stands for the net compensation that the public owner receives and rC is the net premium payment that the public owner pays. ■

We note that the amount of compensation C_n declared by user n represents the value of commons or a club to him/her. The sum $\sum C_n$ is equal to the value of the land (or the value of the services produced by the land) to the users. This is a case of the Lindahl-Samuelson valuation of a public good.

As seen, the structure of RIC-L(4) is almost identical to that of RIC-L(3). Thus, Figures IIIB.1 and 2 may be used to illustrate RIC-L(4) as well. There are, of course, differences between RIC-L(3) and RIC-L(4) in interpreting the figures. In particular, the number of users of commons or a club in RIC-L(4) may be far greater than the number of tenants in RIC-L(3). Further, the meaning of the second part of RIC-L in Figure IIIB.2 differs between RIC-L(3) and RIC-L(4). In RIC-L(3), the second-part pair (C, rC) insures the vested right of the landowner on top of the vested

right of the tenants. In RIC-L(4), the pair insures the vested right of those users who choose not to enter into a RIC-L with regard to the land used as commons or a club.

Further, observe that, the public owner of the land taken may purchase a new block of land which can be offered to the users as commons or a club with the level of service as great as with the land taken and of which the cost is less than the total compensation (3b.5); in this case, the public owner obtains a net surplus. In this case, the public owner should pay back (reimburse) the surplus amount to each user proportionally to the amount declared.

In short, this is the case in which the value to the users of the services produced by the land used as commons or a club is greater than the cost of supplying the services, i.e., the case in which the demand price is greater than the supply price so that a positive net surplus can be realized and given to the users.

C. RIC-L with multiple reallocation periods

In this subsection, we introduce a RIC-L in which the issue of timing of executing forced acquisition of land is explicitly taken into account. For simplicity, we consider extending the simple RIC-L, i.e., RIC-L(1) for this.

In general, the cost that the landowner is forced to bear because of reallocation of his/her land depends on the time at which the reallocation is executed. If the landowner is asked to give up the ownership of the land in a short notice, he/she may face a great deal of difficulty in finding a new place to live or to work. If the landowner is given a few months or years before vacating his/her house, store, or office, it will be much easier for the landowner to leave. Thus, it is advantageous for the landowner to be given flexibility as for the timing of the execution of forced acquisition, even if the landowner needs to give up a portion of the compensation in exchange for the time allowed before the execution.

From the standpoint of the new user of the land taken such as a local government planning to expand a road or to construct a community center, that the new user might choose to save money by waiting for some time longer before actually acquiring the land (or the other way around). Thus, it is advantageous for the new user of land to be given flexibility as for the timing of, and the amount of money to pay for, forced acquisition.

In the following, we write down a RIC-L in which the landowner can declare an amount of compensation for forced acquisition which takes place at each alternative points of time.

Let *reallocation period* (t) stand for the length of time (years) between the time at which a decision is made for forced acquisition and the time at which it is executed. Thus, $t = 0$ means that the forced acquisition will be executed in the same year that the decision is made, $t = 1$ means that it will be executed in the year following the year the decision is made, and so on. Let T denote the longest reallocation period so that $t = 0, 1, 2, \dots, T$.

Let E_t be the event of forced acquisition with reallocation period equal to t , $t = 0, 1, \dots, T, T + 1$, where E_{T+1} is the event of no forced acquisition. Further, let C_t denote the amount of compensation declared by a landowner for the event E_t , i.e., for the event that the land is taken with reallocation period t ($t = 0, 1, \dots, T, T + 1$). Figure III.C.1 illustrates this for $T = 3$.

(3c.1)

Since the utility of the landowner increases (or does not decrease) as the reallocation period becomes longer, we have

$$C_0 \geq C_1 \geq \dots \geq C_T \geq C_{T+1} = 0. \quad (3c.2)$$

Figure III.C.2 is a graph of C_t 's for $T = 3$, where the reallocation period is measured along the horizontal axis from right to left.

We formulate the RIC-L with multiple reallocation periods ($t = 0, \dots, T$) as follows:

RIC-L(5a) (multiple reallocation periods):

The landowner declares compensations C_t which will be paid to him/her by the government agency in the event E_t , and pays the premium payment

$$R_t = r_t C_t \quad (3c.3)$$

annually to the government agency, where r_t is the premium rate determined by the government agency ($t = 0, \dots, T$). The total premium payment by the landowner is equal to

$$R = \sum_{t=0, \dots, T} R_t. \quad \blacksquare \quad (3c.4)$$

In short, the landowner with RIC-L(5a) enters into $(T + 1)$ insurance contracts with the government agency. If the premium rate r_t is set equal to the probability of the event E_t , then a rational risk-averse landowner will choose C_t to insure him/her completely so that his/her utility is unchanged over all E_t ($t = 0, \dots, T, T + 1$).

It may be stated that, although RIC-L(5a) leads to fair and complete insurance, individual landowners may feel difficult to deal with as many as $(T + 1)$ insurance plans, each with its own insurance rate. In fire insurance, for example, usually the insurant pays a premium on the full compensation for an entire loss from fire and receives an amount less than the full compensation in case of a partial loss from fire without paying an additional premium⁶; that is to say, the insurant deals with a single premium rate in the fire insurance which covers both an entire loss and a partial loss.

We write down below an alternative RIC-L with multiple allocation periods in which the landowner needs to face only a single premium rate.

Observe first that the difference (a shaded area in the graph of Figure IIIC.2)

$$\Delta C_t = C_t - C_{t+1}, \quad t = 0, \dots, T, \quad (3c.5)$$

⁶ Note, however, that, in the case of fire insurance, the amount of compensation for partial damage is not predetermined in the insurance plan, since it is difficult to define “the degree of damage,” and this often causes a problem. In contrast to this, there is no such ambiguity in RIC-L.

expresses the increase in the compensation when reallocation period is shortened from $(t + 1)$ to t , so that

$$\sum_{s=t,T} \Delta C_s = C_t, \quad t = 0, \dots, T. \quad (3c.6)$$

In particular, the differences add up to C_0 :

$$\sum_{t=0,T} \Delta C_t = C_0. \quad (3c.7)$$

Let F_t be the event of forced acquisition with reallocation period greater than or equal to t :

$$F_t = \bigcup_{s=t,T+1} E_s \quad (t = 0, \dots, T, T + 1). \quad (3c.8)$$

The F_t 's are nested events, as illustrated by Figure IIIC.3 for the case $T = 3$.

Define an insurance contract $INS(t)$ with regard to the event F_t , $t = 0, \dots, T$, as follows:

INS(t):

The insured receives the amount ΔC_t if and only if the event F_t takes place. The insured pays the insurance premium $(r \cdot \Delta C_t)$ annually for this. ■ (3c.9)

Now, the alternative RIC-L with multiple reallocation periods $(t = 0, \dots, T)$ with a single premium rate r is written down as follows:

RIC-L(5b) (multiple reallocation periods with a single premium rate):

The landowner declares compensations C_t ($t = 0, \dots, T$) and enters into $(T + 1)$ insurance contracts $INS(t)$ ($t = 0, \dots, T$) with the government agency. The total premium payment for this is:

$$R = \sum_{t=0,T} r \cdot \Delta C_t = r C_0, \quad (3c.10)$$

as seen from (3c.7), where r is the premium rate determined by the government agency. ■

To make sure that, under RIC-L(5b), the landowner receives C_t in the event F_t of forced acquisition with reallocation period t , observe first that, in that case, each of the events F_s ($s = t, \dots, T$) takes place (see (3c.8)). Then, each of the insurance contracts $INS(s)$ ($s = t, \dots, T$) will turn into action and each of the

compensations ΔC_s ($s = t, t + 1, \dots, T$) will be paid; the total compensation will be equal to C_t (see (3c.6)). ■

Equation (3c.10) means that the premium payment in RIC-L(5b) is calculated to be the product of the premium rate and the compensation for the event least preferred by the insured (i.e., C_0); the premium payment appears to be independent of the compensation declared for any of the events other than the least preferred. Observe that this arrangement is similar to that of the usual plan for fire insurance; and RIC-L(5b) should appear to the landowner to be simpler than RIC-L(5a).

We note, however, that RIC-L(5b) cannot be a fair insurance; for this, it suffices to see that it is impossible to set the premium rate r_t to be equal to the probability of each of the nested events F_t 's (see (3c.8)). This is a price of having RIC-L(5b), which is simpler than RIC-L(5a).

The way in which the government agency forms a plan of forced acquisition and executes it with multiple reallocation periods, i.e., with RIC-L(5a) or RIC-L(5b), is similar to, if more complicated than, the way with RIC-L(1). We write it down briefly below.

We note that, with multiple reallocation periods, the government agency, unlike in the case of single reallocation period RIC-L(1), cannot determine an optimal reallocation plan from the set of admissible plans for a given plan of forced acquisition. What the government agency can do is to offer a menu from which the new user of land selects one in consideration of the tradeoff between time and money. We state this formally, below.

Given a particular plan of forced acquisition of land and given the longest reallocation period (T), the government agency should choose, for each $t = 0, \dots, T$, an optimal plan ($\mathcal{B}(t)$) from the set of admissible plans ($\mathcal{A}(t)$). Let $\mathcal{R}(t)$ be the total amount of compensations for $\mathcal{B}(t)$, $t = 0, \dots, T$. Then, the government agency should present to the new user the set of $(T + 1)$ pairs $(\mathcal{B}(t), \mathcal{R}(t))$.

$$\{B(t), \mathcal{R}(t): t = 0, \dots, T\}, \quad (3c.11)$$

and let the new user select a pair, say $(B(t^*), \mathcal{R}(t^*))$, from it, where t^* denotes the reallocation period for executing this forced acquisition of land.

D. RIC-L for zoning

1. Single reallocation period

In this subsection, we propose an extension of RIC-L in order to deal with issues arising from zoning of land. As stated previously, from the standpoint of the landowner, a zoning regulation restricts a part of the owner's right to use the land, and forced acquisition restricts (takes) the right in its entirety. In other words, zoning and forced acquisition are the same thing with different degrees. It is therefore convenient to handle the two in one system. Thus, we will consider a RIC-L in which forced acquisition and zoning changes are dealt with in a single plan. For simplicity, we first consider a case of single reallocation period; i.e., we will extend RIC-L(1) for zoning changes.

Figure IIID.1 is an example in which the land is currently designated to be of residential use; its zoning may be changed into commercial or industrial use, or the land may be taken altogether. Let C_0 , C_1 , and C_2 be the compensation declared by the landowner for the cases of forced acquisition, industrial zoning, and commercial zoning, respectively, where the landowner's utility increases in that order so that

$$C_0 \geq C_1 \geq C_2 \geq 0. \quad (3d.1)$$

In general, the utility of a landowner is increased or decreased by a change in zoning designation. For example, the owner of land with a building located in a residential zone in which commercial activities are prohibited may get a net benefit when that is changed into a commercial zone, since the owner can use the building for commerce such as renting it as stores, thereby increasing his/her income significantly. In that case, the owner may be willing to *pay* for such a

change in zoning. A natural way to introduce this possibility into the framework of RIC-L is to remove the non-negativity restriction in (3d.1) and allow a negative “compensation” and a negative premium “payment.” In other words, the landowner could offer to pay a declared amount, say D , to the government agency for a zoning change in favor of him/her and to receive annually income in the amount of rD . Theoretically, the efficiency of using land would be increased by introducing such possibility. For simplicity, however, we limit our consideration in this paper to the case of nonnegative compensations, (3d.1). Removing the non-negativity restriction is left for research in the future.

Let M be the number of possible zoning designations and m be the m -th zoning designation, $m = 1, \dots, M$. Let $m = 0$ stand for the case of forced acquisition, and $m = M + 1$ for the case of no zone change or forced acquisition. Assume that the landowner’s utility increases as the index m increases. (That is, assume that the zoning designations are ordered in this way.) Let compensations $C_m \geq 0$, differences $\Delta C_m \geq 0$, events E_m and F_m , and the insurance contract $INS(m)$ be defined in exactly the same way as in section III.C, where the index t in section III.C is replaced by the index m in this section, $m = 0, \dots, M, M + 1$. It is seen that the structure of RIC-L with forced acquisition and zoning changes being considered here is the same as that of RIC-L with multiple reallocation periods considered in the preceding subsection.

Thus, we write two alternative RIC-L’s for forced acquisition and zoning changes as follows:

RIC-L(6a) (zoning):

The landowner declares compensations $C_m (m = 0, \dots, M)$ to be paid by the government agency in case of forced acquisition or a zoning change, and pays the premium payment

$$R_m = r_m C_m \tag{3d.2}$$

annually to the government agency ($m = 0, \dots, M$). In effect, the landowner enters into $(M + 1)$ insurance contracts with the government agency, of which the total premium payment

is equal to

$$R = \sum_{m=0, \dots, M} R_m. \quad \blacksquare \quad (3d.3)$$

The following is the alternative RIC-L to RIC-L(6a) in which there is only one premium rate:

RIC-L(6b) (zoning with a single premium rate):

The landowner declares compensations $C_m(m = 0, \dots, M)$ and enters into $(M + 1)$ insurance contracts $INS(m)(m = 0, \dots, M)$ with the government agency. The total premium payment for this is:

$$R = \sum_{m=0, \dots, M} r \Delta C_m = r C_0, \quad (3d.4)$$

where r is the rate of compensation premium to be determined by the government agency. \blacksquare

As stated above, the structure of RIC-L(6a) and RIC-L(6b) is exactly the same as that of RIC-L(5a) or RIC-L(5b), respectively. In particular, in RIC-L(6b), the assumption that the common premium rate r applied to each insurance contract $INS(m)(m = 0, \dots, M)$ leads to the result (3d.4); the annual premium payment is equal to $r C_0$, which is independent of the compensations $C_m(m = 1, \dots, M)$, each declared for a case of zoning change.

We also note that the M states of the land is ordered by the index m according to the preference of the landowner being considered. In general, this preference ordering is different between different landowners, so that the insurance contracts $INS(m), m = 0, \dots, M$, are different for different landowners. This does not matter to a landowner in making decision for RIC-L(6a) or RIC-L(6b). This does not matter to the government agency running RIC-L (6a) or RIC-L(6b) either except that the agency should adjust the amounts of compensations declared by the landowners appropriately in calculating the total amount of compensations declared by the landowners appropriately in calculating the total amount of compensations to be paid to the landowners for forced acquisition or a zoning change.

Further, we state that, as in the case of multiple reallocation periods, the information that the

government agency can obtain from RIC-L(6a) or RIC-L(6b), which is entered with each of the landowners, provides only with the total amount of compensations needed for a given plan of forced acquisition or zoning change. This means that, when alternative plans are given, it does not provide with the information for choosing a single plan (an optimal plan) from the given ones. In short, what RIC-L(6a) or RIC-L(6b) does is to provide the government agency only with the cost of a given plan of forced acquisition or zone changes.

2. Multiple reallocation periods

In this subsection, we extend the RIC-L for forced acquisition and zoning changes to the case of multiple allocation periods.

Figure IIID.2 gives an example in which the owner of land currently in a residential zone declares compensation C_{mt} for the case that the land is taken ($m = 0$) or zoning is changed into m with reallocation period t , where the index m is assumed to be chosen so that the utility of the owner increases with it.

We write down a RIC-L to deal with forced acquisition and zoning changes with multiple reallocation periods. Unfortunately, it is impossible to formulate a RIC-L with a single premium rate for this case; that is, we present only a RIC-L which is an extension of RIC-L(6a), not of RIC-L(6b).

Let t denote the reallocation period ($t = 0, \dots, T$) and m denote the m -th zoning ($m = 1, \dots, M$) with $m = 0$ denoting forced acquisition. Let E_{mt} be the event with the forced acquisition/zoning with the index equal to m , and the reallocation period equal to t , $m = 0, \dots, M$; $t = 0, \dots, T$.

Let C_{mt} be the amount of compensation declared by the landowner for the event E_{mt} ; we assume that

$$C_{mt} \geq C_{m't'} \geq 0, \text{ for all } m \geq m', \text{ and } t \geq t', \quad (3d.5)$$

RIC-L(7) (zoning with multiple reallocation periods):

The landowner receives compensation in the amount C_{mt} from the government agency if and only if the event E_{mt} takes place, and pays the annual premium

$$R_{mt} = r_{mt} C_{mt} \quad (3d.6)$$

to the government agency, where r_{mt} is the premium rate determined by the government agency ($m = 0, \dots, M; t = 0, \dots, T$). In effect, the landowner enters into $(M + 1)(T + 1)$ insurance contracts with the government agency, of which the total annual premium payment is

$$R = \sum_{m=0, \dots, M; t=0, \dots, T} R_{mt}. \quad (3d.7)$$

IV. Government Agencies for RIC-L

A. Outline

In the preceding section, we proposed a number of RIC-L's by means of which the landowner enters into an insurance contract with the government agency in regard to possible forced acquisition or a possible zoning change. In this section, we consider the behavior of the government agency for running RIC-L. In particular, we attempt to propose a set of behavior rules for the government agency in order to achieve reallocation of land through forced acquisition or zoning changes as efficiently as possible. For simplicity, however, we start with a RIC-L with a single reallocation period in which no zoning change is taken into consideration.⁷ Later in this section, we attempt to extend the behavior rules for the government agency to cases with multiple reallocation periods and zoning changes.

As stated in the preceding section, the amount of compensations declared by landowners with a RIC-L forms a supply schedule of land for forced acquisition. The role of the government agency

⁷ This means that we consider the behavior rules for the government agency with RIC-L(1) (simple case), RIC-L(2) (joint ownership), RIC-L(3) (leasing and renting), and RIC-L(4) (Commons and clubs) only.

to be discussed in this section is to intermedicate the landowners and new users of the land with regard to forced acquisition of land, where examples of new users of land are a public corporation, a local or prefectural government, and the government of Japan. As illustrated by Figure IVA.1, we propose that the government agency (to be shortened as **GA** henceforth) let the new users reveal their “demand schedule” for land to be taken and match the demand and the supply so that the reallocation of land by means of forced acquisition be realized “as efficiently as possible at least in the long run.”

It may seem that the role of GA as explained above is similar to that of the function of competitive markets in which the demand and the supply of goods or services meet. This is correct in one sense. We will attempt to exploit some of the implications of the similarity between GA with a RIC-L and competitive markets. We need to point out, however, that there are significant differences between the role of GA and the function of competitive markets. We will discuss many of them later in this section.

At this point, we would like to draw the reader’s attention to one of such differences. See Figure IVA.2. In that figure, the demand and supply schedules of land to be taken are depicted, in a standard supply-demand graph, where P and Q stand for the price and the quantity of land, respectively; the supply curve summarizes the choice made by the landowners and the demand curve represents the preferences of new uses of land. If the demand and the supply were put to function under a competitive market, then the actual outcome would be located near to the equilibrium point E of the graph. Because of the rigidities in the reallocation of land by means of forced acquisition, as explained in Section II, the actual state of the reallocation of land may be represented by the point S in the graph, which is located far apart from E . In other words, the actual quantity of land reallocated by means of forced acquisition is at the level of Q_S , which is far less than the equilibrium

quantity Q_E .⁸ Consequently, the actual total benefit to the society, of which the size is represented by the shaded area in the graph, remains far less than the optimal level, represented by the area of the triangle formed by the two curves and the vertical axis and located to the left of point E .

We may state that the objective of introducing RIC-L for reallocation of land by means of forced acquisition is to bring the actual point S in the diagram toward the equilibrium point E . Because of the vested rights in land ownership, it is impossible to move from point S to point E as in competitive markets of goods. In the preceding section, we introduced RIC-L so that the supply schedule of land may be revealed by the landowners. This section is devoted to propose a set of behavior rules for GA so that the actual point S may be moved toward the equilibrium (and optimal) point E gradually.

⁸ In stating that the actual state of reallocation of land by means of forced acquisition is represented by a point like S , we are assuming that the land taken was chosen from those landowners with relatively low supply prices and the new users were chosen from those with relatively high demand prices. At the best, this is correct only approximately. Surely, some attempt may be made to take into account of the supply and the demand prices of land to be taken, that is, the one who makes decision on forced acquisition of land may attempt to avoid taking land from owners claiming excessively high compensations and to give land taken to those with great need for it. Actual forced acquisition of land, however, is conducted with a great deal of discretion and arbitrariness; its consequence may be one which cannot be represented by means of supply-demand diagram.